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

Part 1, A-F

GEOLOGICAL SURVEY BULLETIN 1200

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By GRACE C. KEROHER *and others*

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

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Major stratigraphic and time divisions in use by the U.S. Geological Survey

Era	System or Period	Series or Epoch	Estimated ages of time boundaries in millions of years Holmes [1]	Kulp [2]
Cenozoic	Quaternary	Recent		
		Pleistocene	1	1
	Tertiary	Pliocene	11	13
		Miocene	25	25
		Oligocene	40	36
		Eocene	60	58
		Paleocene	70	63
Mesozoic	Cretaceous [3]	Upper (Late) Lower (Early)	135	135
	Jurassic	Upper (Late) Middle (Middle) Lower (Early)	180	181
	Triassic	Upper (Late) Middle (Middle) Lower (Early)	225	230
Paleozoic [3]	Permian [3]	Upper (Late) Lower (Early)	270	280
	Carboniferous Systems: Pennsylvanian [3]	Upper (Late) Middle (Middle) Lower (Early)		
	Carboniferous Systems: Mississippian [3]	Upper (Late) Lower (Early)	350	345
	Devonian	Upper (Late) Middle (Middle) Lower (Early)	400	405
	Silurian [3]	Upper (Late) Middle (Middle) Lower (Early)	440	425
	Ordovician [3]	Upper (Late) Middle (Middle) Lower (Early)	500	500
	Cambrian [3]	Upper (Late) Middle (Middle) Lower (Early)	600	600?
Precambrian [3]		Informal subdivisions such as upper, middle, and lower, or upper and lower, or younger and older may be used locally.	3, 000+	

Terms designating time are in parentheses. Informal time terms early, middle, and late may be used for the eras, and for periods where there is no formal subdivision into Early, Middle, and Late, and for epochs. Informal rock terms lower, middle, and upper may be used where there is no formal subdivision of a system or of a series.

[1] Age values given are the Holmes time scale (Holmes, A , 1960, A revised geological time scale: Edinburgh Geol. Soc., Trans. v. 17, pt. 3, p. 204).

[2] Ages given are the Kulp time scale (Kulp, J. Laurence, 1961, Geologic time scale: Science, v. 133, no. 3459, p. 1111).

[3] Includes provincial series accepted for use in U.S. Geological Survey reports.

LEXICON OF GEOLOGIC NAMES OF THE UNITED STATES FOR 1936–1960

By Grace C. Keroher and Others

INTRODUCTION

PREVIOUS COMPILATIONS OF GEOLOGIC NAMES

The U.S. Geological Survey has published six compilations treating the names of geologic formations and stratigraphic classification and nomenclature. The Survey publishes lexicons of geologic names at regular intervals as a means of keeping the geologic profession informed as to changes and current status of geologic names within the United States and its possessions.

The first compilation, "North American Geologic Formation Names," Bulletin 191, by F. B. Weeks, was published in 1902. This bulletin contains: (1) an alphabetical listing of 1,500 North American sedimentary formation names and 100 names applied to igneous rocks, together with their geologic age, geographic occurrence, and pertinent references, (2) a list of sedimentary formations arranged alphabetically by geographic provinces under the geologic periods to which they had been assigned, and (3) an index list of formation names.

The next compilation, "The Geologic Time Classification of the United States Geological Survey Compared with Other Classifications, Accompanied by the Original Definitions of Era, Period, and Epoch Terms," Bulletin 769 by M. Grace Wilmarth, was published in 1925 and is still invaluable for its quotations from original definitions and descriptions of standard and other stratigraphic and time divisions from widely scattered and sometimes unavailable sources.

In 1931, the Survey published the third compilation, "Names and Definitions of the Geological Units of California," Bulletin 826, by M. Grace Wilmarth. This work was actually an extract from a larger, more exhaustuve compilation on which Wilmarth was working; it was published to test the reactions of geologists to the material and the format of the forthcoming lexicon and at the same time to make available a useful reference for geologists who worked exclusively in California.

The first exhaustive compilation, M. Grace Wilmarth's "Lexicon of Geologic Names of the United States (including Alaska)," also called the Wilmarth Lexicon, was published in 1938 as Bulletin 896; it met a long-standing and continuing need and was reprinted in 1951 and again in 1957. The Wilmarth Lexicon contains 13,090 names. Of this number, 9,128 are stratigraphic units in the United States and its possessions.

After the publication of the Wilmarth Lexicon, the Survey planned to continue the compilation of geologic names as new names or revisions of old names appeared in the literature. This work was interrupted by World War II, but in 1952 a sustained effort was begun to review the pertinent geologic publications for preparation of a new lexicon. After the review had been brought up to date (through calendar year 1955), Bulletin 1056–A, "Geologic Names of North America Introduced in 1936–1955," by Druid Wilson, W. J. Sando, R. W. Kopf, and others, was published in 1957. A brief form of presentation made it possible to publish quickly some of the essential data concerning new names that had been published since 1935, the cutoff date of the Wilmarth Lexicon. Bulletin 1056–A listed about 5,000 new names introduced for use in North America, the Pacific Island possessions of the United States, and the Trust Territory of the Pacific Islands, as well as a few pre-1936 names not included in the Wilmarth Lexicon.

In the nonalphabetical "Index to the Geologic Names of North America," Bulletin 1056–B, by Druid Wilson, Grace C. Keroher, and Blanche E. Hansen, published in 1959, geologic names of North America, Greenland, the West Indies, the Pacific Island possessions of the United States, and the Trust Territory of the Pacific Islands, that were published before 1956 are arranged to form an index to both the Wilmarth Lexicon (1938) and the "Geologic Names of North America Introduced in 1936–1955" (1957). Grouping the geologic names by the age of the unit and by the politico-geographic divisions containing the type locality of the unit provided a valuable key to the literature not available elsewhere.

PRESENT LEXICON

Those who have collaborated in and contributed to the preparation of the present lexicon are Barbara Bedette, Jean L. Eggleton, Blanche E. Hansen, Rudolph W. Kopf, Carolyn Mann, William G. Melton, Jr., Helen L. Nace, Kay Dennison Palmer, William J. Sando, Jack E. Smedley, Sandra Whalen Stock, Carol S. Swift, Martha S. Toulmin, and Druid Wilson.

The geographic area covered includes the United States, its possessions, the Panama Canal Zone, and the Trust Territory of the Pacific Islands presently administered by the United States. This geographic area is much smaller than that for the Wilmarth Lexicon, which, in addition to U.S. geologic units, included the names and ages (but not the definitions) of geologic units of Canada, Mexico, the West Indies, and Central America. This smaller geographic area was selected primarily because the International Lexicon, compiled under sponsorship of the Stratigraphic Commission of the International Geological Congress, now treats the geologic nomenclature of the other countries.

The stratigraphic papers summarized and used in preparing this lexicon were published between January 1, 1936, and December 31, 1960. In order to clarify the history of some of the older names, however, several pre-1936 reports not summarized in the Wilmarth Lexicon were also included. In all, approximately 200,000 papers were evaluated in selecting the material to be summarized.

This lexicon contains 14,634 names, including cross references. Of this number, 9,128 names appeared previously in the Wilmarth Lexicon and 5,506 are post-1935 names or pre-1936 names not included in the Wilmarth Lexicon.

Names of subsurface units are included if they have been defined or distinguished as a part of formal stratigraphy.

Names listed in the Wilmarth Lexicon but omitted from the present lexicon include (1) all paleontologic and descriptive terms, (2) all names of economic units, such as miner's terms, trade names, and subsurface oil and gas sands, (3) names of moraines and other units of which physiography is an essential part of the definition, and (4) names of orogenies.

Research on the names from the Wilmarth Lexicon reveals that 3,589 of them have not been used since 1935, the cutoff date of that lexicon. These names are listed in the present lexicon, and the ages of the geologic units, the geographic areas, original references, and type localities or statements of derivation of the names are given verbatim as they appeared in the Wilmarth Lexicon.

The superscript (1) after a name in the present lexicon denotes entries taken from the Wilmarth Lexicon. Many pre-1936 names are still being used in the same way in which they are defined in the Wilmarth Lexicon. Other names are still being used as defined in the Wilmarth Lexicon but in addition have slightly modified usages that involve changes in rank and (or) lithology; the changes are noted in the present lexicon. For still another group of pre-1936 names, the usage given in the Wilmarth Lexicon has been replaced by a new usage, which is given in the present lexicon.

Thus, the superscript (1) indicates that additional annotated material can be found in the Wilmarth Lexicon; it also can be useful in tracing the history of the nomenclature of a particular formation. For example, the entry for the Ste. Genevieve Limestone is:

Ste. Genevieve Limestone
Ste. Genevieve Limestone (in Blue River Group)
Ste. Genveieve Limestone (in Meramec Group) [1]

The superscript (1) shows that the accepted name of the formation as of 1935 was the "Ste. Genevieve Limestone in the Meramec

Group." Since then the formation has been called "Ste. Genevieve Limestone in Blue River Group" in another area. Finally, the name in boldface indicates that the Survey now considers it a formation. The absence of the superscript, of course, means that the name has been introduced since 1935.

The term "original reference" refers to the original reference as cited in the Wilmarth Lexicon. As a general rule, these references were not rechecked.

In the interest of brevity, a semitelegraphic style of writing has been used in the summary material. Because this material has usually been gleaned from many pages of the report cited, not all pages from which the factual material was obtained are listed; only the page or pages containing the essential part of the data or the inclusive pages of the paper cited are given.

Various transliterations of many of the names of units described from the Trust Territory of the Pacific Islands have appeared in English, in the Romaji of Japanese publications, and in English translations of the Japanese. The published and unpublished recommendations of the U.S. Board on Geographic Names on the native geographic names from which the geologic names are derived have been followed, but there were no decisions on some names of obscure origin. Cross references are given if the recommended forms and published sources differ and if the transliterations are inconsistent.

The stratigraphic code proposed by the American Commission on Stratigraphic Nomenclature (1961, Am. Assoc. Petroleum Geologists Bull., v. 45, no. 5, p. 645–665) was adopted by the U.S. Geological Survey on June 6, 1961. Article 10 of this code recommends that the initial letters of all words used in forming the names of formal rock-stratigraphic units be capitalized. All the geologic names listed in this lexicon, however, were published before the 1961 code, and the bulk of the present lexicon had been compiled before the code became effective. Therefore, the Commission's recommendation on capitalization is followed in the entry listings but not in the summaries. Undoubtedly there will be differences of opinion about the capitalization (or noncapitalization) used for some of the names listed in this lexicon. Quotation marks are used around names if the author cited used them.

Geologic names currently adopted for use by the U.S. Geological Survey are printed in boldface type, as in the Wilmarth Lexicon. These names have been used in Survey reports, and they constitute a part of the official geologic nomenclature of the Survey. The Survey has had occasion to consider for acceptance or rejection considerably less than half of the names that have been applied to geologic units in the United States.

The rank, lithology, and (or) age designations of some units for which the Survey has approved names are shown as they are currently

(1964) carried in the files of the Survey, even if the reports for which such designations were adopted either were still in preparation or were published after 1960. These changes will be documented in future lexicons.

Ages of all the units are given in terms of the standard major divisions of geologic time, as used by the U.S. Geological Survey (p. iv). For the sake of consistency, the designation "early" or "late," if used by an author with the age of rock units, is changed to "lower" or "upper." The age given for a unit whose name is printed in boldface type is the age presently (1964) assigned by the U.S. Geological Survey. The age given for a unit not printed in boldface is the age given by the author of the report being cited.

ACKNOWLEDGMENTS

The cooperation and assistance of George V. Cohee, the late Roger G. Miller, Walter S. West, Rudolph W. Kopf, and Verda M. Dougherty, all of the staff of the Geologic Names Committee, is gratefully acknowledged. Information and suggestions generously furnished by many geologists with State universities and State geological surveys are greatly appreciated. Many helpful suggestions were given by U.S. Geological Survey colleagues. Special thanks are due Blanche E. Hansen for her accuracy and consistency in the compilation, Helen L. Nace for her invaluable assistance during the final stages of the preparation of the manuscript and, Dimitra J. Kalivas for her able help during the proofreading.

SYMBOLS

Names printed in boldface type have been adopted for use by the U.S. Geological Survey.

Names preceded by a dagger (†) have either been abandoned by their authors or rejected for use by the U.S. Geological Survey.

Names followed by the superscript (¹) are listed in the Wilmarth Lexicon (U.S. Geol. Survey Bull. 896).

Names in roman type without a dagger have not been considered by the Committee on Geologic Names of the U.S. Geological Survey for use in Survey reports.

LEXICON—PART 1, A–F

Aarde Shale[1] Member (of Howard Limestone)

Pennsylvanian (Virgil Series) : Eastern Kansas.

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. Guidebook 6th Ann. Field Conf., p. 94, 96.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 57 (fig. 22), 63, 70 (fig. 25). Bluish- to yellowish-gray clayey and sandy shale containing a persistent coal bed (Nodaway), ranging from about 1 inch to 2 feet in thickness, and a persistent black fissile shale in many outcrops. Thickness ranges from about 2 to 15 feet. Underlies Church limestone member; overlies Bachelor Creek limestone member.

M. R. Mudge, C. P. Walters, and R. E. Skoog, 1959, U.S. Geol. Survey Bull. 1060–D, p. 193, 252–253, pl. 7. In Nemaha County, Kans., member is basal unit of Howard limestone. Consists of silty slightly calcareous dark-gray to tan shale. Average thickness 4½ feet. Base of Nodaway coal designated as base of Aarde. Underlies Church limestone member.

Named for Aarde farm, sec. 4, T. 26 S., R. 11 E., Greenwood County.

Aaron Slate[1]

Precambrian or Paleozoic: Central northern North Carolina and central southern Virginia.

Original reference: F. B. Laney, 1917, Virginia Geol. Survey Bull. 14, p. 15, 19–27, map.

J. L. Calver, 1960, Virginia Div. Mineral Resources Bull. 75, p. 17. In Pittsylvania and Halifax Counties, overlies Hyco quartz porphyry. Varies from nearly pure greenstone to fairly pure argillaceous sandstone and slate; in some areas decidedly conglomeratic. Paleozoic or Precambrian.

Well exposed at many places along Aaron's Creek, Person and Granville Counties, N.C.

Abbott Formation (in McCormick Group)

Middle Pennsylvanian: Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 8 (fig. 1), 28 (fig. 4), 30–31, 44 (table 1), pl. 1. geol. sections. Proposed for strata from top of Pounds sandstone member of Caseyville formation to top of Bernadotte sandstone member of western Illinois. Overlaps Caseyville formation, and throughout most of central, northern, and western Illinois is basal formation of Pennsylvanian. Overlapped by Spoon formation (new) of Kewanee group (new). Consists of strata that were included in lower part of sequence formerly called Tradewater group. Characterized by dominance of sandstone, sandy shale, and siltstone; coals rarely more than 24 inches thick and have much less continuity than higher coals. Maximum thickness 300 to 350 feet in southern Illinois; thins westward and northward. Members: southern Illinois—(ascending) Reynoldsburg coal, Grindstaff sandstone, Willis coal, Finnie sandstone (new), Delwood coal, and Murray Bluff sandstone; western Illinois—(ascending) Babylon sandstone, Manley coal, Tarter coal, Pope Creek coal, and Bernadotte sandstone. Report presents new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification is retained but is independent of rock-stratigraphic classification.

Type locality: Along Illinois Central Railroad, secs. 5–7, T. 11 S., R. 5 E., Pope County. Named for Abbott Station.

Abbyville Gabbro[1]

Precambrian: Central southern Virginia.

Original reference: F. B. Laney, 1917, Virginia Geol. Survey Bull. 14, p. 37–38, map.

Occurs in vicinity of Abbyville, Mecklenburg County.

Abercrombie Formation[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). Correlation chart of recommended revision of stratigraphic units pertaining to Great Basin shows Abercrombie formation below Young Peak dolomite and above Busby quartzite.

Underlies and named for Abercrombie Peak, on ridge south of Dry Canyon, in Gold Hill district.

Aberdeen Sandstone (in Pottsville Formation)[1]

Aberdeen Sandstone (in Tradewater Formation or Group)

Pennsylvanian: Western Kentucky, southern Illinois, and southern Indiana.

Original reference: A. F. Crider, 1915, Kentucky Geol. Survey, 4th ser., v. 3, pt. 1, p. 173–175.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 33. Noted as occurring in Illinois and Indiana.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart (column 26). Shown on correlation chart as sandstone in Tradewater formation. Underlies Mannington coal; overlies Ice House coal.

C. L. Cooper, 1946, Illinois Geol. Survey Bull. 70, p. 14 (fig. 2). Shown on correlation chart as sandstone in Tradewater group. Below Rock Island coal and above Pope Creek coal.

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

Aberdeen Sandstone Member (of Blackhawk Formation)[1]

Upper Cretaceous: East-central 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, 184, pl. 3. Stratigraphically extended to include overlying coal-bearing rocks and associated offshore bar deposits. Consists of basal white-capped sandstone with maximum thickness of 88 feet and an overlying series of shale, sandstone, and coal with a maximum thickness of about 100 feet at Kenilworth. Includes the Castlegate "A" or Aberdeen coal. Underlies Kenilworth member (new); overlies Spring Canyon member (new).

Exposed near Aberdeen mine, northeast of Kenilworth, Castlegate quadrangle, Carbon County.

Abilene Conglomerate[1]

Tertiary: Central Kansas.

Original reference: C. S. Prosser, 1895, Jour. Geology, v. 3, p. 786, 789, 797.

C. C. Williams and S. W. Lohman, 1949, Kansas Geol. Survey Bull. 79, p. 60. Locally conglomeratic bed occurs at base of McPherson formation. Material in conglomerate is similar to materials composing so-called Abilene conglomerate, a good exposure of which is near NW cor. sec. 30, T. 18 S., R. 2 E., just east of mapped area. Believed that, at various outcrops, beds called Abilene conglomerate may represent different ages; hence, term Abilene may not have much stratigraphic significance. Conglomerate at base of McPherson in this area [McPherson County, most of Harvey County, and parts of Sedgwick, Marion, and Reno Counties] may be equivalent to some exposures of the Abilene conglomerate in Dickinson County.

Named for Abilene, Dickinson County.

Abilene Formation[1]

Permian: Central and central northern Texas.

Original reference: W. E. Wrather, 1917, Southwestern Assoc. Petroleum Geologists Bull., v. 1, p. 95–96.

Occurs around Abilene and perhaps southward beneath Callahan Divide.

Abilene Limestone[1]

Age not stated: Kansas.

Original reference: E. C. Parker, 1925, Am. Assoc. Petroleum Geologists Bull., v. 9, no. 6, p. 982.

Type section: Abilene, Dickinson County.

Abingdon 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 above Isabel sandstone member and below Browning sandstone member. Very thin; represented by coaly streak in type section of Spoon. Coal named by Culver (1925, Illinois Geol. Survey Min. Inv. 29). Report presents new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: Center sec. 6, T. 9 N., R. 2 E.

Abingdon cyclothem (in Carbondale Group)

Abingdon cyclothem (in Spoon Formation)

Pennsylvanian: Western Illinois and eastern Iowa.

J. M. Weller and H. R. Wanless *in* J. M. Weller and others, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 10, p. 1586 (fig. 1), 1589. Commonly embryonic and thin; characterized only by a dark streak or coal horizon separating underclay and gray shale; in most areas, identified and correlated solely on basis of its stratigraphic position. In area of Knox and Fulton Counties, Ill., includes basal sandstone, underclay, and a few inches of coal, and gray shale bearing a thin unpersistent layer of brownish- to purplish-gray fine-grained limestone. Neither a basal sandstone nor a marine limestone is characteristically present, and most distinctive member of cyclothem in Iowa is thin red platy almost fissile shale directly above coal horizon. In western Illinois and Iowa, persistently present between Greenbush cyclothem below and Liverpool cyclothem above. Formerly tentatively termed Lower Liverpool.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 83–85, geol. sections 6, 23, 25, 28–32, 34, 36, 37, 40, 42. Includes Isabel sandstone. Also includes a channel sandstone, called Browning by Searight (1929). It is possible Browning may be channel facies of Isabel sandstone. However, in this report Browning is included in Liverpool cyclothem. Cyclothem also present in western Indiana and western Kentucky, where it probably includes lowest beds of Carbondale formation as used in Kentucky.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 52 (table 2), pl. 1. Included in Spoon formation, Kewanee group (both new). Occurs above Greenbush cyclothem and below Tonica cyclothem (new). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Well exposed in tributaries of Brush Creek, especially near the center of sec. 6, T. 9 N., R. 2 E., 4 miles east of Abingdon, Knox County, Ill.

Abiquiu Tuff

Abiquiu Tuff Member (of Santa Fe Formation)

Miocene: 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), 944–952, 958. Consists of stream-laid tuff and volcanic conglomerate, with a few small interbedded lava flows; maximum thickness more than 1,000 feet. Underlies Santa Fe formation; overlies El Rito formation (new). Miocene.

C. E. Stearns, 1953, Geol. Soc. America Bull., v. 64, no. 4, p. 467 (fig. 3), 469–472, pl. 1. Name Abiquiu(?) formation assigned to lower part of late Tertiary beds of Galisteo-Tonque area. Beds are chiefly nontuffaceous. Believed to be southward extension of water-laid volcanic debris named Abiquiu tuff by Smith (1938). Abiquiu(?) is as much as 1,500 feet thick. Occurs above Cienequilla limburgite and below Santa Fe formation.

A. J. Budding, C. W. Pitrat, and C. T. Smith, 1960, New Mexico Geol. Soc. Guidebook 11th Ann. Field Conf., p. 83, 84. Rank reduced to member status in Santa Fe formation. Unconformably overlies El Rito formation. Thickness at least 1,350 feet on west slope of Sierra Negra. Area of report is southeastern part of Chama basin.

Named for outcrops in Abiquiu quadrangle.

Abo Sandstone,[1] Redbeds,[1] or Formation

Lower Permian (Wolfcamp and Leonard): New Mexico.

Original reference: W. T. Lee, 1909, U.S. Geol. Survey Bull. 389.

G. F. Loughlin and A. H. Koschmann, 1942, U.S. Geol. Survey Prof. Paper 200, p. 20–22, pl. 2. In Magdalena district, Abo sandstone unconformably overlies Madera limestone of Magdalena group. Unconformable below Datil(?) formation. Maximum thickness about 175 feet.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 674–676. In some previous reports, Abo sandstone was considered to be approximately equivalent to Wolfcamp series, and supposed unconformity at its base was thought same as that at base of Wolfcamp. This correlation now seems to be incorrect. Herein suggested that Abo is mostly or wholly post-Wolfcamp and that equivalent of Wolfcamp series lies in upper part of Magdalena group as at present defined and mapped. Basal formation of Manzano group.

C. E. Needham and R. L. Bates, 1943, Geol. Soc. America Bull., v. 54, no. 11, p. 1654–1657. Lee (1909) gave name Abo sandstone to succession of dark-red coarse-grained sandstones, in part conglomerate, exposed in Abo Canyon at south end of Manzano Mountains. He gave maximum thickness of 800 feet. Lee stated that Abo was underlain unconformably by Magdalena limestone (Pennsylvanian), but his definition of upper boundary is not clear. Abo was termed basal member of Manzano group, which contained (ascending) Abo sandstone, Yeso formation, and San Andres limestone. Several thin fossiliferous limestones that Lee described as lying near base of Abo are now known to belong to underlying Pennsylvanian. Lee's conclusion that shale in Abo is subordinate in amount to sandstone and conglomerate is in error. Lee did not designate type section. In type section herein designated and described, Abo consists of about 60 percent red shale and about 40 percent sandstone, arkose, and conglomerate. This ratio holds approximately true for most exposures in central New Mexico. It is incorrect to refer to formation as Abo sandstone. Thickness 915 feet at type section. Overlies unnamed basal Permian limestone; underlies Yeso (redefined).

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, Abo formation underlies and intertongues with Meseta Blanca sandstone member (new) of Yeso formation.

V. C. Kelley and G. H. Wood, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 47. In Lucero uplift, Valencia, Socorro, and Bernalillo Counties, Abo formation overlies and intertongues with Red Tanks member (new) of Madera limestone and underlies and intertongues with Meseta Blanca sandstone member of Yeso formation.

R. H. Wilpolt and others, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 61. Consists of dark-red shale, dark-red sandstone and arkose, conglomerate, and lime-pellet conglomerate. Thickness ranges from 300 feet in Joyita Hills to 910 feet in type section. Overlies Bursum formation (new). Age of formation is in question. Fossil plants indicate at least upper part should be correlated with strata of Leonard and not Wolfcamp age.

J. T. Stark and E. C. Dapples, 1946, Geol. Soc. America Bull., v. 57, no. 12, pt. 1, p. 1155. In Los Pinos Mountains, Abo formation disconformably overlies Aqua Torres formation (new). Thickness exceeds 500 feet.

R. L. Bates and others, 1947, New Mexico Bur. Mines Mineral Resources Bull. 26, p. 26–28. As described by Needham and Bates, Abo in Abo Canyon, consists of 914 feet of continental red beds that overlie a thin "unnamed basal Permian limestone." Fieldwork for present report shows that this limestone is at top of Bursum formation. Uppermost unit of type Abo of Needham and Bates is a 6-foot white massive sandstone. Further work in Gran Quivira quadrangle has shown presence, just above this sandstone, of a thin limestone that is identical with lowest unit of Yeso as redefined by Needham and Bates. It has been pointed out by C. B. Read (personal commun.) that basal Yeso limestone cannot be found in Yeso sections in northern part of state—in Glorieta Mesa and Zuni Mountains, for example—and consequently cannot serve as universally recognizable base of Yeso. Read states that a 100- to 300-foot section of sandstones and shales, heretofore considered uppermost Abo, can be recognized and mapped regionally. Read and his workers have mapped Abo-Yeso contact some distance below basal Yeso limestone of Needham and Bates. Applied to Abo type section, this revision lowers Abo-Yeso contact 104 feet, to top of interval 32 of Needham and Bates section. Wood and Northrop (1946) have named this 104-foot section Meseta Blanca sandstone member of Yeso.

L. C. Pray, 1954, New Mexico Geol. Soc. Guidebook 5th Field Conf., p. 93 (columnar section), 101. Discussion of Sacramento Mountain escarpment. Abo formation was deposited over entire escarpment area. In basinal area east of Tularosa, Abo is about 1,100 feet thick and composed principally of dark-reddish-brown mudstone and arkose. Here it grades into underlying latest early Wolfcampian marine strata. Thins rapidly toward positive block in southeast and is about 400 feet thick in High Rolls area. Here it is composed of basal quartzite conglomerate cobbles and an overlying thicker sequence of dark-reddish-brown mudstones and arkose. Farther south, it is 200 to 550 feet thick and splits into an uppermost and a basal series of red beds and a middle sequence composed principally of thin-bedded limestone, dolomitic limestone, and nonred shales. Middle sequence thickens southward to Hueco Mountains, changes from brackish to marine facies, and forms most of Wolfcampian part of Hueco limestone. Upper tongue of Abo red beds (entire Abo of Darton, 1928, U.S. Geol. Survey Bull. 794) can be traced nearly to Texas border, and forms Deer Mountains red shale of Hueco limestone. Throughout area, overlies angular unconformity cut on folded and faulted pre-Permian strata. Columnar section shows Abo penetrated by Pendejo tongue (new) of Hueco formation.

M. L. Thompson, 1954, Kansas Univ. Paleont. Contr. 14, Protozoa, art. 5. p. 17. Mentioned as containing Powwow conglomerate member at base.

W. H. Tonking, 1957, New Mexico Bur. Mines Mineral Resources Bull. 41, p. 6, 7 (fig. 2), 10, pl. 1. In Socorro County, Abo formation conformably underlies Los Vallos member of Yeso formation.

G. O. Bachman and P. T. Hayes, 1958, Geol. Soc. America Bull., v. 69, no. 6, p. 689–700. Discussion of Sand Canyon area, Otero County, N. Mex. Abo sandstone is divided into lower and upper tongues by interfingering with Hueco limestone. Lower tongue is herein named Danley Ranch and upper tongue Lee Ranch. About 15 miles north of area, Hueco wedges out between upper and lower parts of Abo. Rocks that previous workers have identified as Abo formation south of Culp Canyon are interpreted as distinct unit and herein named Otero Mesa member of Yeso formation. Contact with underlying Pennsylvanian rocks (Magdalena group) unconformable throughout area. Locally relief before deposition of Abo was so great that Danley Ranch tongue is absent because of nondeposition. Lee Ranch tongue is apparently early Leonard. Lower Permian.

Carel Otte, Jr., 1959, New Mexico Bur. Mines Mineral Resources Bull. 50, p. 58–71. In northern Sacramento Mountains, Abo formation overlies

Labrocita formation (new) and underlies Yeso formation; locally overlies Holder formation. Thickness as much as 1,400 feet. Basal formation of Manzano group. Wolfcampian and Leonardian.

U.S. Geological Survey has abandoned term Manzano Group.

Type section (Needham and Bates): From base of formation in sec. 32, T. 3 N., R. 5 E., Valencia County, just north of U.S. Highway 60, through sec. 33, into sec. 2, T. 2 N., R. 5 E., to upper limit of formation at top of hill just east of road to Abo Ruins in sec. 25, T. 3 N., R. 5 E., Torrance County. Base of section lies about 1 mile northwest of village of Scholle; top lies about 2 miles west-northwest of village of Abo. Named for Abo Canyon at south end of Manzano Range, Valencia and Torrance Counties.

Abrams Mica Schist[1]

Pre-Silurian: Northern California.

Original reference: O. H. Hershey, 1901, Am. Geologist, v. 27, p. 225–245.

Seymour Mack, 1958, U.S. Geol. Survey Water Supply Paper 1462, p. 16–18, pl. 1. Thick series of metasedimentary rocks, dominantly quartz-mica schist, which is overlain unconformably by Salmon hornblende schist. Hinds (1932) introduced term Siskiyou terrane to include Abrams and Salmon schists. Exact stratigraphic position of rocks composing Siskiyou terrane is not known. Abrams and Salmon are oldest formations in area of this report [Scott Valley]. In northern and western parts of area, they are overlain unconformably by several thousand feet of greenstone and greenstone schist possibly correlative with Devonian(?) Copley greenstone of southern Klamath Mountains. In southern part of mountains surrounding Scott Valley, Chanchelulla(?) formation of probable Silurian age lies unconformably on Abrams and Salmon schists. Present evidence indicates only that Abrams and Salmon schists can be adjudged with certainty to be of pre-Silurian age. Assignment 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. Geologic mapping in Weaverville quadrangle indicates that (1) structure of metamorphic rocks in that quadrangle is synclinorial and Abrams mica schist overlies Salmon hornblende schist, (2) Abrams is probably younger, rather than older, than Salmon, and (3) marble lenses are of stratigraphic significance in that they are chiefly in lower part of Abrams.

Named for Abrams post office, in upper Coffee Creek region, Trinity County.

Abrigo Limestone[1] or **Formation**

Middle and Upper Cambrian: Southeastern Arizona.

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

James Gilluly, 1956, U.S. Geol. Survey Prof. Paper 281, p. 8, 9, 16–20, pl. 5. In Cochise County, described as limestone, limestone mottled with shale, shale, sandstone, edgewise conglomerate, and a little quartzite. Thickness varies but is 770 feet at type locality. Underlies Upper Devonian Martin limestone; overlies Bolsa quartzite.

Named for exposures in Abrigo Canyon, 3 miles southwest of Bisbee.

Absalona Formation

Precambrian(?): Rhode Island.

G. M. Richmond *in* G. M. Richmond and W. B. Allen, 1951, Rhode Island Port and Indus. Devel. Comm. Geol. Bull. 4, p. 10, 11–12, pl. 1. Predominantly porphyroblastic biotite gneiss; includes, locally, lenses of quartz-biotite schist at its base and mappable units of biotite gneiss and amphibolite in its upper part; small quartzite lenses occur throughout. Thickness 650 to 4,700 feet. Underlies Woonasquatucket formation (new); overlies Nipsachuck gneiss (new).

Named for exposures on southwest slope of Absalona Hill along U.S. Route 44, Georgiaville quadrangle.

Absaroka sequence

Mississippian (Chesterian) to Pennsylvanian (Des Moinesian): 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. 110–111, 112 (table 2), 121. "Operational unit" for use in interregional facies analysis. Term derived from Absaroka Mountain Range in northwestern Wyoming and southern Montana. Outcrops along eastern flank of range at western border of Bighorn basin expose base of sequence at contact between Madison limestone and Amsden formation. Top of sequence not defined, but no regionally significant discontinuity is recognized short of base of Upper Jurassic Morrison formation.

Absher Limestone (in Carbondale Group)

Pennsylvanian (Des Moines): Southern 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. 17 (fig. 3), 23 [1943]. Comparatively thin and somewhat impure bed. Overlies Harrisburg (No. 5) coal; in vicinity of Harrisburg, generally separated from coal by as much as 20 feet of shale (bed 6 of complete cyclothem). Included in St. David cyclothem.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 54 (table 3). Replaced by St. David limestone member of Carbondale formation (redefined). Report presents new rock-stratigraphic classification of Pennsylvanian strata in Illinois. Cyclical classification is retained but is entirely independent of rock-stratigraphic classification.

Named from village in southeastern Williamson County.

†Accabee Gravels[1] or Phos-gravels[1]

Pleistocene: Southern South Carolina.

Original references: E. Sloan, 1905, South Carolina Geol. Survey geognostic map of South Carolina, advance copies; published 1908 *in* South Carolina Geol. Survey, ser. 4, Bull. 2; 1907, Summary of mineral resources of South Carolina, p. 12, 20, 21.

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

Accord Shale

Upper Silurian (Murderian): Southeastern New York.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser., no. 1. Suggested for unfossiliferous calcareous shale underlying Rosendale waterlime. Thickness at type section 18 feet.

Type section: Abandoned railroad cut, southern edge of Accord, Rosendale quadrangle.

Acebedo Formation

Acebedo Member (of Lodo Formation)

Eocene, middle: Southern California.

V. S. Mallory, 1959, Lower Tertiary biostratigraphy of the California Coast Ranges: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 46 (footnote), 50–51. Name Acebedo formation applied by Leo Herrera (1951, unpub. thesis) to siltstones underlying Avenal sandstone in Tent Hills area. Consists, at least locally, of a basal conglomerate containing a coarse orbitoidal sandstone and a siltstone sequence. Rests unconformably on Cretaceous. May represent a coarser clastic phase of Lodo formation deposition, about equivalent, at least in upper part, in age and stratigraphic position to Arroyo Hondo member of Lodo farther north at Cantua Creek. Falls within Ulatisian stage. Footnote, page 46, refers to unit as member of Lodo formation.

Well exposed in Tent Hills region, south of Reef Ridge area, about 18 miles southwest of Avenal, Kern County.

†Ackerman Formation (in Wilcox Group)[1]

Eocene, lower: Northeastern Mississippi, southwestern Alabama, southeastern Missouri, and western Tennessee.

Original reference: E. N. Lowe, 1913, Mississippi Geol. Survey Bull. 10, p. 23–35.

J. M. Weller and H. S. McQueen, 1939, Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 159. Geographically extended into Scott County, Mo., where it underlies Holly Springs formation and overlies Porters Creek formation.

F. F. Mellen, 1939, Mississippi Geol. Survey Bull. 38, p. 30 (fig. 6), 33, 37–43. Restricted to exclude Midway-Wilcox "transitional beds" or "basal clays" of Lowe. As thus restricted, underlies Holly Springs formation and overlies Fearn Springs formation (new) and includes not only clays and lignites as exposed in type section but a persistent basal sand member.

G. I. Whitlatch and Benjamin Gildersleeve, 1946, Econ. Geology, v. 41, no. 8, p. 843 (fig. 2), 844–845. Geographically extended into western Tennessee where it underlies Holly Springs formation and overlies Porters Creek clay.

F. S. MacNeil, 1946, U.S. Geol. Survey Strategic Minerals Inv. Prelim. Rept. 3–195, p. 17–18. In 1943, during work on Mississippi geologic map, it was found that type Holly Springs 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 was abandoned in favor of Tallahatta for all of Mississippi. Removal of beds designated as Holly Springs from Wilcox group left Ackerman formation as only unit formerly recognized by U.S. Geological Survey in the Wilcox of Mississippi. Although usually correlated with Nanafalia formation of Alabama, Ackerman at its type locality in Mississippi was found to correlate with beds well up in Tuscahoma sand of Alabama. It was decided, rather than attempt to redefine Ackerman, to adopt Wilcox formation for all beds of Wilcox age in Mississippi. [Hence, Ackerman formation is abandoned.]

J. S. Attaya, 1951, Mississippi Geol. Survey Bull. 71, p. 10–19. Ackerman formation in its outcrop in Lafayette County is entirely nonmarine. On basis of data obtained from shallow exploratory holes and surface exposures, Ackerman is herein divided into four units (numbered 1 to 4 in ascending order), the composite of which forms a cyclothem. Third unit of Ackerman has probably been confused with Holly Springs formation. Herein proposed that name Holly Springs be dropped from literature. Overlies Fearn Springs formation; underlies Meridian formation.

James Turner, 1952, Mississippi Geol. Survey Bull. 76, p. 10–14. Described in Yalobusha County, Miss., as composed of sand, clay, shale, lignite, quartzite, and iron concretions. Basal sand not present at surface. Thickness 68 to 140 feet. Underlies Meridian formation.

T. W. Lusk, 1956, Mississippi Geol. Survey Bull. 80, p. 25–43, pl. 1. Entire Ackerman is present in Benton County. Thickness varies from featheredge on east to about 100 to 150 feet on west. Overlies Fearn Springs formation; underlies Meridian formation. Wilcox.

Typically exhibited in cut 1 mile east of town of Ackerman, Choctaw County, northeastern Mississippi.

Acme Dolomite Member (of Blaine Formation)[1]

Permian: Northwestern Texas and west-central Oklahoma.

Original reference: A. M. Lloyd and W. C. Thompson, 1929, Am. Assoc. Petroleum Geologists Bull., v. 13, p. 948 (fig. 1), 951.

R. L. Clifton, 1942, Jour. Paleontology, v. 16, no. 6, p. 686 (table 1). Geographically extended into Oklahoma where it is shown as underlying shales below Shimer member and overlying shales above Cedartop member.

Named Acme from type exposure in Hardeman County, Tex.

Acton Granite

Late Paleozoic(?): Eastern Massachusetts.

W. R. Hansen, 1956, U.S. Survey Bull. 1038, p. 48–50, pl. 1. Fine-grained moderately foliated light-gray to light-olive-gray granite. Composed chiefly of quartz, orthoclase, microcline, and oligoclase. Occurs in small individual plutons, chiefly as intruded sheets or sill-like bodies, and as crosscutting dikes and irregular masses that range in thickness from a few inches to several hundred feet and in length from a few yards to more than a mile. All observed exposures lie within boundaries of Nashoba formation (new).

Named for town of Acton where it is well exposed. Also exposed in Boxborough, Bolton, Harvard, Hudson, and Stow.

Acworth Gneiss[1]

Precambrian: Northwestern Georgia.

Original reference: C. W. Hayes, 1901, Am. Inst. Mining Engineers Trans., v. 30, p. 408.

Named for development around Acworth, Cobb County.

Ada Formation[1]

Pennsylvanian (Virgil Series): South-central Oklahoma.

Original reference: G. D. Morgan, 1924, [Oklahoma] Bur. Geology Bull. 2. p. 128–132, pls. 3, 27, map.

W. F. Tanner, 1956, Oklahoma Geol. Survey Bull. 74, p. 99–103. Formation in Seminole County consists of variegated pastel shales, sandstones, and siltstones, and limestones and limestone conglomerates. Includes Snomac limestone member (new). Thickness 150 to 250 feet; thickens and thins in no regular manner. Overlies Vamoosa formation; underlies Vanoss formation. Fieldwork across Okfuskee, Seminole, and Pontotoc Counties coupled with data taken from Morgan's map shows that Ada formation truncates in succession Pawhuska, Vamoosa, Hilltop, Belle City, Nellie Bly, Coffeyville, and Seminole formations.

Named for development within and to west of town of Ada, Pontotoc County.

Ada Limestone

Upper Ordovician: Central Oklahoma, western Illinois, and Missouri.

W. H. Shideler, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 367–368. The "Fernvale," extending from Glen Park, Mo., and Valmeyer, Ill., to south side of Arbuckles in Oklahoma, is massive, uniformly crystalline limestone with varied fauna of ostracods and trilobites; this limestone differs from the typical Fernvale. Name Ada is proposed for the crystalline limestone.

A. M. Gutstadt, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 3, pt. 1, p. 524. Templeton and Willman (1953, unpub.) reported that name Ada was preempted and proposed name Cape limestone for the Missouri "Fernvale."

Well exposed at Lawrence quarry, 7 miles southwest of Ada, Pontotoc County, Okla.

Ada Shale (in Bluefield Formation)[1]

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

Original reference: D. B. Reger. 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 300, 421.

C. L. Cooper, 1941, Illinois Geol. Survey Rept. Inv. 77, p. 12. Mentioned in discussion of Chester ostracodes of Illinois. Overlies Reynolds limestone member; underlies Talcott shale member.

Type locality: On north side of East River, in public road between Ada and Stony Gap, and less than one-fourth mile west of Ada, Mercer County, W. Va.

Adamana shales[1]

Lower Triassic: Northeastern Arizona.

Original reference: C. R. Keyes, 1922, Pan-Am. Geologist, v. 38, p. 250, 335.

Exposed near railroad station of Adamana, Apache County.

Adamant Granite

Devonian: Central Vermont.

W. M. Cady, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–79. Mottled gray fine- to medium-grained granite, occurring as thick sills, thinner subsidiary sills, and sill-like dikes. Maximum thickness of individual sills several hundred feet. Enclosed in Waits River formation, except for one thin sill in Moretown formation.

Typically exposed at surface and in quarries within a mile north and northwest of village of Adamant in southwestern Calais Township, Montpelier quadrangle.

Ada Mayes facies[1]

See **Mayes Formation.**

Adams Branch Limestone Member (of Graford Formation)[1]

Adams Branch Formation (in Graford Group)

Upper Pennsylvanian: Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 387, 391.

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 (redefined). Expanded below to include shale and sandstone section about 50 feet thick above Wiles limestone.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 64–65. Middle member of Graford formation. Overlies Brownwood shale member; underlies Cedarton shale member. Commonly light-gray wavy-bedded slabby limestone. A few miles northeast of Brownwood, member grades laterally into shale, calcareous sandstone, and, in some places, a coquina of brachiopod, mollusk, and crinoid fragments. Thickness about 15 feet, just west of Brownwood; thickens downdip to about 40 feet in wells; 50 to 60 feet in McCulloch County, south of Colorado River.

Type locality: Adams Branch, Brown County, close to town of Brownwood.

Adaville Formation[1]

Upper Cretaceous: Southwestern Wyoming.

Original reference: A. C. Veatch, 1907, U.S. Geol. Survey Prof. Paper 56.

R. H. Peterson, D. J. Gauger, and R. R. Lankford, 1953, Utah Geol. and Mineralog. Survey Bull. 47, p. 16 (fig. 4), 17–18. Consists of about 4,000 feet of yellow, gray, and black carbonaceous clays with irregularly bedded brown and yellow sandstones and numerous coal beds. Includes Lazeart member at base. Overlies Hilliard formation.

Well exposed at Adaville mine, 2 miles south of Hodges Pass Tunnel, on Oregon Short Line.

Addington Formation[1]

Permian: Central southern Oklahoma.

Original reference: J. R. Bunn, 1930, Oklahoma Geol. Survey Bull. 40PP, p. 8–9.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 106. Rejected by Oklahoma Geological Survey. Name preoccupied.

Exposed in Jefferson County.

Addington Sandstone Member (of Wise Formation)[1]

Pennsylvanian: Southwestern Virginia.

Original reference: J. B. Eby, 1923, Virginia Geol. Survey Bull. 24.

H. R. Wanless, 1946, Geol. Soc. America Mem. 13, p. 72, 77 (table 5). In Wise formation about 180 feet above base, between Addington and Clintwood coals.

Named for Addington Station, 1½ miles south of Glamorgan, Wise County.

Addison Formation[1]

Middle Ordovician: Northwestern Vermont.

Original reference: E. J. Foyles, 1929, Vermont State Geologist 16th Rept., p. 275–279.

In central part of Ferrisburg Township, northwestern part of Addison County.

Addy Quartzite[1]

Lower Cambrian: Northeastern Washington.

Original reference: C. E. Weaver, 1920, Washington Geol. Survey Bull. 20, p. 61, map.

H. E. Culver, 1939, Washington State Coll. Monthly Bull., v. 22, no. 7, pt. 1, p. 19. Mentioned as overlying Huckleberry greenstone (new).

W. A. G. Bennett, 1941, Washington Div. Geology Rept. Inv. 5, p. 9, pls. 1, 2. Restricted to exclude underlying greenstone and conglomerate. These units, now named Huckleberry greenstone and Huckleberry conglomerate, were included in Addy by Weaver (1920). Thickness at least 3,000 feet; may be as much as 5,000 feet. In most of area, Addy lies on greenstone, but in south, locally overlaps greenstone and lies on schistose conglomerate. Overlain by what are presumably extensions of Old Dominion limestone.

Ian Campbell and J. S. Loofbourow, Jr., 1946, (abs) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1250. Unconformably overlies Huckleberry group. Probably Cambrian.

U.S. Geological Survey currently considers Addy Quartzite to be Lower Cambrian in age.

Near Addy, Stevens County.

Adel Mountain Volcanics

Upper Cretaceous: Northwestern Montana.

J. B. Lyons, 1944, Geol. Soc. America Bull., v. 55, no. 4, p. 449 (fig. 2), 455, 459–460, pl. 1. Trachybasalt and basalt agglomerates, coglomerates, and flows, with numerous intrusives, analcime and augite trachybasalts in upper measures. Contains plant fossils in upper conglomerates. Entire succession strongy zeolitized. Unconformably underlies Great Falls lake sands (new); unconformably overlies Two Medicine formation. Thickness 3,200 feet. In area of Lewis overthrust, Precambrian Spokane shale is thrust over Adel Mountain volcanics.

J. D. Barksdale, 1951, Am. Jour. Sci., v. 249, no. 6, p. 439–442. Mentioned in discussion of Cretaceous glassy welded tuffs of Lewis and Clark County, Mont.

M. R. Klepper, R. A. Weeks, and E. T. Ruppel, 1957, U.S. Geol. Survey Prof. Paper 292, p. 40. Adel Mountain volcanics are younger than Elkhorn Mountains volcanics (new) in southern Elkhorn Mountains.

Area of reports includes about 900 square miles of northern end of Big Belt Range and adjacent plains. Adel Mountain volcanics occupy approximately 330 square miles of northern Big Belts. Adel Mountain is in mapped area.

Aden Basalt Flow

Quaternary: Southwestern New Mexico.

F. E. Kottlowski, 1960, New Mexico Bur. Mines Mineral Resources Geol. Map 14. Named on map legend. Unit mapped in southwestern part of Las Cruces quadrangle.

Adirondack (Anorthosyte) Anorthosite[1]

Precambrian: Eastern New York.

Original reference: C. H. Chadwick, 1930, Geol. Soc. America Bull., v. 41, no. 1, p. 82.

W. J. Miller, 1943, Am. Geophys. Union Trans., v. 24, pt. 1, p. 257–264. Discussion of emplacement of Adirondack anorthosite. Terms Adirondack anorthosite body (or massif) and Adirondack syenite-granite series also used in text.

Anorthosite mass constitutes all high central peaks of true Adirondack Mountains.

Adirondack Gneiss[1]

Precambrian: Northeastern New York.

Original reference: C. H. Hitchcock, 1879, Macfarlane's Geol. Ry. Guide, p. 56.

David Gallagher, 1937, New York State Mus. Bull. 311, p. 15–16. Suggests that best term for the rock as a whole is granite.

In Adirondack region.

Adirondack-Border Series

Upper Cambrian: Northern New York.

R. R. Wheeler, 1946, Harvard Univ. Summ. of Theses, 1942, p. 143, 145. Term used for Upper Cambrian deposits which represent an on-lap and off-lap cycle of deposition. Comprises (descending) Whitehall formation, Little Falls dolomite, Theresa passage beds, and Potsdam sandstone. Physically and faunally distinct from overlying Beekmantown rocks.

Adirondack-Border region.

Adler Sedimentary Series (in Yavapai Group)

See **Alder Group** (in Yavapai Series).

Admiral Formation (in Wichita Group)[1]

Admiral Group

Lower Permian (Wolfcamp Series): West-central Texas.

Original reference: F. B. Plummer and R. C. Moore, 1922, Texas Univ. Bull. 2132, p. 192–195, charts.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 93, 94–96. Rank raised to group. Restricted; redefined to include beds above Coleman Junction and below Jim Ned shale members (new) of Belle Plains formation. Comprises Fisk formation (new), above, and redefined Hords Creek formation.

R. C. Moore, 1947, *in* A. K. Miller and Walter Youngquist, Kansas Univ. Paleont. Contr. 2, Mollusca, art. 1, p. 1 (footnote). Mentioned as formation including two new members: Overall limestone and underlying Wildcat Creek shale.

R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80. Shown on composite columnar section as comprising (ascending) Lost

Creek shale, Hords Creek limestone, Wildcat Creek shale, and Overall limestone. Underlies Belle Plains formation; overlies Putnam formation.

Named for village of Admiral, Callahan County.

Admiralty Drift[1] or Clay

Pleistocene (pre-Wisconsin): Western Washington and British Columbia, Canada.

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. 13–18, 38–39, pl. 1. Described in Snohomish County as firm finely bedded gray, green, and blue silt and clay with carbonized wood and a few dirty sand and gravel beds. Exposed thickness about 200 feet. In some areas underlies Pilchuck clay member (new) of Vashon drift, and in some areas Esperance sand member (new) of Vashon. In plateau blocks of the county, clay is overlain by several hundred feet of water-laid deposits.

J. E. Sceva, 1957, U.S. Geol. Survey Water-Supply Paper 1413, p. 14–15, 26, pl. 1. Drift described in Kitsap County where it consists principally of massive blue clay and silt; deformed in most places. Contains till, volcanic ash, peat, or lignite, sand, and some gravel. Top of formation commonly near or below sea level. Thickness as much as 400 feet. Underlies lower member of Orting gravel.

Principal exposures in bluffs along shores of Admiralty Inlet.

Admiralty glacial epoch[1]

Pleistocene (pre-Wisconsin): Western Washington.

Original reference: B. Willis, 1898, Geol. Soc. America Bull., v. 9, p. 111.

Admire Group[1]

Admire Formation

Admire Shale (in Wabaunsee Group)[1]

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

Original reference: G. I. Adams, 1903, U.S. Geol. Survey Bull. 211, p. 53.

G. E. Condra, 1935, Nebraska Geol. Survey Paper 8, p. 8–9. Rank raised to group; age designated as Permian. Subdivided into (ascending) Towle shale, Aspinwall limestone, Hawxby shale, Falls City limestone, West Branch shale, Five Point limestone, and Hamlin shale. Underlies Council Grove group; overlies Wabaunsee group (Pennsylvanian).

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Group mapped in Oklahoma. Not subdivided.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2274 (fig. 1). Redefined. Subdivided into three formations (ascending): Onaga shale (new), Falls City limestone, and Janesville shale (new). Overlies Wood Siding formation of Wabaunsee group.

C. C. Branson, 1956, Oklahoma Geology Notes, v. 16, no. 11, p. 123, 124–125. Stratigraphic unit from top of Brownville limestone to base of Foraker limestone is indivisible in Lincoln, Payne, and Pawnee Counties. Corresponds to entire Admire group of Kansas and can be referred to as Admire formation.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 73–77. Group, as currently defined, is basal Permian (Wolfcampian) unit of midcontinent area and includes beds overlying Brownville limestone and underlying

Americus limestone. In Nebraska and Kansas, group is subdivided into seven limestone and shale units; Indian Cave channel sandstone occurs locally at base. Taylor (1953), Vosburg (1954), and Fisher (1956) in unpublished theses made tentative correlations with some Kansas units. In Pawnee County, exposures of group are poor, and no attempt at subdivision has been made. Branson (1956) proposed that, where subdivision of group is not possible, name Admire formation be applied to sedimentary sequence separating Brownville and Americus limestones. Formation in Pawnee County forms broad valley, averaging 3 miles in width, that trends north-south across county. Thickness 140 feet, representing abrupt increase in thickness southward from Osage County.

Probably named for Admire, Lyon County, Kans.

Adobe Formation (in Veredas Group)

Pennsylvanian (Missouri Series): New Mexico.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 27 (table 2), 61–62. Name introduced for all rocks in northern part of Oscura Mountains between top of Coane formation (new) and base of Council Springs limestone (new). At type locality, composed of noncherty to highly cherty gray limestone, gray shale, and arkosic sandstones. In most areas of central New Mexico, basal part of formation is fossiliferous highly arkosic sandstone to granule conglomerate. Thickness ranges from about 47 feet at type locality to more than 200 feet in area of Ladron Mountains and Cadronito Hills.

Type locality: Northeast slope of Oscura Mountains (SE¼ sec. 36, T. 5 S., R. 5 E.) in Socorro County. Geographic term Adobe is derived from Adobe village, about 3 miles northeast of north end of Oscura Mountains.

Aeolian Buttes Glacial Stage

Aeolian Buttes Till

Pleistocene: East-central California.

W. C. Putnam, 1949, Geol. Soc. America Bull., v. 60, no. 8, p. 1289, pl. 1. At least four ice advances occurred in Pleistocene; earliest stage, here named Aeolian Buttes, was followed by the Sherwin, Tahoe, and Tioga previously named by Blackwelder. Till may be equivalent in age to McGee stage, but Aeolian Buttes can be dated with respect to local volcanic and glacial succession and McGee at its type locality 25 miles southeast cannot; therefore new name is proposed. Rhyolitic ash and pumice, now Bishop welded tuff, were erupted in interval between Aeolian Buttes and Sherwin stages. Aeolian Buttes till rests on an abraded surface of quartz monzonite.

W. C. Putnam, 1960, California Univ. Pubs. Geol. Sci., v. 34, no. 5, p. 235. Sherwin till is pre- rather than post-Bishop tuff. Name Aeolian Buttes till should be considered invalid as representing an earlier Pleistocene, pre-Sherwin glacial till. If name is retained at all, it should be regarded as having significance only in Mono Basin as probable equivalent of more widely recognized Sherwin glacial stage.

Till crops out on crest of Aeolian Buttes, a low craggy ridge between U.S. Highway 395 and Mono Craters; till also exposed in Mono Craters tunnel.

Aetna[1]

Permian: Kansas and western Oklahoma.

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

Named from Aetna, Barber County, Kans.

Afono Trachyte

Pleistocene(?): Samoa Island (Tutuila).

R. A. Daly, 1924, Carnegie Inst. Washington Pub, 340, p. 108, 129–130. Trachyte plug and associated trachyte dike. Pioa rhyolite, Matafao, Papatele, Afono, and Vatia trachytes were erupted contemporaneously or nearly so.

H. T. Stearns, 1944, Geol. Soc. American Bull., v. 55, no. 11, p. 1285–1286 (table 1), 1305. Afono 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. 150. Pleistocene(?).

Forms 200-meter cliff on east side of Afono Bay.

Afton Beds

Middle Devonian: Northeastern Michigan.

[G. M. Ehlers], 1938, Michigan Acad. Sci., Arts and Letters Sec. Geology and Mineralogy [Guidebook] 8th Ann. Field Excursion, [fig. 2] after p. 8. Shown on columnar section as underlying Marvin Quarry bed (new) and overlying Black Killians bed [Killians limestone].

W. A. Kelly, 1940, Michigan Acad. Sci., Arts and Letters Sec. Geology and Mineralogy [Guidebook] 10th Ann. Field Excursion, [p. 1, figs. 3, 4, 6, and 7], maps 1 and 2. Shown on columnar section as limestone beds. Thickness about 29 feet. Upper half of section at Afton cannot be definitely correlated with section near Lake Huron, and provisional names Afton beds, Marvin beds, and Beebe beds are used in place of Alpena, Norway Point, Potter Farm, Partridge Point, and Squaw Bay, employment of which would imply stricter correlation than is justified.

Present in Black Lake-Afton area.

Afton Limestone Member (of Wellington Formation)

Permian: Southeastern Kansas.

W. A. Ver Wiebe, 1937, Wichita Municipal Univ. Bull., v. 12, no. 5, p. 4, 10–11. Claystones, green and red shales and clays at top of formation. Claystones at the top of the member carry copper carbonate flakes and nodules. Underlies typical Harper red beds; overlies Slate Creek limestone member (new).

Type locality: Afton Township 28 S., R. 3 W., Sedgwick County.

Aftonian Interglaciation

Aftonian Age, Stage

Aftonian stage of deglaciation[1]

Pleistocene: Iowa, Illinois, Kansas, and Nebraska.

Original reference: T. C. Chamberlain, 1895, Jour. Geology, v. 3, no. 3, p. 272–277.

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99. Discussion of Pleistocene of Kansas. Aftonian age (stage), second time unit in Pleistocene, is an interglacial interval. Follows Nebraskan age (stage) and precedes Kansan age (stage).

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 128–130. Aftonian stage represented in this area—Beardstown, Glasford, Havana, and Vermont quadrangles—by brown leached gravel, of early Aftonian or possibly Nebraskan age, and noncalcareous silt with wood, probably of early or middle Aftonian age.

Name amended to Aftonian Interglaciation to comply with Stratigraphic Code adopted 1961.

Name derived from exposures between Afton and Thayer, southwestern Iowa.

Agamenticus Complex[1]

Devonian (?) or Mississippian (?) : Southwestern Maine.

Original reference: Alfred Wandke, 1922, Am. Jour. Sci., 5th ser., v. 4, p. 149, 152–154.

M. P. Billings, 1956, Geology of New Hampshire, pt. 2, Bedrock geology: Concord, New Hampshire State Plan. Devel. Comm., p. 104. Age given as Mississippian (?).

Occurs on slopes of Mount Agamenticus, York County.

Agamok Sediments

Precambrian (Knife Lake Series) : Northeastern Minnesota.

J. W. Gruner, 1941, Geol. Soc. America Bull., v. 52, no. 10, p. 1583 (table 1), 1615. Name applied to beds that have not been correlated successfully with any of the other 19 units of Knife Lake series described in this report. It seems these sediments were among earlier ones to form. They could antedate Knife Lake series if it were not for fact that some pebbles of Saganaga granite are found in conglomerate layers which are interstratified with slates and graywackes in NE¼ sec. 30, T. 65 N., R. 5 W. Sediments form a synclinorium which strikes about S. 60° E. between Ogishkemuncie and Gabimichigami Lakes.

Report covers belt in eastern Vermilion district more or less parallel to international boundary.

Agate Bay Group[1]

Precambrian (Keweenawan) : Northeastern Minnesota.

Original reference: R. D. Irving, 1883, U.S. Geol. Survey 3d Ann. Rept., p. 143–146, pl. 14.

Exposed on Agate Bay, northeast of Duluth, St. Louis County.

Agathla Sandstone[1]

Lower Triassic: Northeastern Arizona and southeastern Utah.

Original references: D. Hager, 1924, Min. and Oil Bull., v. 10, no. 2, p. 137; no. 4, p. 383–384, 423, 437.

Near Agathla Peak, northern part of Navajo County, northeastern Arizona.

Agathla Shale[1]

Lower Triassic: Northeastern Arizona and southeastern Utah.

Original references: D. Hager, 1924, Min. and Oil Bull., v. 10, no. 2, p. 137; no. 4, p. 383–384, 423, 437.

Near Agathla Peak, northern part of Navajo County, northeastern Arizona.

Agattu Beds

Cretaceous or Tertiary: Southwestern Alaska.

R. P. Sharp, 1945, (abs.) Geol. Soc. America Bull., v. 56, no. 12, pt. 2, p. 1197; 1946, Jour. Geology, v. 54, no. 3, p. 193–199. Name applied to well-bedded sedimentary strata occurring on Agattu Island. Consist chiefly of amorphous silica and fine detritus derived from a volcanic terrain. Beds are gently tilted, faulted, and possibly folded. Thickness at least 2,000 feet. Deposits may be as old as Cretaceous but are more probably Tertiary.

Exposed on Agattu, Aleutian Islands.

†Agawa Iron-Formation Member (of Knife Lake Slate)[1]

Precambrian (Knife Lake Series): Northeastern Minnesota, and western Ontario, Canada.

Original reference: J. M. Clements, 1903, U.S. Geol. Survey Mon. 45.

J. W. Gruner, 1941, Geol. Soc. America Bull., v. 52, no. 10, p. 1616; F. F. Grout and others, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 1035–1036. Suggests that term Agawa formation be dropped. In area of this report [Knife Lake region to northwestern Minnesota], Knife Lake series consists of 10 to 20 recognizable members. Agawa iron formation as described by Clements (1903) may not exist as a formation at all. It does not occur at a definite horizon in the series, and except on Lake Agawa it is never more than a very few feet thick. Some of Agawa formation of older surveys is really a replacement.

Named for exposures on shores of Agawa Lake, Ontario, 1½ miles north of international boundary.

Agawan Gypsum Bed (in Marlow Formation)

Permian: Southwestern Oklahoma.

C. C. Branson, 1954, Shale Shaker, v. 4, no. 6, p. 7. A thin white gypsum bed in the Marlow.

Occurs only in Grady and Stephens Counties.

Agency Shale Member (of Pierre Shale)

Agency Shale zone (in Sully Member of Pierre Formation)

Upper Cretaceous: North-central South Dakota.

W. L. Russell, 1930, South Dakota Geol. and Nat. History Survey Rept. Inv. 7, p. 5. Hard fissile very light gray shale defined as basal member of Pierre shale. Exposed thickness about 120 feet.

W. V. Searight, 1937, South Dakota Geol. Survey Rept. Inv. 27, p. 8, 18, 19, 22–23, pls. 2, 3. Rank reduced to zone in Sully member (new) of Pierre formation.

D. R. Crandell, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 12, p. 2340 (table 10), 2341, 2343. Abandoned. Agency-Oacoma zone redefined and included in DeGrey member (new) of the Pierre shale.

Named from Cheyenne River Agency where it is well exposed. Unit extends up Missouri River to within a few miles of mouth of Moreau River, down the Missouri below mouth of Cheyenne River, and some distance up Cheyenne River.

Agua Sandstone Member (of Santos Shale)[1]

Agua Sandstone Member (of Temblor Formation)

Miocene, lower: California.

Original reference: L. M. Clark and A. Clark, 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 1, p. 137.

H. H. Heikkila and G. M. MacLeod, 1951, California Div. Mines Spec. Rept. 6, p. 4 (table 1), 5 (table 2), 8, pl. 1. Described in Bitterwater Creek area, where it is treated as basal member of Temblor formation. Consists of gray to buff fine- to medium-grained friable sandstone with abundant fragments of pectens. Thickness as much as 48 feet. Unconformably overlies Point of Rocks sandstone; overlapped by upper Santos shale.

Traceable from vicinity of Carneros Creek to mouth of Cedar Canyon, several miles northwest, Temblor Range, Kern County.

Agua Caliente Gabbro

Precambrian (Keweenawan?): Northern New Mexico.

Evan Just, 1937, New Mexico Bur. Mines Mineral Resources Bull. 13, p. 11, 25. Gabbroic rocks; not schistose. Suggests that they may be intrusive and of Keweenawan age.

Exposed on one of southern tributaries of Agua Caliente Creek, Picuris area.

Aguada Formation or **Limestone**

Miocene, lower: Puerto Rico.

A. D. Zapp, H. R. Bergquist, and C. R. Thomas, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 85, 2 sheets. Proposed for transitional beds, approximately 75 meters thick, between underlying Río Guatemala group (new) and overlying Aymamón limestone (new). Consists essentially of interbedded hard pure limestone and softer chalky to marly limestone; from 1 to 10 meters of basal gravel, sand, and shale present where unit rests directly on Cretaceous rocks.

C. A. Kaye, 1959, U.S. Geol. Survey Prof. Paper 317–A, p. 7 (table), 33–34, pl. 2. In San Juan metropolitan district, consists predominantly of noncarbonate rocks; hence termed formation to allow for lithologic variation. Estimated thickness 325 feet; 62½ feet exposed in quarry near Bayamón hospital. There is some question whether formational name Aguada is correctly applied to these beds. From lithologic standpoint, they resemble noncarbonate clastic subdivisions of late Oligocene Río Guatemala group which, according to Zapp and others (1948), does not occur in San Juan area. Because no paleontologic study was made of middle Tertiary section of San Juan area in preparation of this report, formational assignment cannot be examined in light of age criteria.

W. H. Monroe, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B356, B358 (fig. 164.2). Oligocene and Miocene sequence in north-central Puerto Rico is (ascending) San Sebastian formation, Lares limestone, Cibao formation, Aguada limestone, and Aymamón limestone. Aguada, about 90 meters thick, consists of somewhat earthy limestone interbedded with chalk and marl.

Named from prominent exposures in vicinity of town of Aguada, near west coast of Island.

Aguadilla Limestone (in Arecibo Formation)

Miocene, lower: Puerto Rico.

C. J. Maury, 1919, Am. Jour. Sci., v. 48, no. 285, p. 214 (chart). Shown on correlation chart as subdivision of Arecibo formation above Lares limestone and below Quebradillas limestone. Upper Oligocene.

C. J. Maury, 1919, Science, v. 70, no. 1825, p. 609. Lower Miocene.

J. D. Weaver *in* R. Hoffstetter and others, 1956, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2b, p. 315. Not distinguished in field and of doubtful stratigraphic value. Lower Miocene.

Aguadulce Formation

Pleistocene(?): Panama.

Original reference: O. H. Hershey, 1901, California Univ. Dept. Geol. Bull., v. 2, p. 258.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 322. Poorly defined name for surficial deposits. Pleistocene(?).

Occurs in Aguadulce Plain, Coclé Province.

Agua Fria[1] Formation (in Amador Group)

Middle or Upper Jurassic: East-central California.

Original reference: N. L. Taliaferro, 1933, Geol. Soc. America Bull., v. 44, no. 1, p. 149.

N. L. Taliaferro, 1943, California Div. Mines Bull. 125, p. 283, 284. In Merced River section Agua Fria is uppermost formation in Amador group. Thickness 3,500 feet. Overlies Penon Blanco volcanics. Age of Amador group believed to be upper Middle to lower Upper Jurassic.

Occurs on Merced River and southward into Indian Gulch quadrangle.

Aguagua [Formation in Tapaliza Group or Member of Tapaliza Formation]

Aquaqua formation

Miocene: Panamá.

Karl Sapper, 1937, Mittelamerika, Handbuch der regionalen Geologie: Heidelberg, v. 8, Abt. 4a, no. 29, p. 131–132, 134 (chart). Correlation chart shows Aquaqua formation above Arusa formation and below Tuira formation. Upper Oligocene and lower Miocene.

A. A. Olsson, 1942, 8th Am. Sci. Cong. Proc., v. 4, p. 234 (chart), 241. Tapaliza can be divided into an upper or Miocene part and a lower or Oligocene part. These are known respectively as the Aguagua and the Arusa.

W. P. Woodring, 1960, *in* R. Hoffstetter and others, Lexique Strat. Internat., v. 5 Amérique Latine, fasc. 2a, p. 322. Aguagua formation is undefined name for early Miocene fine-grained deposits. Age based on foraminifera.

In Darien area.

Aguanga Tonalite

Cretaceous: Southern California.

J. F. Mann, Jr., 1955, California Div. Mines Spec. Rept. 43, p. 9 (table), pl. 1. Named on map legend in list of Cretaceous plutonics. Occurs below Lake Mountain tonalite and above San Marcos gabbro.

1956, California Dept. Public Works, Div. Water Resources Bull. 57, v. 1, pl. 13B; v. 2, p. B–21 (table B–1), B–34. Mapped in Santa Margarita

River watershed. Described as a biotite-rich quartz diorite. In plutonic sequence, occurs below Bonsall tonalite and above San Marcos gabbro.

Well exposed on north and south sides of Aguanga Valley and north of Lancaster Valley, Riverside County.

Aguas Buenas Limestone Member (of Fajardo Formation)

Aguas Buenas Limestone[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. 64.

R. C. Mitchell, 1954, Puerto Rico Univ. Agr. Expt. Sta. Tech. Paper 13, p. 36 (table 2), 47, 48 (table 4). Heading on table 2 (stratigraphic table for Puerto Rico) reads Upper(?) Cretaceous; however, text and other table headings do not qualify Upper Cretaceous.

H. L. Berryhill, Jr., R. P. Briggs, and Lynn Glover 3d, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 2, p. 143. Assigned to member status in Fajardo formation. Contains rudistids and crinoid remains. Lies at base of formation and unconformably overlies nonstratified rocks of volcanic complex.

Named for occurrences near town of Aguas Buenas, San Juan district.

Agua Verde Shale Member (of Fayette Formation)

Eocene: Southern Texas.

J. M. Patterson, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 2, p. 269–270. Proposed for marine shales overlying Sanchez sandstone tongue. Shales are 150 feet thick, mostly gray green, and bentonitic but contain some red nonmarine beds in upper part. Underlies Villa Nueva sandstone member. In southern Zapata County, the shales appear to be overlapped by the Frio, or may, in part, grade into nonmarine shales that resemble Frio. Area in which Agua Verde shale crops out is limited, and beds are poorly exposed because of heavy overburden.

Named from Agua Verde ranchhouse on north line of Escobares quadrangle [Zapata County].

Agua Zarca Sandstone Member (of Chinle Formation)

Agua Zarca Sandstone 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. Consists of conglomeratic sandstone with occasional siltstone and silty shale. Underlies Salitral shale tongue (new); overlies Glorieta sandstone member of San Andres formation. From latitude of San Miguel Canyon, unit thins rapidly; in Mesa Poleo it is thin but recognizable.

J. A. Momper and W. W. Tyrrell, Jr., 1957, Four Corners Guidebook 2d Field Conf., p. 17. Age given as Lower Triassic. Type locality indicated.

J. A. Momper, 1957, Four Corners Geol. Soc. Guidebook 2d Field Conf., p. 91, 92. Interpreted as basal sand member of Moenkopi. Thickness ranges from less than 70 feet to 150 feet across San Juan basin; Salitral member thickens westward in main body of Moenkopi at expense of underlying Agua Zarca.

Type locality: Agua Zarca Creek, Rio Arriba County.

Aguigan (Aguijan) Limestone

Pliocene or Pleistocene: Mariana Islands (Aguigan).

Risaburo Tayama and Yasushi Ota, 1940, Geomorphology, geology, and coral reefs of Aguijan Island: Tropical Industry Inst., Palau, South Sea Islands Bull. 6 [English translation in library of U.S. Geol. Survey, p. 16–17, 19 (chart)]; 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]. Gray well-bedded limestone. Unconformably underlies Mariana limestone. Pliocene.

S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 14–16. Age given as Pleistocene.

Occupies base of sea cliff on southern coast of island.

Aguila 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), 19–20, pls. 2, 3. Massive light-brown medium-grained graywacke with closely spaced concretionary ledges and local thin conglomerate at top. Thickness at type locality 2,035 feet. Rests with apparent conformity upon Johnson Peak formation (new); at most places conformably underlies Serpiente sandstone (new); along south limb of Stoker Canyon syncline, where perhaps as much as 8,000 feet of Upper Cretaceous strata have been removed by erosion, Aguila is unconformably overlain by middle Eocene Avenal sandstone; locally underlies lower Eocene(?) beds.

Type locality: Stoker Canyon syncline, Orchard Peak area, Tent Hills quadrangle, Kern County. Named for Aguila Canyon on north limb of Stoker Canyon syncline.

Aguja Formation[1]

Upper Cretaceous (Gulf Series): Western Texas.

Original reference: W. S. Adkins, 1933, Texas Univ. Bull. 3232, p. 239, 271, 505, 506.

C. G. Moon, 1953, Geol. Soc. America Bull., v. 64, no. 2, p. 153, 170–173, pl. 1. Described in Agua Fria quadrangle. Consists primarily of sandstone and shale. Standstone yellowish gray, gray, and brown, fine grained; shales light to dark gray or almost black and blackish red; lignite and lignitic shales. Thickness, partial section, 101 feet. Underlies Terlingua beds; contact gradational. Wherever Aguja is overlain by Tertiary rocks, contact is distinctly marked by an unconformity which is angular in some localities and apparently disconformable in others.

Type locality: Sierra Aguja (Needle Peak), in the flat in front of Santa Helena fault scarp, 6 miles south of Terlingua, Brewster County.

Aguja sandstone

Precambrian (Protozoic): Northern Arizona.

C. R. Keyes, 1939, Pan-Am. Geologist, v. 71, no. 1, p. 69. Substitute title for the Protozoic Chiquito sandstone of the Grand Canyon.

Named for "The Needle," or Aguja, hillock at mouth of Little Colorado River, near entrance to Grand Canyon.

Ahearn Member (of Chadron Formation)

Oligocene, lower: Southwestern South Dakota.

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

Type locality: At standard section of Chadron formation in Big Badlands on south fork of Indian Creek, Pennington County, from sec. 34, T. 3 S., R. 12 E. to sec. 10, T. 4 S., R. 12 E. Name is that of a ranch formerly at mouth of south fork of Indian Creek.

Ahern Quartzite

See **Ahorn Quartzite.**

Ahlosa Member (of Caney Shale)

See Ahloso Member (of Caney Shale).

Ahloso Member (of Caney Shale)

Mississippian (Meramecian): 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. 60–62, 70 (table 2). Name Ahlosa introduced for basal unit of Caney shale; commonly referred to as "Mayes" or "Ada Mayes." Consists of dark-gray fine-grained coarsely laminated to nearly massive calcareous shale. Thickness 25 to 190 feet. Underlies Delaware Creek member (new); overlies Welden limestone.

M. K. Elias and C. C. Branson, 1959, Oklahoma Geol. Survey Circ. 52, p. 5, 7, 21. Name emended to Ahloso. Type section designated. Thickness 49.2 feet.

Type section: Beds 10 to 18, measured section D, sec. 14, T. 2 S., R. 7 E., Johnston County. Name derived from village at junction of Highways 99 and 3, in sec. 14, T. 3 N., R. 6 E., about 3 miles southeast of Ada, Pontotoc County.

Ahorn Quartzite

Precambrian (Belt Series): Northwestern Montana.

Charles Deiss, 1943, Geol. Soc. America Bull., v. 54, no. 2, p. 211, 213 (table 1), 217–218. Composed of two sharply demarcated units, a lower pink quartzite about 1,700 feet thick and an upper green and red argillite 400 feet thick. Because upper part of formation has been greatly eroded, thickness varies considerably within relatively short distances. Unconformably underlies Flathead formation; overlies Hoadley formation (new). Miller Peak argillite, Cayuse formation (new), Hoadley formation, and Ahorn quartzite are equivalent in age to lower and middle part of Missoula group of Clapp and Deiss (1931) in Sapphire and Garnet Ranges.

Present in Saypo and Silvertip quadrangles. Named from Ahorn Creek in southeastern corner of Silvertip quadrangle where headward part of creek is incised in these rocks.

Ahtell Diorite[1]

Carboniferous: Southeastern Alaska.

Original reference: W. C. Mendenhall, 1905, U.S. Geol. Survey Prof. Paper 41, p. 38, map.

Composes hills drained by west tributaries of Ahtell Creek.

Aibonito Conglomerate[1]

Cretaceous: Puerto Rico.

Original reference: C. P. Berkey, 1915, New York Acad. Sci. Annals, v. 26, p. 61.

†Aiken Beds[1]

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

Original reference: E. Sloan, 1904, South Carolina Geol. Survey, ser. 4, Bull. 1, p. 72.

Exposed at Aiken, Aiken County.

Aimeliik Formation

Aimiriiki Agglomerate

See Aimiliiki Agglomerate or Conglomerate.

Aimiliiki (Aimiriiki) Agglomerate or Formation

Eocene, upper: Caroline Islands (Babelthuap).

Risaburo Tayama and Misaburo Shimakura, 1937, On the coal of Babelthuap Island, Palau group. Geol Soc. Japan Jour., v. 44, no. 6, p. 526 [English translation in library of U.S. Geol. Survey, p. 1]. Aimiliiki listed in stratigraphic succession on Babelthuap. Below lignite-bearing beds and above Galdog beds.

Risaburo Tayama, 1939, Brief report on the geology and ore resources of Babelthuap Island (Palau Island proper): Tropical Industry Inst., Palau South Sea Islands Bull. 3 [English translation in library of U.S. Geol. Survey, p. 8–9]; 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 65, table 4 [English translation in library of U.S. Geol. Survey, p. 77]. Older than Almongui agglomerate and younger than Ngardok beds. Agglomeratelike tuff; contains fragments of amygdaloidal andesite, shale, and limestone in lower part.

S. Hanzawa *in* J. Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 16. Conformably and locally unconformably underlain by Ngardok (Galdog) formation and probably unconformably overlain by Ngaremlengui (Almonogui) agglomerate. Upper Eocene.

U.S. Army Corps of Engineers, 1956, Military geology of Palau Islands, Caroline Islands: U.S. Army Corps of Engineers, Far East, p. 40–45, pls. 4, 8, 9. Aimeliik formation consists of andesitic basaltic volcanic breccias, tuff breccias, and tuff. Divided into older Ngarsul member and younger Ngardok member. Thickness may be more than 2,000 feet. Overlies Babelthuap formation; underlies Ngeremlengui formation. Eocene.

Type locality: Aimelik, Babelthuap Island.

Ainoni 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. 76. Nepheline basalt flow about 100 feet thick, and associated cinder cone. Eruption probably occurred simultaneously with that of Maunawili volcanics. Distribution noted.

Named for Ainoni Spring, which issues from east margin of flow. Flow is 0.75 mile long and 0.5 mile wide; lies on northeast side of Koolau Range about 8 miles northwest of Makapuu Head.

Ainsworth Formation[1]

Upper Cretaceous: Southwestern South Dakota and northwestern Nebraska.

Original reference: F. Ward, 1922, South Dakota Geol. and Nat. History Survey Bull. 11.

First described in southeastern part of Pennington County and southwestern part of Jackson County, S. Dak.

Airai Clay or Formation

Airai Lignite Bearing Beds

Miocene and Pliocene: Caroline Islands (Babelthuap).

Risaburo Tayama, 1939, Brief report on the geology and ore resources of Babelthuap (Palau Island proper): Tropical Industry Inst., Palau, South Sea Island Bull. 3 [English translation in library of U.S. Geol. Survey, p. 6–7, 17]; 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull. v. 11, p. 66, table 4 [English translation in library of U.S. Geol. Survey, p. 78–79]. Referred to as lignite-bearing beds containing carbonaceous clay, sand and gravel, and brown lignite. Thickness on Palau proper, less than 40 meters. Resembles Talofofo peat-bearing beds on Guam. Older than Palau limestone; younger than Alumongui agglomerate. Pliocene.

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), 52–55, pls. 4, 8, 9. Airai clay or formation probably has maximum thickness of 150 feet, but beds rest on irregular base. Assigned to Miocene and Pliocene, but exact age not certain. Probably equivalent to lower beds of Palau limestone at some localities, although not lowermost beds of Palau.

Named for deposits north of Goikul, in Airai municipality.

Air Point Granite[1]

Precambrian: Southwestern Virginia.

Original reference: A. I. Jonas, 1933, Geol. Soc. America Bull., v. 44, p. 29–30.

Edward Steidtmann, 1945, Virginia Geol. Survey Bull. 64, p. 26, 27–28. Mentioned in discussion of commercial granites in Virginia.

Named for Air Point on Bent Mountain, Roanoke County.

Aitkin Formation[1]

Precambrian (upper Huronian): Central Minnesota.

Original reference: C. Zapffe, 1930, Lake Superior Min. Inst. Proc., v. 28, p. 101–106.

Underlies large area in northern and eastern parts of Aitkin County and extends into Crow Wing and Cass Counties.

Ajax Dolomite

Ajax Limestone[1]

Upper Cambrian: Central northern Utah.

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

H. T. Morris, 1957, Utah Geol. Soc. Guidebook 12, p. 5 (fig. 2), 9, 11 (fig. 3). Limestone described in East Tintic Mountains. Subdivided into three members: lower, 90 to 100 feet thick, chiefly medium- to coarse-grained medium- to dark-blue-gray faintly mottled dolomite which encloses pods and short lenses of black and brown chert; Emerald dolomite member, about 30 feet; upper, averaging about 450 feet, chiefly dolomite with thin-bedded argillaceous dolomite at top. Conformably overlies Opex formation; conformably underlies Opohonga limestone.

J. K. Rigby, 1958, Utah Geol. Soc. Guidebook 13, p. 25–26, 28 (fig. 4). Limestone described in Stansbury Mountains where it is 750 to 900 feet thick. Overlies Dunderberg shale and underlies Garden City formation.

R. E. Cohenour, 1959, Utah Geol. and Mineralog. Survey Bull. 63, p. 12 (table 1), 57, pls. 1, 17. Described in Sheeprock Mountains where it is entirely dolomite. Thickness in West Lookout Hills 1,012 feet. Includes Emerald member, 150 feet thick, near middle. Underlies House limestone; overlies Opex formation.

Named for Ajax mine, one-fourth mile east of Mammoth, Tintic district.

†Ajax Quartzite[1]

Middle Cambrian: Southeastern Arizona.

Original reference: J. A. Church, 1903, Am. Inst. Mining Engineers Trans., v. 33, p. 3–37.

In Tombstone district.

Ajibik Quartzite[1]

Precambrian: Northwestern Michigan.

Original reference: C. R. Van Hise and W. S. Bayley, 1895, U.S. Geol. Survey 15th Ann. Rept., p. 540.

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, Koma dolomite, Wewe slate, and Ajibik quartzite. Table 1 shows middle Huronian sequence in Marquette area (ascending): Ajibik quartzite, Siamo slate, and Negaunee iron-formation.

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 700 to 900 feet in Marquette district. Underlies Siamo slate. Overlies Wewe slate; unconformity. Middle Huronian.

Typical exposures on Ajibik Hills northeast of Palmer.

Ajo Volcanics

Tertiary, middle(?): Southwestern Arizona.

James Gilluly, 1937, Arizona Bur. Mines Bull. 141, Geol. Ser. 9, p. 15 (table 1), 43–45, pl. 1; 1946, U.S. Geol. Survey Prof. Paper 209, p. 39–40. Biotite and hornblende andesite tuffs and breccias, passing upward into flows. Unconformably underlies Sneed andesite (new); interfingers with underlying Locomotive fanglomerate (new). Thickness 3,500 to 5,000 feet.

Ajo quadrangle, Pima County. Caps Ajo Peaks; makes up hills west and southwest of Ajo Peaks and extends for about 3 miles in low range of hills southeastward from peaks.

†Akins Shale Member[1] (of Winslow Formation)

Pennsylvanian: Central eastern Oklahoma.

Original reference: J. A. Taff, 1905, U.S. Geol. Survey Geol. Atlas, Folio 122.

Named for Akins, Sequoyah County.

Akron Dolomite[1]

Upper Silurian: Western New York and Ontario, Canada.

Original reference: A. W. Grabau, 1909, Geol. Soc. America Bull., v. 19, p. 544, 550.

Winifred Goldring, 1946, New York State Mus. Bull. 332, p. 129. Dolomitic phase of Cobleskill limestone in Erie County.

D. W. Fisher, 1959, New York State Mus. Sci. Services Geol. Map and Chart Ser. 1. Shown on correlation chart above Williamsville waterlime of Bertie group.

Named for exposures in village of Akron, Erie County, N.Y.

†Alabama White Limestone[1]

Tertiary: Alabama.

Original reference: T. L. Casey, 1902, Philadelphia Acad. Nat. Sci. Proc., v. 53, p. 513.

Exposed on Tombigbee River near St. Stephens and on Alabama River near Claiborne, Monroe County.

Alabaster Gypsum Member (of Blaine Formation)

Permian: Oklahoma.

Sherwood Buckstaff, 1931, Am. Assoc. Petroleum Geologists Bull., v. 15, no. 4, p. 434–435. A fifth gypsum bed, called by field men the "alabaster" or "rock-crusher" gypsum, and lying between the Shimer and Medicine Lodge members of the Blaine as defined by Evans (1931, Am. Assoc. Petroleum Geologists Bull., v. 15, no. 4, p. 409–412), is present in Blaine County. Probably not present in area discussed by Evans, but should be considered in any complete revision of Blaine nomenclature.

D. A. Green, 1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 11, p. 1468. Name applied to gypsum bed in Blaine formation; occurs above Medicine Lodge member and below Shimer gypsum member. Thickness 3 feet.

Occurs northwest of El Reno in Canadian County.

Alachua Formation[1]

Pliocene: Northern Florida.

Original reference: W. H. Dall, 1892, U.S. Geol. Survey Bull. 84, p. 127–130, 157, 320.

H. E. Wood, 2d, and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 13, pl. 1. Hemphillian.

R. O. Vernon, 1951, Florida Geol. Survey Bull. 33, p. 189–208. As described in Citrus and Levy Counties, Alachua includes terrestrial deposits of diverse lithology, but is composed largely of clays, fine sands, and a basal rubble of phosphate rock, silicified wood, clay beds, and silicified Suwannee and Ocala limestone residuum. Sediments rest on bedrock of limestone ranging in age from middle Eocene to Oligocene, except in Citrus County where they interfinger with, and, in part, lie upon

Hawthorn formation. Unconformably overlain by fine to medium quartz sand containing no phosphate and believed to be early Pleistocene in age. Undetermined phosphate clay mineral forms matrix for much of fine sand and phosphate rubble, and Alachua formation is characterized by presence of this mineral and by fairly numerous specimens of vertebrate remains contained in sinks and depressions. These vertebrates range in age from lower Miocene into Pleistocene, and sediments of formation may have accumulated not only throughout Miocene epoch but also during period extending into Pleistocene. No stratigraphic relationships were determined during identification of vertebrate fossils, and presence of Pliocene and Pleistocene fossils may represent contamination by entrapment of these animals during epochs following Miocene, Maximum thickness about 66 feet.

H. S. Puri and R. O. Vernon, 1956, (abs.) Jour. Paleontology, v. 30, no. 4, p. 1000. Facies in Hawthorn facies of Alum Bluff stage.

K. B. Ketner and L. J. McGreevy, 1960, U.S. Geol. Survey Bull. 1074–C, p. 59–62. Lower Miocene strata commonly included in Alachua formation of Sellards (1914, Florida Geol. Survey 6th Ann. Rept.) are included in Tampa limestone. Simpson (1930, Am. Mus. Nat. History Bull., v. 59), who considered type locality of Alachua to be in vicinity of Williston, reviewed evidence to determine age of formation. He studied vertebrate fossils, which were collected from clay of Alachua on Mixson farm and from largely unknown stratigraphic positions in several hardrock phosphate mines north of area. He concluded that Alachua is late Miocene or early Pliocene in age. Cooke (1945, Florida Geol. Survey Bull. 29), on basis of same fauna, designated age as middle Pliocene. Authors of present report believe that term Alachua should be used only in its original sense; that is, for clay deposits which Simpson designated to be of late Miocene or early Pliocene age, typified by those on Mixson farm.

Named for its many exposures in Alachua County.

Aladdin Sandstone

Middle Ordovician: Eastern Wyoming and western South Dakota.

M. R. McCoy, 1952, Billings Geol. Soc. Guidebook 3d Ann. Field Conf., p. 45 (chart), 46–47. Quartzose-type sandstone which is occasionally calcareous. Commonly 25 to 30 feet thick. Conformably underlies Ice Box shale (new); conformably overlies Deadwood formation.

Type section: Bear Lodge Mountains, Crook County, Wyo., in sec. 14, T. 52 N., R. 63 W. Formation crops out on southern flank of Sheep Mountain, where it is exposed by faulting. Name taken from town of Aladdin, Wyo.

Alajuela Formation

See **Alhajuela Sandstone Member** (of Caimito formation).

Alameda 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. Inv. Map I–239. Overlain by Temescal formation, Merritt sand, or Bay mud. Maximum known thickness 1,050 feet (south of Oakland West quadrangle).

Named for fact that it is well developed at Alameda, San Francisco region.

Alamito shale[1]

Pennsylvanian: New Mexico.

Original reference: C. R. Keyes, 1906, Jour. Geology, v. 14, p. 147–154.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 22. Keyes proposed to divide Pennsylvanian into two (or possibly three) series which he called Ladronesian below and Manzanan above. He listed term Alamito under Ladronesian. He did not give source or definition of any of his terms. Terms introduced by Keyes are not considered established and are not used in present report.

Alamo Formation

Pliocene, lower: Northern California.

A. S. Huey, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 335. Incidental mention.

Carlton Condit, 1938, Carnegie Inst. Washington Pub. 476, p. 224, 228. Underlies Orinda formation; overlies Neroly formation. Southwest side of Mount Diablo.

B. L. Clark, 1940, (abs.) Geol. Soc. America Bull., v. 51, no. 12, pt. 2, p. 1957. Underlies newly defined Green Valley formation (previously referred to as Orinda).

B. L. Clark *in* C. E. Weaver and others, 1944, Geol. Soc. America Bull., v. 55, no. 5, p. 585, chart 11. Abandoned; formation renamed Diablo.

G. D. Louderback, 1951, California Div. Mines Bull. 154, p. 76. Mentioned as 1,000 feet of marine beds deposited above Neroly beds during lower Pliocene.

Occurs in Tesla quadrangle located about 40 miles southeast of Berkeley.

Alamogordo Member (of Lake Valley Formation)

Mississippian (Osage): Southern New Mexico.

L. R. Laudon and A. L. Bowsher, 1941, (abs.) Tulsa Geol. Soc. Digest, v. 9, p. 73, 74 (strat.. column); 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 12, p. 2114–2116, 2118–2119 (figs. 5, 6), 2125–2133. Defined as basal member of Lake Valley formation. Consists normally of four distinct facies: siltstone at base, overlain by hard cherty limestone, overlain by soft blue-gray marl, and capped with gray thin-bedded crinoidal limestone. Member is complicated by large crinoidal bioherms; bioherm facies consists of rounded dome-shaped masses of black relatively unfossiliferous almost featureless limestone. Thickness 130 feet. Underlies Arcente member (new); unconformably overlies Caballero formation (new).

L. R. Laudon and A. L. Bowsher, 1949, Geol. Soc. America Bull., v. 60, no. 1, p. 13, 26, 27 (fig. 13). As originally defined Alamogordo included beds here designated as Andrecito, Nunn, and Tierra Blanca. Alamogordo is here restricted to massive black very cherty poorly fossiliferous cliff-forming limestone beds above thin-bedded Andrecito member and below blue-gray crinoidal marls of Nunn member. Thickness averages from 30 to 50 feet and is fairly constant. Alamogordo (restricted) makes conspicuous scarp along front of Sacramento Mountains.

V. C. Kelley and Caswell Silver, 1952, New Mexico Univ. Pubs. in Geology 4, p. 74 (fig. 9), 83, 84 (fig. 10). Geographically extended to Caballo Mountain area where it is shown as overlying Percha shale.

Type area: Deadman Canyon, sec. 3, T. 17 S., R. 10 E., near Alamogordo, Otero County.

Alamosa Formation[1]

Pliocene, upper, or Pleistocene, lower: Central southern Colorado.

Original references: C. E. Siebenthal, 1910, Science, new ser., v. 31, p. 745; U.S. Geol. Survey Water-Supply Paper 240, p. 40.

W. J. Powell, 1958, U.S. Geol. Survey Water-Supply Paper 1379, p. 20–24. Underlies large part of San Luis Valley but is well exposed only in southern part, where Rio Grande and its tributaries have cut into upper part of formation. Thickness 41½ feet at Hansen Bluff on east bank of Rio Grande southeast of Alamosa. Recent deposits overlie Alamosa, but similarity of materials make it difficult to determine contact between the two; in this report, Recent materials are included in Alamosa except in some well logs. Most reliable data on formation comes from well logs.

Named for Alamosa, Conejos County, near center of San Luis Valley.

Alapah Limestone (in Lisburne Group)

Upper Mississippian: Northern Alaska.

A. L. Bowsher and J. T. Dutro, Jr., 1957, U.S. Geol. Prof. Paper 303–A, p. 4, 6, 25–34, figs. 2–4, pl. 2. Forms upper part of Lisburne group. Comprises nine unnamed members at type locality (ascending): shaly limestone, 85 feet thick; dark limestone, 175 feet; platy limestone, 187 feet; banded limestone, 210 feet; black chert-shale, 38 feet; light-gray limestone, 46 feet; fine-grained limestone, 80 feet; chert-nodule member, 80 feet; and upper limestone, 70 feet. Total thicknss 970 feet. Disconformably overlies Wachsmuth limestone (new).

Type locality: On northern part of Mount Wachsmuth, Shainin Lake area, central Brooks Range. Named from Alapah Creek, which flows into south end of Shainin Lake.

Alapah Mountain Glaciation

Pleistocene (late Wisconsin): Northern Alaska.

R. L. Detterman, A. L. Bowsher, and J. T. Dutro, Jr., 1958, Arctic, v. 11, no. 1, p. 45, 54–57, 60 (table 1), figs. 2, 3. Six glacial advances recognized in northern Brooks Range and on Arctic Slope. Alapah Mountain preceded by Echooka and Itkillik glaciations and succeeded by Fan Mountain glaciation (new). Deposits largely remnants of unsorted drift composed of limestone, sandstone, and shale fragments derived from nearby cirques. Morainal areas contain kettle lakes, and consequent drainage has undergone little or no modification.

Morainal remnants found in pass between Anaktuvuk River and Ernie Creek 16 miles south of Shainin Lake, these deposits having been formed at snouts of glaciers originating on slopes of Alapah Mountain, Arctic slope of Brooks Range.

Alaska Bench Limestone[1] (in Big Snowy Group)

Alaska Bench Limestone Member (of Amsden Formation)

Mississippian or Pennsylvanian: Central Montana.

Original reference: O. W. Freeman, 1922, Eng. and Min. Jour.-Press, v. 113, no. 19, p. 826–827.

P. A. Mundt, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 8, p. 1925–1929. Limestone is light to dark brown and gray, with dull purplish red mottlings. Where exposed, commonly weathers to shades of pink, red, and gray; weathered Alaska Bench limestone superficially resembles unweathered carbonate rocks of Amsden formation. Many workers have assigned both limestone and overlying dolomite to Amsden, and this is common usage among Montana geologists. Thickness along

Durfee Creek, Fergus County, 201 feet. Underlies Amsden formation; overlies and is gradational with Tyler formation.

H. D. Hadley and P. J. Lewis, 1956, Billings Geol. Soc. Guidebook 7th Ann. Field Conf., p. 142, 143. Overlies Cameron Creek formation and underlies Devils Pocket formation (both new).

L. S. Gardner, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 2, p. 332 (fig. 2), 334 (fig. 3), 338–339, 347. Included in Big Snowy group. Alaska Bench limestone, as used in this report, includes not only massive limestone sequence recognized by Freeman but also similar and closely related overlying beds of limestone and dolomite that are missing from type area but that are exposed on south flank of Big Snowy Mountains. Freeman gave no specific measured section for formation but implied that Beacon Hill, sec. 6, T. 12 N., R. 20 E., should be type locality. On Alaska Bench and throughout most of Fergus County, all overlying strata and much of Alaska Bench limestone itself have been removed by erosion; only known complete surface sections are in vicinity of Stonehouse Ranch on south slope of Big Snowy Mountains and at Durfee Creek. Overlies Cameron Creek formation; underlies Devils Pocket formation.

R. P. Willis, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 1942 (fig. 2), 1963. Reallocated to member status in Amsden formation (restricted). Underlies unnamed dolomite member; overlies Cameron Creek member of Tyler formation.

Well exposed on top of Alaska Bench, east of the Snowies. Forms series of hogbacks and sloping benches around Big Snowy Mountains.

Alaskan Glaciation

Recent: Alaska.

T. N. V. Karlstrom, 1957, Sci., v. 125, no. 3237, p. 74. Named on correlation chart of Alaskan glacial sequences. Younger than Naptowne glaciation.

T. N. V. Karlstrom, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B331 (fig. 153.1). Table shows Alaskan glaciation as Recent. Includes Tustumena and Tunnel advances.

Report discusses Cook Inlet area.

Albanian series[1]

Permian: North-central Texas.

Original references: C. R. Keyes, Pan-Am. Geologist, 1933 v. 57, p. 350, 351; 1933, v. 59, p. 144, 146.

Albany Clay[1]

Pleistocene: Eastern New York and western Vermont.

Original reference: E. Emmons, 1846, New York Nat. History, Agric., v. 1, p. 202–204.

G. H. Chadwick, 1944, New York Mus. Bull. 336, p. 196 (fig. 72). Varved clays in part of Cats Kill delta in Lake Albany.

Well developed at Albany, N.Y.

Albany Conglomerate[1]

Lower Ordovician: Northeastern Vermont.

Original reference: C. H. Richardson, 1929, Vermont State Geologist 16th Rept., p. 107–110.

In Orleans County.

†Albany Formation[1]

Permian: Northern Texas and southwestern Oklahoma.

Original reference: E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept., pl. 3, p. lxvii.

J. E. Adams and others, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 11, p. 1677. Incidental mention in discussion of Wolfcamp series equivalents.

Well developed in vicinity of Albany, Shackelford County, Tex.

Albany Granite[1]

Upper Devonian or Upper Carboniferous: Northern New Hampshire.

Original references: C. H. Hitchcock, 1874, Geology of New Hampshire, pt. 1, p. 508–545; 1877, pt. 2, p. 143.

In northern part of Carroll County.

Albany Porphyritic Nordmarkite[1]

Devonian(?): New Hampshire.

Original reference: L. Kingsley, 1931, Am. Jour. Sci., 5th, v. 22, p. 143.

Albany Porphyritic Quartz Syenite (in White Mountain Plutonic-Volcanic Series)

Albany Quartz Syenite[1]

Mississippian(?): New Hampshire.

Original reference: C. R. Williams, 1934, Appalachia, v. 20, no. 4, Summer Mag. No., p. 73.

Alonzo Quinn, 1941, Geology of the Winnipesaukee quadrangle, New Hampshire: New Hampshire State Plan. and Devel. Comm., p. 14, geol. map. Albany porphyritic quartz syenite mapped in Winnipesaukee quadrangle. Included in White Mountain magma series. Probably Carboniferous.

Alonzo Quinn, 1953, Geology of the Wolfeboro quadrangle, New Hampshire: New Hampshire State Plan. and Devel. Comm., p. 13, geol. map. Mapped in northwestern part of Wolfeboro quadrangle. Intrudes Moat volcanics. Mississippian.

M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000): U.S. Geol. Survey. Included in the White Mountain plutonic-volcanic series of Mississippian(?) age.

Town of Albany is in Carroll County.

Albany and Boston Amygdaloid[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: A. R. Marvine, 1873, Michigan Geol. Survey, v. 1, pt. 2, p. 25–27, 80, 81, 85, chart.

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

†Albany and Boston Conglomerate[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: A. R. Marvine, 1873, Michigan Geol. Survey, v. 1, pt. 2, p. 53–57, 61, 81, 84, 85, chart.

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

Albee Formation[1]

Ordovician: Northwestern New Hampshire and eastern Vermont.

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

M. P. Billings, 1937, Geol Soc. America Bull., v. 48, no. 4, p. 472–475, pl. 1. Four belts of Albee formation cross area [Littleton-Moosilauke], one near Gardner Mountain (Littleton quadrangle), second near Towns Mountain (Littleton quadrangle), third near village of Littleton, and fourth near villages of Lisbon and Bath. Thickness about 4,000 feet. Base not exposed in area. Not everywhere possible to establish precise boundary between Albee and overlying Ammonoosuc volcanics. Probably Upper Devonian.

J. B. Hadley and others, 1938, Geologic map and structure sections of the New Hampshire portion of the Mount Cube quadrangle (1:62,500): New Hampshire Highway Dept. In Grafton County, includes Piermont member (new). Thickness about 5,000 feet. Ordovician.

J. B. Hadley, 1950, Vermont Geol. Survey Bull. 1, p. 17. Geographically extended into Orange County, Vt. Two narrow tongues of formation extend on either side of Orfordville formation just south of village of Bradford.

D. J. Melton, 1960, New England Intercollegiate Geol. Assoc. Guidebook 52d Ann. Mtg., p. 25. Stratigraphic nomenclature developed by Billings and his coworkers in New Hampshire is, in general, valid in Speck Mountain quadrangle, Maine, but is used here only in an informal sense. Oldest formation is Albee considered to be of Ordovician age.

W. M. Cady, 1960, Geol. Soc. America Bull., v. 71, no. 5, pl. 3. Shown on correlation chart as Middle Ordovician.

Type locality: That part of Gardner Mountain which lies between Hunt Mountain (just southwest of Littleton quadrangle) and Albee Hill in Littleton quadrangle, New Hampshire.

Alberhill Clay[1]

Eocene: Southern California.

Original reference: P. H. Dudley, 1932, Geol. Soc. America Bull., v. 43, no. 1, p. 223.

P. H. Dudley, 1936, Geol. Soc. America Bull., v. 47, no. 3, p. 361. Clays include marine, lacustrine, and residual facies. Shown on table as underlying San Jacinto sediments and overlying late Jurassic(?) Cajalco quartz monzonite.

Occurs in area between towns of Riverside, San Jacinto, Corona, and Elsinore.

Albertan System

Middle Cambrian: Western North America.

A. W. Grabau, 1921, A text book of geology, pt. 2, Historical geology; New York, D. C. Heath & Co., p. 243 (footnote). Author states he proposed name Albertan for Middle Cambrian of Pacific Province in his "Geology of the Non-Metallic Mineral Deposits other than Silicates," v. 2, chapter 21, 1920. [Apparently this was never published.]

A. W. Grabau, 1936, Pan-Am. Geologist, v. 66, no. 1, p. 24. Restricted to western North America where Cambrian (old Middle Cambrian) has its greatest development.

Albin shale[1]

Upper Cambrian: Northeastern Iowa.

Original reference: C. R. Keyes, 1922, Pan-Am. Geologist, v. 38, p. 319, 326.

Named for fine exposures at Albin, Allamakee County.

Albion Formation or Shale

Mississippian (Meramecian): Southeastern Oklahoma.

B. H. Harlton, 1947, Tulsa Geol. Soc. Guidebook Field Trip, May 8, 9, and 10, p. 41. Basal section of Stanley is well exposed on east side of Black Knob Ridge in T. 1 S., R. 12 E., and along outer periphery of Potato Hills, especially in T. 2 N., R. 19 E. Gray to dark-gray fossiliferous siliceous shale bed, about 20 feet thick, is present near base. T. A. Hendricks contemplates using name Albion for this shale.

R. M. Becker, chm., 1954, Ardmore Geol. Soc. [Guidebook] Field Trip, October 1954, chart facing p. 1. Shown on chart as underlying Ten Mile Creek formation.

Albion Glacial Stage

Pleistocene (Wisconsin): North-central Colorado.

R. L. Ives, 1953, Geog. Review, v. 43, no. 2, p. 237–243, 249 (table). Time covered by deposition of Albion moraines. Younger than Pretty Meadow glacial stage (new).

Area: Silver Lake Valley at head of North Boulder Creek in Boulder County.

Albion Gravel[1]

Pleistocene: Central northern Iowa.

Original reference: S. W. Beyer, 1897, Iowa Geol. Survey, v. 7, p. 210, 231.

Albion, Marshall County.

Albion Group

Albion Sandstone[1]

Albion Series

Lower Silurian: Western New York and Ontario, Canada.

Original reference: E. O. Ulrich, 1913, Int. Geol. Cong. 12th, Canada, p. 26, 27, 30, 36, 39.

Tracy Gillette, 1940, New York State Mus. Bull. 320, p. 15–26. Term Albion group, Medinan series, used in this report [Clyde and Sodus Bay quadrangles] in preference to Alexandria group. Term used to include Whirlpool sandstone, Manitoulin sandstones and shales, Cabot Head shale, and Grimsby sandstones and shales. Grimsby sandstone is oldest rock cropping out in area of report. There may be an equivalent age relationship between Albion group and Alexandria group. Overlies Richmond group.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Term Albion group used to include (ascending) Whirlpool sandstone, Manitoulin shale, Cabot Head shale (restricted), Grimsby sandstone, and Thorold sandstone. Occurs below Clinton group. Term Albion series used for lower part of Silurian below Niagaran series.

R. E. Griswold, 1951, New York Water Power and Control Comm. Bull. GW–29, p. 10–12. Only upper beds of Albion sandstone are exposed in Wayne County. These consist mainly of thick red layers of sandstone interbedded with a few layers of red sandy shale; pebbly layer present locally. Thickness about 119 feet. Underlies Clinton formation of Niagara group.

J. J. Galloway, J. B. Patton, and T. G. Perry, 1953, Indiana Geol. Survey Field Conf. Guidebook 6, pl. 1. Term Albion series used on generalized stratigraphic column of Silurian rocks exposed in Jefferson and Switzerland Counties. Includes Medina group.

D. W. Fisher, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 9, p. 1983, 1984. Silurian of type section along Niagara Gorge is divided into three groups (ascending): Medinan, Clintonian, and Niagaran. Recommended that term Albion be suppressed.

Named for village of Albion, Orleans County, N.Y.

Albion Monzonite

Cretaceous(?): Eastern Colorado.

R. L. Ives, 1950, Sci. Monthly, v. 71, no. 2, p. 114. Albion monzonite of Colorado Front Range is substantially similar to Little Cottonwood monzonite in Little Cottonwood Canyon, Utah.

R. L. Ives, 1953, Geog. Rev., v. 43, p. 232 (fig. 3). Albion monzonite mapped in Silver Lake Valley.

Silver Lake Valley is at head of North Boulder Creek, Boulder County.

Albion Schist Member (of Westboro Quartzite)[1]

Precambrian(?): Eastern Rhode Island.

Original reference: B. K. Emerson and J. K. Perry, 1907, U.S. Geol. Survey Bull. 311, p. 8, 10–13, map.

A. W. Quinn, R. G. Ray, and W. L. Seymour, 1949, Bedrock geology of Pawtucket quadrangle, Rhode Island-Massachusetts: U.S. Geol. Survey Quad. Map [GQ–1]. Lens of schist 4,500 feet long and 400 feet thick lying within Westboro quartzite. Includes conglomerate beds that contain boulders as much as 10 feet in diameter.

Extends northwestward from village of Albion that it underlies.

Albion Range Group[1]

Precambrian(?): South-central Idaho.

Original reference: A. L. Anderson, 1934, Jour. Geology, v. 42, no. 4, p. 377–379.

C. P. Ross and J. D. Forrester, 1947, Geologic map of the State of Idaho (1:500,000): U.S. Geol. Survey. Age given as Precambrian(?).

C. P. Ross and J. D. Forrester, 1958, Idaho Bur. Mines and Geology Bull. 15, p. 3–4. Postulated Precambrian(?) beds in Cassia County were first named Harrison series by Anderson (1931) and later changed to Albion group by Anderson (1934). Consists mainly of quartzite, with some schist and marble. Thickness more than 9,000 feet. Anderson suggests correlation between his Albion Range group and Hyndman and East Fork formations on basis of lithologic similarity. Not correlated with Belt series.

Type locality not stated, but Albion Range is in Cassia County.

Albirupean Black Marl[1]

Upper Cretaceous: Maryland.

Original reference: P. R. Uhler, 1901, Maryland Acad. Sci. Trans., new ser., v. 1, p. 185–201.

†Albirupean Formation[1]

Upper Cretaceous: Eastern Maryland and Virginia.

Original reference: P. R. Uhler, 1888, Am. Phil. Soc. Proc., v. 25, p. 42, map.

Excellent sections on the Severn River, Md.

Alboroto Rhyolite (in Potosi Volcanic Group)

Alboroto Quartz Latite[1] or Group

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. 93 (table 18), 132–143, pl. 1. Referred to as rhyolite. Described in detail in San Juan district. Lies between Sheep Mountain quartz latite (below) and Huerto quartz latite (above). Lower part chiefly tridymite rhyolite, 0 to 500 feet thick, which consists of widespread thin flows and associated tuff beds. Found chiefly near borders of mountains. Includes Campbell Mountain rhyolite, Willow Creek rhyolite, and probably Outlet Tunnel quartz latite [all included in Alboroto group] of Creede district. Upper part biotite-hornblende latitic rhyolite, 0 to 3,000 feet, makes up most of formation; includes Equity and Phoenix Park quartz latites [included in Alboroto group] in Creede district.

U.S. Geological Survey currently designates the age of the Alboroto Rhyolite or Group as middle or upper Tertiary on the basis of age change of Potosi Volcanics.

First described in Platoro-Summitville district.

Albright Limestone (in Conemaugh Formation)[1]

Pennsylvanian: Northeastern West Virginia and western Maryland.

Original reference: R. V. Hennen and D. B. Reger, 1914, West Virginia Geol. Survey Rept. Preston County, p. 140.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 120. Bloomfield limestone member of the Conemaugh was named by Stout (1918) in Muskingum County, Ohio. According to Waagé (1950, Maryland Dept. Geology, Mines and Water Resources Bull. 9), Hennen and Reger (1914) named an equivalent limestone in Preston County, W. Va., the Albright. Thus, Albright has precedence over Bloomfield. Recommended that term Albright replace term Bloomfield if and when positive correlation is determined.

Occurs at Albright, Preston County, W. Va.

Albuquerquan series[1]

Precambrian: New Mexico.

Original reference: C. R. Keyes, 1915, Conspectus of geological formations of New Mexico, p. 4.

Exposed in the Tijeras Canyon, east of Albuquerque.

Albuquerque Marl[1]

Tertiary, upper: Central northern New Mexico.

Original reference: C. L. Herrick, 1898, Am. Geologist, v. 22, p. 26–43.

Kirk Bryan and F. T. McCann, 1937, Jour. Geology, v. 45, no. 8, p. 806. Mentioned in discussion of Santa Fe formation. Herrick recognized dissimilarities between valley fill at Albuquerque and Santa Fe marls of Hayden (1869) and Cope (1874, U.S. Geol. and Geog. Survey W. 100th Mer. (Wheeler report), p. 115–130), but his attention was largely directed to caliche on the upland surface, which he regarded as lake deposit. His term Albuquerque marl applies strictly to the caliche.

Named for occurrence in Albuquerque region.

Albuquerque series[1]

See Rio Grande series.

Alcalde 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), 991. Panoche group (or formation) is subdivided into 10 units. Alcalde shale is seventh in sequence (ascending). Underlies Joaquin Ridge sandstone (new); overlies Los Gatos sandstone. Assigned to Cachenian stage (new). Name credited to J. Q. Anderson.

Occurs in Alcalde Hills, Coalinga-Ortigalito area, San Joaquin Valley.

Alcova Limestone Member (of Chugwater Formation)[1]

Alcova Dolomite (in Chugwater Group)

Triassic: Central Wyoming.

Original reference: W. T. Lee, 1927, U.S. Geol. Survey Prof. Paper 149, p. 14.

E. B. Branson and C. C. Branson, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 135. In Wind River basin, referred to as Alcova dolomite in Chugwater group. Overlies Red Peak formation; underlies Crow Mountain formation.

J. D. Love and others, 1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 17. Underlies Popo Agie member; overlies Red Peak member. Crow Mountain member not present in area of this report [central Wyoming]. Thickness ranges from wedge-edge to 15 feet.

T. C. Woodward, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 2, p. 230, 231. In Deadman Butte area, Alcova member overlies Red Peak member and underlies Crow Mountain sandstone member (restricted usage). Thickness 6 to 10 feet.

G. N. Pipiringos, 1957, Wyoming Geol. Survey Bull. 47, p. 2, 9 (table 1), 13–15, pl. 5. Described in Laramie basin where it consists of about 11 feet of limestone, separated into beds 1 to 4 feet thick, colored gray black, purple to green brown, green gray and gray white; upper and lower parts sandy. Overlies main body of Chugwater; under lies Jelm formation (restricted). Contains mollusks of probable Early Triassic; may be Middle Triassic, but unlikely to be of Late Triassic age.

E. D. McKee and others, 1959, U.S. Geol. Survey Misc. Geol. Inv. Map I-300, p. 12. In this report [paleotectonic map of Triassic], Alcova member is assigned to interval C, which is approximately correlative with Upper Triassic series and with Karnian, Norian, and Rhaetian of Europe.

Named for occurrence near Alcova, Natrona County.

Alcyone Trachyte[1]

Teritary, 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. 27, map.

Named for Alcyone mine.

Alden Limestone[1]

Mississippian: North-central Iowa.

Original reference: F. M. Van Tuyl, 1925, Iowa Geol. Survey, v. 30, p. 52, 92, 99.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 101, 150. Also called Gilmore City limestone.

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

Alden Limestone[1] (in Arbuckle Group)

Ordovician: Southern Oklahoma.

C. E. Decker, 1933, Tulsa Geol. Soc. Digest, p. 55, 56. Included in Arbuckle group. Shown in list of formations for Arbuckle and Wichita Mountains section as underlying West Spring Creek formation and overlying Cool Creek limestone.

C. E. Decker, 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1313. Name Kindblade formation substituted for preoccupied name Alden.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 106. Abandoned by Oklahoma Geological Survey.

Alder Group

Alder Formation

Alder Sedimentary Series (in Yavapai Group)

Precambrian (Yavapai Series): 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), 1121–1123. Yavapai group is subdivided into Yaeger greenstone, Red Rock rhyolite, and Adler [Alder] sedimentary series (all new). Series consists of locally metamorphosed shale, grit, quartzite, and conglomerate; intensely folded and faulted. Exposed thickness unknown; appears to exceed 5,000 feet. All observed contacts with Yaeger greenstone (probably oldest in group) and Red Rock rhyolite are faults; hence relative age not definitely known, but character of rhyolite pebbles in its conglomerate suggests that Alder is younger than Red Rock.

Gordon Gastil, 1954, (abs.) Geol. Soc. America Bull., v. 65, no. 12, pt. 2, p. 1225; 1958, Geol. Soc. America Bull., v. 69, no. 12, pt. 1, p. 1498 (tables 1 and 2), 1499–1500, pl. 1. Referred to as formation. Divided into three unnamed members (ascending): interbedded slate, wacke, quartzite, and conglomerate, thickness unknown, probably 4,000 feet or more; quartzite, 300 to 1,000 feet; slate, wacke, and conglomerate as much as 580 feet. In Diamond Butte quadrangle (this paper), conformably underlies Flying W formation (new); in fault contact with pre-Alder(?) rocks. Upper contact of formation, as here defined, is base of lowest cobble volcanic or volcanic strata. Wilson's Alder series includes up to 1,000 feet of cobble conglomerate. This portion of Alder series may be equivalent to part of Flying W formation. Correlation chart shows Wilson's Alder series stratigraphically above Yaeger greenstone and below Red Rock rhyolite.

C. A. Anderson and C. S. Creasey, 1958, U.S. Geol. Survey Prof. Paper 308, p. 9, 20–32, pl. 1. Wilson's Alder series modified to Alder group. Rocks divided into six formations, which fall into two classes: those of probable known stratigraphic succession and those of unknown stratigraphic succession. Former comprises three volcanic sequences (ascending): Indian Hills, Spud Mountain, and Iron King (all new); latter divided into Green Gulch volcanics, Chaparral volcanics, and Texas Gulch formation (all new). Thickness not known; appears to be 20,000 feet or more, and may be as much as 30,000. Separated from Ash Creek group (new) by Shylock fault; hence relative ages not certain.

Named for typical occurrence in vicinity of Alder Creek in central segment of Mazatzal Range, Jerome area. Crops out extensively in Mazatzal Mountains, eastern Tonto basin, Black Hills, and to small extent in Del Rio area.

Alder Creek Basalt

Recent: Northern California.

Howel Williams, 1949, California Div. Mines Bull. 151, p. 46–47. Contains conspicuous phenocrysts of augite. Has blocky to scoriaceous crust. Thickness 100 to 150 feet. Covers Butte Creek basalt (new).

Issued from fissure near top of precipitous north wall of Alder Creek Canyon and cascaded 1,700 feet to canyon floor, Macdoel quadrangle.

Alderson Limestone (in Greenbrier Limestone)[1]

Mississippian (Chesterian): Eastern West Virginia and southwestern Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 449, 462, 699.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (columns 98, 99). Shown on correlation chart in Greenbrier series. Chesterian.

Type locality: On road toward Wolf Creek one-third mile south of Alderson, Monroe County, W. Va.

Alderton Formation or Interglaciation

Pleistocene: Northwestern Washington.

D. R. Crandell, D. R. Mullineaux, and H. H. Waldron, 1958, Am. Jour. Sci., v. 256, no. 6, p. 389–391. Consists of alluvial and lacustrine sediments, peat, volcanic ash, and mudflows from Mount Rainier. Alluvial sediments, composed chiefly of andesite fragments, range from sand to pebble and cobble gravel. Lacustrine sediments are mostly silt and fine to medium sand. Volcanic ash occurs both as distinct layers and disseminated throughout formation. Mudflows, which occur at several horizons, range from less than 10 feet to several tens of feet in thickness and are lenticular in cross section. Exposed thickness at type section 52 feet; probable total thickness more than 130 feet. Considered to have been deposited during a nonglacial interval that followed Orting glaciation and preceded Stuck glaciation. Separated from overlying Stuck drift (new) by erosional unconformity.

Typically exposed in west wall of Puyallup-Duwamish Valley in gullies under transmission line of Bonneville Power Administration in center sec. 1, T. 19 N., R. 4 E., about half a mile southwest of Alderton, Pierce County.

†Aldrich Limestone[1]

Middle or Upper Cambrian: Central Alabama.

Original reference: H. McCalley, 1897, Alabama Geol. Survey Rept. on Coosa Valley, p. 41–42.

Near Aldrich, Shelby County.

Aldrich Station Formation (in Wassuk Group)

Miocene, upper, and Pliocene, lower: Western Nevada.

D. I. Axelrod, 1956, California Univ. Pubs. Geol. Sci., v. 33, p. 23–29, 63–64, figs. 2, 3, 4. Consists of six major lithologic units (ascending): sandstone, shale, conglomerate, and breccia—thickness 150 feet; siliceous shale—thickness 400 feet; sandstone and conglomerate—thickness 750 feet; siliceous shale—thickness 350 feet; diatomaceous shale—thickness 1,600 feet; and silt, sandstone, and pebble conglomerate—thickness 800 feet. Aggregate thickness 4,050 feet. Underlies Coal Valley formation with local unconformity; overlies older rocks with unconformity.

Type area named for Aldrich Station, an old stagecoach station which is now represented by a stone foundation on county road at north base of Aldrich Hill; this site lies near middle of formation. Crops out prominently near base of Wassuk Range 5 miles southeast of Morgan's ranch, where lower part forms conspicuous white knolls against base of the range, Hawthorne quadrangle.

Aldwell Formation

Eocene, middle to upper: Northwestern Washington.

R. D. Brown, Jr., H. D. Gower, and P. D. Snavely, Jr., 1960, U.S. Geol. Survey Oil and Gas Inv. Map OM–203. Named for a sequence of well-indurated greenish-gray to medium-olive-gray marine siltstone that overlies and interfingers with Crescent formation in south limb of Clallam syncline. At type locality, lentil of pillow lava and flow breccia about 350 feet thick occurs 1,000 feet above base of formation; similar lentils or tongues of lava present in formation in other parts of area. Thickness about 2,950 feet at type locality; less than 100 feet near western boundary of mapped area. Underlies and interfingers with Lyre formation. Foraminifera, together with stratigraphic position, establish age of formation as middle to early late Eocene.

Type section: Exposures along Lake Aldwell on Elwha River from point 700 feet south of NE cor. sec. 28, T. 30 N., R. 7 W., to point 1,600 feet east, 1,200 feet south of NW cor. sec. 22, T. 30 N., R. 7 W.

Alegria Formation

Oligocene (Refugian): Southern California.

T. W. Dibblee, Jr., 1950, California Div. Mines Bull. 150, p. 30–31, pls. 1, 2. Defined as marine facies of continental Sespe formation in Gaviota and Point Conception quadrangles. Consists of about 1,200 feet of sandstone and minor amount of siltstone lying conformably above Gaviota formation and disconformably below Vaqueros formation. Varies in lithology and thickness along strike. From Agua Caliente Canyon grades laterally eastward into nonmarine Sespe; red clays appear progressively lower until at Capitan Canyon they occur throughout section, which apparently is all nonmarine.

Type locality: Ridge east of Canada de Santa Anita, Santa Barbara County. Formation is developed only on south flank of Santa Ynez

Range between a point 4 miles north of Point Conception and Capitan Canyon.

Aleman Cherty Member (of Montoya Dolomite)

Aleman Formation (in Montoya Group)

Upper Ordovician: Southwestern New Mexico.

V. C. Kelley and Caswell Silver, 1952, New Mexico Univ. Pubs. in Geology 4, p. 57, 60–62, figs. 2, 3; F. E. Kottlowski and others, 1956, New Mexico Bur. Mines Mineral Resources Mem. 1, p. 25–26. Consists of alternating beds of chert and dolomite. Chert occurs as irregular bands 1 to 3 inches thick alternating with 1- to 6-inch bands of dolomite. Chert weathers white, brown, and black, and the dolomite light gray to medium gray. Thickness varies; about 200 feet in Organ Mountains. Thins to an edge northward owing to pre-Percha, pre-Lake Valley, and pre-Magdalena erosion. Underlies Cutter formation (new); overlies Upham dolomite (new).

U.S. Geological Survey currently classifies the Aleman as a member of Montoya Dolomite on basis of study now in progress.

Type locality: In Cable Canyon opposite Sierrite mine in NW¼ sec. 10, T. 16 S., R. 4 W. (Sierra County). Name taken from station along Santa Fe Railroad to east of the mountains in the Jornada del Muerto.

Aleuts Member (of Kialagvik Formation)

Lower Jurassic: Southwestern Alaska.

L. B. Kellum, 1945, New York Acad. Sci. Trans., ser. 2, v. 7, no. 8, p. 203 (table 1), 205–206. Lower 650 feet consists of dark-gray to black shale grading upward into gray shaly sandstone; upper 450 feet consists of interbedded sandstone, shale, and conglomerate, increasing in coarseness upward with several beds of conglomerate in upper 200 feet. Underlies Kolosh member (new); overlies Bidarka formation (new).

Occurs in vicinity of Wide Bay, south of Katmai National Monument, Alaska Peninsula.

Alexandria Syenite[1]

Precambrian: Northeastern New York.

Original reference: H. P. Cushing and others, 1910, New York State Mus. Bull. 145, p. 10, 39, map.

Named for Alexandria Township, west and north of Redwood.

Alexandrian Series[1]

Alexandrian Group

Lower Silurian: Mississippi Valley.

Original reference: T. E. Savage, 1908, Illinois Geol. Survey Bull. 8, p. 110.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Alexandrian group comprises (ascending) Girardeau limestone (Orchard Creek shale), Edgewood limestone, and Brassfield limestone. In Albion series.

D. W. Fisher, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 9, p. 1984. Discussion of stratigraphy of Medinan group in New York and Ontario. Recommended that terms Albion, Alexandrian, Anticostian, Cataract, and Power Glen be suppressed and discontinued in type area of "Early" Silurian.

U.S. Geological Survey uses term Alexandrian as provincial series comprising Lower Silurian in Missouri, Illinois, and Michigan.

Named for Alexander County, Ill.

Alferitz Formation

Miocene, middle (Luisian): Central California.

Martin Van Couvering and H. B. Allen, 1943, California Div. Mines Bull. 118, pt. 3, p. 496–500. Whitish to yellowish siltstone containing orange concretionary layers and occasional thin poorly sorted sands. Maximum thickness 700 feet. Unconformably underlies McLure shale; overlies Escudo sandstone (new).

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.

Alfred Shale[1]

Upper Devonian: Western New York.

Original reference: E. R. Eller, 1935, Carnegie Mus. Annals, v. 24, no. 164, art. 8, p. 263–264.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Listed on correlation chart. Stratigraphically above Dunkirk shale and below Rushford sandstone.

Occurs at Alfred Station, Allegany County.

Alger Formation[1]

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

Original reference: A. F. Foerste, 1905, Kentucky Geol. Survey Bull. 6, p. 145; 1906, Bull. 7, p. 27, 61.

Wilber Stout, 1941, Ohio Geol. Survey Bull. 42, p. 34–35. Subdivided in southwestern Ohio into three members (ascending): Osgood, Laurel, and Massie. Average thickness about 55 feet.

Named for Alger, a station on railroad between Panola and Irvine, about 1 mile east of Estill-Madison County line, Kentucky.

Algomah Amygdaloid[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler, 1929, U.S. Geol. Survey Prof. Paper 144.

Named for occurrence at Algomah mine, Ontonagon County.

Algomah Flow[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Probably named for occurrence at Algomah mine, Ontonagon County.

Algoman granite or gneiss[1]

Precambrian: Lake Superior district.

[Original reference]: A. C. Lawson, 1914, *in* Internat. Geol. Cong., 12th, Canada, 1913, Comptes rendus, p. 349–370.

F. F. Grout and others, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 1038–1041, 1070 (table 4). Terms Algoman intrusives, Algoman granite, and Algoman time used in discussion of Precambrian stratigraphy in

Minnesota. As shown on table of possible correlations, Algoman granite is younger than Knife Lake group and older than Animikie group.

Name derived from Algoma, a district in western Ontario, Canada.

Alhajuela Sandstone Member (of Caimito Formation)

Alajuela Formation or Member (of Caimito Formation)

Miocene, lower: Panamá.

Charles Schuchert, 1935, Historical geology of the Antillean-Caribbean region: New York, John Wiley and Sons, p. 586. Alajuela formation consists principally of sandstones which become more calcareous below and have a barnacle limestone at their base. In part, marine equivalent of Caimito formation. Lower Miocene.

A. A. Olsson, 1942, 8th Am. Sci. Cong. Proc., v. 4, p. 234 (chart). Correlation chart shows Alajuela as uppermost member of Caimito formation. Lower Miocene.

W. P. Woodring and T. F. Thompson, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 2, p. 235–236, 246 (fig. 2). Uppermost member of Caimito formation in Madden basin. Present only in type area. Consists of massive fine- to coarse-grained tuffaceous sandstone. Thickness 275 feet. Late early Miocene or possibly early middle Miocene. The Alhajuela is the Gatún(?) formation of Reeves and Ross (1930, U.S. Geol. Survey Bull. 821) and member 1 of sandstone formation of Kellogg (1931, Final report on field investigations of the Madden Dam and Reservoir site at Alhajuela, Panama Canal Zone, Panama Canal Rept.).

Type region: Small area at and near Madden Dam in central part of Madden Basin, including site of former village of Alhajuela.

Alhambra Formation

Eocene, upper: Northwestern California.

C. E. Weaver, 1953, Washington [State] Univ. Pubs. in Geology, v. 7, p. 19 (chart), 49, 50–53, pls. 2B, 4A. Proposed for a sequence of brown silty shale, coarse silty sandstone and thinly laminated light-gray to white brittle shale which unconformably underlies San Ramon formation and overlies Escobar sandstone (new) in both limbs of Pacheco syncline. Thickness about 834 feet. In area of type section, comprises (ascending) Castro shale, Roop sandstone, and Pereira shale members (all new). Alhambra was mapped as Tejon in Concord quadrangle of San Francisco folio.

Type section: West limb of Pacheco syncline in Santa Fe cuts east of east portal of Muir Tunnel near Martinez, Contra Costa County.

Aliamanu Basalt (in Honolulu Volcanic Series)

Pleistocene: Oahu Island, Hawaii (subsurface).

H. T. Stearns, 1940, Hawaii Div. Hydrography Bull. 5, p. 55; G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 76–77. Melilite nepheline basalt. Overlain by 47 feet of Salt Lake tuff; underlain by 17 feet of alluvium which rests on Koolau basalt. Occurs between 62 and 93 feet in well.

Named for Aliamanu Crater within which it occurs. Penetrated only in one well, hence extent not known.

Aliamanu Tuff[1] (in Honolulu Volcanic Series)

Pleistocene, upper: Oahu Island, Hawaii.

Original reference: H. T. Stearns, 1935, Hawaii Div. Hydrography Bull. 1.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, 77. Water-laid gray to black or grayish-brown tuff containing numerous olivine crystals and some augite and magnetite, and also rounded gravel and sand; partly deposited by mud flow. Distribution noted.

Named from Aliamanu Crater, from which it is believed to have been erupted. Exposed intermittently over area of about 3 square miles east of Pearl Harbor, southwest of Koolau Range about 17 miles west of Makapuu Head.

Ali Baba Member (of Moenkopi Formation)

Lower Triassic: Southwestern Colorado and southeastern Utah.

E. M. Shoemaker and W. L. Newman, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 1840–1841, 1842–1843, 1845–1846. Consists mainly of red-brown to purplish ledge-forming beds of conglomeratic arkosic sandstone separated by interbedded red- and chocolate-brown silty shale and thin layers of fine- and coarse-grained sandstone. Exhibits marked facies change from northeast to southwest near Uncompahgre Plateau, to northeast, ledge-forming beds of sandstone are highly arkosic, heavily conglomeratic, and constitute dominant part of member. To southwest, sandstones become progressively finer grained, better sorted, and less abundant. Southwest of Moab Valley becomes lithologically indistinguishable from overlying Sewemup member (new). Thickness 0 to 290 feet. Over most of salt anticline region, Ali Baba unconformably overlies Tenderfoot member (new), and locally in Sinbad Valley, Paradox Valley, and around Fisher Valley unconformity is sharply angular. In Sinbad Valley, rests locally on Paradox member of Hermosa formation. In Paradox Valley, rests in places on Cutler formation. In Fisher Valley, rests locally on the Cutler and on Paradox member. Cut out toward Uncompahgre Plateau in vicinity of Gateway, Colo., by angular unconformity at base of Chinle. In Sinbad Valley, thins locally by internal angular uncomformities and is overlapped by Sewemup and Pariott (new) members toward axis of salt anticline.

Type section: East side Sinbad Valley, sec. 15, T. 49 N., R. 19 W., Mesa County, Colo. Named for Ali Baba Ridge in Sinbad Valley, hogback underlain by conglomeratic sandstone of member.

Alibates Dolomite Lentil (of Quartermaster Formation)[1]

Permian: Northern Texas.

Original reference: C. N. Gould, 1907, U.S. Geol. Survey Water-Supply Paper 191, p. 17–20.

L. E. Lincoln, 1946, Texas Univ. Bur. Econ. Geology Pub. 4301, p. 259–264. Described as persistent dolomite occurring in upper portion of Rustler formation.

Named for Alibates Creek, Potter County.

Alkali Formation[1]

Recent: Central southern Oregon.

Original reference: W. D. Smith, 1926, Oregon Univ. Commonwealth Rev., v. 8, p. 207–214.

Type locality: Alkali Lake and Alvord Basin, Lake County.

Alkali Creek[1] (red stratum in Wind River Formation)

Eocene, lower: Wyoming.

Original reference: W. Granger, 1910, Am. Mus. Nat. History Bull., v. 28, p. 244.

Along Alkali Creek near Lost Cabin, northeast corner of Fremont County, Wyo.

Allah Quartzite

Paleozoic: North-central Utah.

B. F. Stringham, 1942, Geol. Soc. America Bull., v. 53, no. 2, p. 271, pl. 1. A 50-foot bed of fine-grained quartzite with prominent bedding planes. Easily traceable across entire district.

Occurs in West Tintic Mining District [Juab County], approximately 21 miles southwest of Eureka, Utah. Named for Allah mine.

Allamakee dolomite[1]

Upper Cambrian: Northeastern Iowa.

Original reference: C. R. Keyes, 1922, Pan-Am. Geologist, v. 38, p. 319–326.

Probably named for exposures in Allamakee County.

Allamoore Limestone or **Formation**

Precambrian: Western Texas.

P. B. King, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 144 (fig. 1), 145, 148–149. Proposed for lower part of Millican formation of Richardson. Limestone is characteristically thin bedded, of blue, gray, or brown color, with nearly all beds seamed at regular intervals by thin bands of chert. Associated with limestone are masses of volcanic rocks; these include diabasic flows, in part amygdaloidal, in part massive, and various pyroclastic rocks, such as breccias and fine-grained, well-bedded tuffs. Volcanics are interbedded with limestone in thin to thick members. Allamoore is exposed only in strongly folded belt north of overthrust mass of Carrizo Mountain schist. Over wide areas its beds stand nearly vertical, so that its thickness is perhaps to be measured in thousands of feet. Underlies Hazel sandstone; overlies Carrizo Mountain schist.

T. S. Jones, 1953, Stratigraphy of the Permian Basin of West Texas: West Texas Geol. Soc., p. 1. Thickness given as 3,000 feet.

Type area: Van Horn region. Name derived from village of Allamoore, 11 miles west of Van Horn on the Texas and Pacific Railway and U.S. Highway 80. This name is spelled two ways, Allamoore for the post office, Allamore for the railroad station. Post office spelling is one adopted.

Allan Hollow Shale Member (of Frontier Formation)

Upper Cretaceous: Northeastern Utah.

L. A. Hale, 1960, Wyoming Geol. Assoc. Guidebook 15th Ann. Field Conf., p. 136 (chart 1), 138–140, 143 (fig. 2), 145 (fig. 3). Dark-gray marine shale with interbedded thin sandstone at base and top. Thickness 780 feet. This occurrence of marine shale represents parts of section by faulting. Only complete surface section found on northwest flank between crest of [Coalville] anticline in sec. 6, T. 2 N., R. 6 E., and Grass Creek Valley 3½ miles north-northwest. Formation, where it occupies northwest flank, partly covered by unconformable overlap of Knight formation and cut by several normal faults. Overlies Coalville member (new).

Named for typical exposures in Allan Hollow immediately northeast of Coalville, Summit County. Allan Hollow is a strike valley between northwest dip slope of Coalville member and overlying cliff of Oyster Ridge sandstone.

Allegany Drift[1]

Pleistocene: Pennsylvania.

Original reference: R. M. Deeley, 1913, Geol. Mag. London, new ser., Dec. 5, v. 10, table opposite p. 14.

Probably refers to drift west of Allegheny River in northwestern Pennsylvania.

Allegany Park parvafacies[1]

Devonian or Carboniferous: Southwestern New York.

Original reference: K. E. Caster, 1934, Bulls. Am. Pal., v. 21, no. 71, p. 28.

Named for development in New York State Park of this name, south of Salamanca, N.Y.

Allegheny Formation[1] or Group

Allegheny Series

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

Original reference: H. D. Rogers, 1840, Pennsylvania Geol. Survey 4th Ann. Rept., p. 150.

C. K. Graeber and R. M. Foose, 1942, Pennsylvania Geol. Survey, 4th ser., Topog. and Geol. Atlas 54, p. 28–55, pls. Group described in Brookville quadrangle. Includes all rock between top of Upper Freeport coal and base of clay under Brookville coal. Contains seven coal beds or horizons (descending): Upper Freeport, Lower Freeport, Upper Kittanning, Middle Kittanning, Lower Kittanning, Clarion, and Brookville. Divided into three formations: Freeport, extending from top of Upper Freeport coal to top of Upper Kittanning coal; Kittanning, extending from top of Upper Kittanning coal to base of clay under Lower Kittanning coal: Clarion, extending from base of Kittanning formation to bottom of clay under Brookville coal. Thickness about 325 feet. Underlies Conemaugh group; overlies Pottsville series.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, p. 665–666, 683, chart 6 (columns 8, 9, 10, 11, 12, 23). Boundary between Pottsville and Allegheny strata has been fixed only by correlations between anthracite and bituminous coal districts, and there are uncertainties in this correlation. Generally, base of Allegheny beds has been drawn at base of Brookville coal. The Allegheny beds, which are designated as a series on present chart, are treated as extending downward to base of Homewood sandstone (slightly below Brookville coal) and upward to top of Freeport coal, which has long been recognized as Allegheny-Conemaugh boundary. Some students believe Allegheny should be defined as extending up from base of Lower Kittanning coal, which corresponds to Buck Mountain coal, just above type Pottsville. In eastern Kentucky, Allegheny is treated as a formation and shown as overlying Breathitt formation.

G. H. Ashley, 1945, Jour. Geology, v. 53, no. 6, p. 374–389. Base of Brookville coal (or top of underlying Homewood sandstone) long accepted Pittsburgh-Pottsville (Upper-Lower Pennsylvanian) boundary in Appalachian bituminous coal fields. But increasingly, for last 45 years, detailed studies have shown that boundary has been drawn at many horizons, some over 500 feet apart in same section, owing to different correlations. Reasons for these diverse correlations cited. It is proposed to shift boundary to base of Lower Kittanning-No. 5 Block coal, believed to correlate with Buck Mountain bed, whose base forms boundary at type Pottsville locality, at Pottsville, Pa. If above proposal is accepted, it is further proposed that, until thoroughly established, the Allegheny group, down to base of Lower Kittanning coal, be called "Allegheny group, restricted," and that all Pottsville series, including all strata up to base of Lower Kittanning coal, be called "Pottsville series, extended."

M. N. Shaffner, 1946, Pennsylvania Geol. Survey, 4th ser., Topog. and Geol. Atlas 55, p. 46–77, pls. Group described in Smicksburg quadrangle, where it is 340 to 370 feet thick. Overlies Pottsville series, base taken at base of clay underlying Brookville coal. Underlies Conemaugh group. Studies by Ashley showed that Lower Kittanning coal is, regionally, most persistent coal in lower Allegheny group. Ashley (unpub. manuscript) proposed reclassification of Pennsylvanian system into Pottsville and Pittsburgh series. Pittsburgh series contained (ascending) Allegheny, Conemaugh, and Monongahela groups. Allegheny group contained (ascending) Kittanning member (with base at base of Lower Kittanning clay) and Freeport member. Clarion member placed in Kanawha group of Pottsville series. Until Ashley's proposal is accepted, Brookville coal considered base of Allegheny group.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 40–57, pl. 1. Series described on cyclothemic basis. Nine cyclothems named. [For sequence see Brookville cyclothem.] In this report, Allegheny includes Homewood, lowest member of Brookville cyclothem. Area of report, Perry County.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 14–24. Considered series in this report. Strata included in Ohio extend from base of Brookville (No. 4) coal to top of Upper Freeport (No. 7) coal. In Morgan County, outcropping strata range from Middle Kittanning (No. 6) coal to top of series, or about top third of Allegheny strata present in Ohio. Total thickness in Morgan County 111 feet including covered interval of 23 feet. Cyclothemic classification not used in this report, but units are referred to as members.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 46–92. Series described on cyclothemic basis in report on Athens County. Thirteen cyclothems named. [For sequence see Brookville cyclothem.] Lower limit of series placed between base of Homewood sandstone and top of Tionesta coal, and top boundary between top of Uffington shale and base of Lower Mahoning shale and sandstone. This transfers Homewood sandstone and Brookville underclay from Pottsville to Allegheny series and Uffington shale from Conemaugh to Allegheny series.

E. G. Williams and R. P. Nickelsen, 1958, Pennsylvania State Univ. Mineral Industries Expt. Sta. Bull. 71, p. 36–50. Allegheny series described in parts of Clearfield and Centre Counties. Boundary between Pottsville and Allegheny series placed at base of clay beneath Brookville coal, following Graeber and Foose (1942). Comprises (ascending) Clarion, Kittanning, and Freeport formations.

R. R. Dutcher and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 68–71. Stratigraphic classification of parts of Pottsville-Allegheny rocks in western Pennsylvania still a matter of controversy. There is general agreement that Allegheny-Conemaugh boundary, drawn at top of Upper Freeport coal, is significant and useful one. However Pottsville-Allegheny boundary, drawn at base of so-called Brookville coal or clay, has not been generally satisfactory. Brookville coal not adequately defined in type area, and coal designated Brookville by later geologists is probably Mercer (Ashley, 1945). Investigations by Renick (1924, Jour. Geology, v. 32, no. 1), Ashley (1945), and Williams and Nickelsen (1958) showed that, throughout many areas of western Pennsylvania, either Mercer or Clarion coals have been mapped as Brookville, and there is some doubt that true Brookville was ever mapped. In present report, Lower Clarion clay is used as boundary between Allegheny and Pottsville groups. Use of this boundary requires the least modification of existing terminology. In southern counties of state, where marine fossils are not associated with lower Allegheny and Pottsville coals, correlation with type areas has not yet been established. Group in western Pennsylvania averages 280 feet thick. Consists of six mappable coals or coal zones separated by variable and locally cyclic sequences of shale, siltstone, sandstone, limestone, and clay. Group has been arbitrarily subdivided into three formations (ascending), Clarion, Kittanning, and Freeport, at horizon of certain economically important clay or coal horizons.

Named for exposures in valley of Allegheny River, western Pennsylvania.

†Allegheny Group[1]

Mississippian: Pennsylvania.

Original reference: A. Sherwood, 1878, Pennsylvania Geol. Survey Rept. G, p. 11–42.

Corresponds approximately to Pocono formation, and name is also preoccupied.

†Allegheny River coal series[1]

Mississippian and Pennsylvanian: Pennsylvania and northern West Virginia.

Original reference: J. P. Lesley, 1877, Pennsylvania 2d Geol. Survey Rept. H_3, p. XXIII.

Allegrippis Sandstone Member (of Chemung Formation)[1]

Upper Devonian: Central Pennsylvania.

Original reference: I. C. White, 1885, Pennsylvania 2d Geol. Survey Rept. T_3, p. 99–100.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Correlation chart shows Allegrippus conglomerate underlying Middle Chemung (Wellsburg sandstone) and overlying Lower Chemung (Cayuta sandstone and shale).

Charles Butts, 1945, U.S. Geol. Survey Geol. Atlas, Folio 227. Member of Chemung formation. Generally, greenish-gray sandstone weathering white but locally coarse conglomerate; commonly has layers or pockets of conglomeratic sandstone. Thickness about 77 feet near Saxton. Occurs about 1,400 feet above Piney Ridge sandstone member. Occurs below Saxton conglomerate member.

Forms Allegrippus [Allegrippis] Ridge, Huntingdon County.

Allen Complex

Tertiary: Western Texas.

D. L. Amsbury, 1958, Texas Univ. Bur. Econ. Geology Quad. Map 22. Name given to an intrusive complex composed of rhyolite porphyries, vitrophyres, perlite, glassy breccias, and some sedimentary breccias.

Most rock types of complex crop out in belt of intrusions that trends west-southwest—east-northeast of old Allen place, Pinto Canyon area, Presidio County.

†Allen Limestone Member[1]

Pennsylvanian: Southeastern Kansas.

Original reference: G. I. Adams, 1904, U.S. Geol. Survey Bull. 238, p. 20.

Named for Allen, Lyon County.

Allenby Coal Member (of Carbondale Formation)

Pennsylvanian: Southern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 35, 48 (table 1), pl. 1. Proposed for coal formerly called Bankston so that name may be restricted to Bankston Fork limestone. Stratigraphically above Bankston Fork limestone member and below Galum 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: In roadside east of railroad crossing in NE¼NW¼ sec. 24, T. 9 S., R. 4 E., Williamson County. Name derived from village of Allenby in Saline County, about one-half mile southwest of type outcrop.

Allen Ridge Formation (in Mesaverde Group)

[Upper Cretaceous]: Southeastern Wyoming.

J. R. Bergstrom, 1959, Rocky Mountain Assoc. Geologists 11th Field Conf., Symposium, p. 114 (generalized composite strat. section). Comprises (ascending) about 550 feet of ripple-marked sandstones alternating with thicker carbonaceous shales and coaly beds; more than 550 feet of light-brown sandstones, generally 5 to 20 feet thick, separated by very poorly consolidated sandy shales and shaly sandstones which contain a few carbonaceous units; and 80 feet primarily of gray to gray-blue soft noncalcareous shale. Total thickness of formation 1,200 feet. Underlies Pine Ridge sandstone; overlies Steele formation.

Composite section from sec. 9, T. 22 N., R. 79 W., and sec. 18, T. 23 N., R. 79 W.

Allens Creek facies (of Edwardsville Formation)[1]

Lower Mississippian: Southern Indiana.

Original reference: P. B. Stockdale, 1931, Indiana Dept. Conserv., Div. Geology Pub. 98, p. 76, 249.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 74. Listed as a facies in Edwardsville formation. Includes (ascending) Mount Ebel sandstone, Weed Patch, and Cutright sandstone members.

Occurs in Lawrence, Monroe, and Morgan Counties.

Allens Falls Fanglomerate

Precambrian: Northwestern New York.

P. D. Krynine, 1948, (abs.) Geol. Soc. America Bull., v. 59, no. 12, pt. 2, p. 1333–1334. Fluvial arkosic fanglomerate referred to as "basal breccia" filling ancient sinkholes in Grenville marble and covered unconformably by Potsdam quartzite.

Vicinity of Allens Falls and Canton, St. Lawrence County.

Allensville Conglomerate Member[1] (of Logan Formation)

Mississippian: Central and southern Ohio.

Original references: J. E. Hyde, 1912, History of Fairfield County, p. 211; 1915, Jour. Geology, v. 23, p. 656, 657, 764, 771, 775–778.

F. T. Holden, 1941, Illinois Acad. Sci. Trans., v. 34, no. 2, p. 173. Included in Pretty Run sandstone facies of Logan formation.

J. E. Hyde, 1953, Ohio Geol. Survey Bull. 51, p. 27, 67, 68. Moderately fine-grained to coarse conglomeratic sandstones interbedded with bluish-gray, argillaceous shale. Thickness commonly 15 to 25 feet. Underlies Vinton member; overlies Byer member.

Named for exposures at Allensville, Vinton County.

Allentown Dolomite

Allentown Limestone[1] or Formation.

Upper Cambrian: Eastern Pennsylvania and western New Jersey.

Original reference: E. T. Wherry, 1909, Science, new ser., v. 30, p. 416.

B. L. Miller, D. M. McCoy, and R. L. Miller, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. C–48, p. 229–241. Formation represented in Northampton County by broad band of magnesian limestones that extends from New Jersey west-southwestward to Lehigh County and underlies major portions of Easton and Bethlehem; also forms floor of larger part of Saucon Valley and occurs in extreme southeastern corner of county in vicinity of Coffeetown and Frya Run. Estimated thickness 1,500 to 1,600 feet; no exposure of entire thickness known in region. Overlies Tomstown with apparent conformity; underlies Beekmantown strata.

B. F. Howell, Henry Roberts, and Bradford Willard, 1950, Geol. Soc. America Bull., v. 61, no. 12, pt. 1, p. 1355–1368. Discussion of subdivision and dating of Cambrian of eastern Pennsylvania. Trempealeauian Late Cambrian age of highest limestones in Lehigh and Durham Valleys established, and formation name, Allentown, applied. Dresbachian Late Cambrian age of next underlying limestones established, and formation name Limesport proposed for them. Restricted Allentown 400 to 500 feet thick. In Lehigh Valley, underlies Beekmantown dolomite. Allentown pinches out and is absent in Buckingham Valley.

Bradford Willard, 1958, Pennsylvania Acad. Sci. Proc., v. 32, p. 178–179, 182. Correlation of magnesian limestone of Ordovician age in Lehigh Valley with Beekmantown questioned. Proposes to reinstate Wherry's Coplay formation for Lower and Middle Ordovician beds between Upper Cambrian Allentown and Middle Ordovician Jacksonburg formations.

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

Allen Valley Shale (in Indianola Group)

Upper Cretaceous: Central Utah.

E. M. Spieker, 1946, U.S. Geol. Survey Prof. Paper 205–D, p. 122, 127–128, 133 (fig. 17). Body of marine shale, 600 to 800 feet thick, underlying Funk Valley formation (new) and overlying Sanpete formation (new).

Consists largely of evenly bedded gray marine shale interbedded with thin layers of yellowish bentonite, siltstone, very fine grained sandstone, and gray limestone. No individual bed more than 1 foot thick. Thickness at type locality 620 feet.

Type locality: Base of Wasatch Plateau in Allen Valley about 3 miles southwest of Manti. Top and base are well exposed in Salina Canyon, about 5 miles east of Salina.

Allison Member (of Menefee Formation)

Allison Member or Barren Member (of Mesaverde Formation)[1]

Upper Cretaceous: Northwestern New Mexico.

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

E. C. Beaumont, C. H. Dane, and J. D. Sears, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2156, 2157. Nomenclature of Mesaverde in San Juan basin, revised. Allison reallocated to member status in Menefee formation. Overlies Cleary coal member (new).

Well exposed near village of Allison, McKinley County.

Alloa Rhyolite[1]

Precambrian: South-central Wisconsin.

Original reference: J. T. Stark, 1932, Jour. Geology, v. 40, no. 2, p. 120, 121, 126.

Exposed on both sides of elliptical mound on Shanks Farm, just northeast of United Presbyterian Church, Caledonia Township.

Allouez Conglomerate (in Portage Lake Lava Series)

Allouez Conglomerate[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: A. R. Marvine, 1873, Michigan Geol. Survey, v. 1, pt. 2, p. 53–57, 60, 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.

Named for occurrence in Allouez mine, Houghton County.

Alloway Clay[1]

Miocene, upper: Southwestern New Jersey.

Original reference: H. B. Kummel and G. M. Knapp, 1904, New Jersey Geol. Survey, v. 6, p. 142.

William Lodding, 1956, Rutgers Univ. Bur. Mineral Research Bull. 7, p. 19, 65, 78, pl. 2. Alloway clay (Kirkwood) mentioned in discussion of raw materials for lightweight aggregate production in New Jersey.

Near Woodstown and Ewan Mills. Continues from near Swans Mill, south of Mullica Hill, Gloucester County, to point 2 miles south of Alloway, Salem County.

Allsboro Sandstone (in Chester Group)[1]

Mississippian: Northwestern Alabama and northeastern Mississippi.

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. Allsboro sandstone of Morse (1928) included in Tanyard Branch member of Pride Mountain formation (both new).

Named for small village in Alabama near Mississippi line.

Alma Glacial Substage

Pleistocene (Wisconsin): Central Colorado.

Q. D. Singewald, 1950, U.S. Geol. Survey Bull. 955-D, p. 120, pl. 9 [1951]. Times of maximum ice advance and of two principal ice stands during retreat are called Fairplay, Briscoe, and Alma substages, respectively, of Wisconsin stage of glaciation. Alma substage represents time covered by deposition of Alma moraine.

Area, northwestern Park County.

†Alma Limestone (in Council Grove Group)[1]

Permian: Northeastern Kansas.

Original reference: C. S. Prosser, 1894, Geol. Soc. America Bull., v. 6, p. 44-45.

Named for Alma, Wabaunsee County.

†Almagre Beds[1]

Eocene, lower: Northwestern New Mexico.

Original reference: Walter Granger, 1914, Am. Mus. Nat. History Bull., v. 33, p. 205-207.

C. H. Dane, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 24. Wasatch formation as described in this report [eastern side of San Juan Basin, N. Mex.] contains lower faunal division of the Wasatch as recognized by Granger (1914), the Almagre beds.

G. G. Simpson, 1948, Am. Jour. Sci., v. 246, no. 6, p. 368, 369, 370-374. In type region of San Jose formation (new) are two distinguishable clay facies corresponding to Granger's (1914) Almagre and Largo beds. "Almagre" facies occurs in lower part of formation throughout type region, except northward of Arroyo Blanco where it is sandstone facies. Forms lower part of formation.

Named for Almagre watershed. Simpson measured section near where continental divide crosses pass between head of the Largo and southwest branch of "Almagre" Arroyo, mostly in NE¼ sec. 8, T. 23 N., R. 1 W., Rio Arriba County.

Almenan Sub-Age

Pleistocene: Midcontinent region.

J. C. Frye and A. B. Leonard, 1955, Am. Jour. Sci., v. 253, no. 6, p. 359 (fig. 1), 363. Provincial term used to designate third and youngest time-stratigraphic and time unit of post-Sangamonian time. Includes time from Bradyan to present.

Name derived from vicinity of Almena, Norton County, Kans., which is type area of Almena terrace of Prairie Dog Creek Valley.

Almond Formation (in Mesaverde Group)[1]

Upper Cretaceous: Southwestern Wyoming.

Original reference: A. R. Schultz, 1920, U.S. Geol. Survey Bull. 702.

J. D. Love, J. L. Weitz, and R. K. Hose, 1955, Geologic map of Wyoming (1:500,000): U.S. Geol. Survey. Consists of white and brown soft sandstone, gray sandy shale, coal, and carbonaceous shale. Overlies Ericson sandstone and underlies Lewis shale.

Rock Springs uplift, Sweetwater County.

Almongui (Almonogui, Arumonogui) Agglomerate

Eocene(?): Caroline Islands (Babelthuap)

Risaburo Tayama, 1939, Brief report on the geology and ore resources of Babelthuap Island (Palau Island proper): Tropical Industry Inst., Palau, South Sea Islands Bull. 3 [English translation in library of U.S. Geol. Survey, p. 7–8, 17]; 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 65, table 4 [English translation in library of U.S. Geol. Survey, p. 78]. Composed chiefly of augite-andesite, with occasional layers of tuff. Bedding horizontal or dips less than 10°. Not in contact with Airai lignite-bearing bed, but considered older than those beds.

S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 17. Consists mostly of augite- and pyroxene-andesite with occasional interbedded tuff. Dip of formation is commonly less than 10°. Distinguished from Babelthuap and Aimelik [Aimiliiki] agglomerates by not being propylitized and by having no limestone lenses and metallic ore deposits. Although direct contact with Aimelik formation not found, latter is supposed to be unconformable below this formation. Eocene(?).

Covers more than half of Babelthuap Island. Along western coast of Almongui edge of formation forms hogback.

Almont Sandstone (in Tongue River Member of Fort Union Formation)

Paleocene: Southwestern North Dakota.

R. V. Hennen, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 12, p. 1573 (fig. 1), 1580. In a measured section, Almont lies approximately 35 feet above base of Tongue River member.

Section was measured along south margin of T. 138 N., Rs. 86 and 87 W. Sandstone forms high cliffs just above drainage, 1 mile south of Almont Railway Station [Morton County].

Almy Formation

Almy Conglomerate

Almy Formation (in Wasatch Group)[1]

Eocene, lower: Southwestern Wyoming.

Original reference: A. C. Veatch, 1907, U.S. Geol. Survey Prof. Paper 56.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 14, pl. 1. Formation included in Wasatch group. Tentatively considered Paleocene (Dragonian-Torrejonian).

A. J. Eardley, 1944, Geol. Soc. America Bull., v. 55, no. 7, p. 824 (table 1), 842–844, pl. 1. Conglomerate, in north-central Wasatch Mountains, includes (ascending) Pulpit conglomerate and Saw Mill conglomerate divisions (both new). Thickness about 3,200 feet. Overlies Henefer formation (new); underlies Fowkes(?) formation. Paleocene; included in Wasatch group, which is here given as middle Paleocene(?) to lower Eocene (Wasatchian?).

A. J. Eardley, 1952, Utah Geol. Soc. Guidebook 8, p. 54–55. In Wasatch hinterland, Almy conglomerate probably rests unconformably on Wanship formation (new). Best exposed in cliffs at mouth of Echo Canyon and up canyon for about 5 miles to where it is covered unconformably by Knight conglomerate. In vicinity of Henefer in core of Henefer anticline, Almy is thousands of feet thick. Some beds were originally thought to underlie Almy unconformably and were named Henefer formation. They are now thought to make up lower part of the Almy. Locally underlies Fowkes formation.

B. E. Lofgren, 1955, Utah Geol. Soc. Guidebook 10, p. 75. Coarse red cliff-making conglomerate near headwaters of South Fork 8 miles above Huntsville has been mapped as Almy conglomerate by Eardley (1944), thus correlating it with Almy formation (Veatch, 1907) in southwestern Wyoming. Since Eardley's original mapping, he and students have remapped area and now regard Saw Mill conglomerate as Knight conglomerate.

J. I. Tracey, Jr., and S. S. Oriel, 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 126–130. Veatch (1907) subdivided Wasatch group in Evanston area into Almy formation—basal unit of reddish-yellow sandy clays containing prominent conglomeratic beds in places; Fowkes formation—sequence of rhyolitic ash beds containing limestone lenses; and Knight formation—reddish-yellow sands and clays similar to Almy but separated from it and Fowkes by pronounced angular unconformity. Veatch noted that in places Almy seemed more closely related to underlying Evanston than to overlying Knight. In Kemmerer and Sage quadrangles, much of areas Veatch mapped as Almy are underlain by rocks more properly assigned to Evanston formation. Also, rhyolitic ash beds that Veatch defined as Fowkes formation, although apparently accordant with dipping beds of Almy at type locality, are, in fact considerably younger than nearby beds of Knight formation that Veatch interpreted as overlying the Fowkes. Fresh-water gastropods from type locality of Fowkes and from lithologically similar beds near Sage which Veatch called Fowkes are late Eocene or, possibly, earliest Oligocene. Massive light-gray conglomeratic cliffs northeast of Sage, called Almy by Veatch, are a part of this late Eocene unit. No vertebrate fossils have been collected from type locality of Almy. Knight and Almy formations were distinguished by Veatch partly on basis that lower peripheral conglomeratic beds of Wasatch are apparently more involved in structural deformation of basin than higher beds near center of basin. Lower, conglomeratic Almy of Veatch's type section may be as old as latest Paleocene despite absence of supporting evidence, whereas beds underlying Green River formation near Fossil Butte in center of basin are of early Eocene (Lysite) age. At present, use of names Almy and Knight seems inadvisable without explicit statements as to their meaning. Future mapping may clarify subdivisions of Wasatch in Fossil basin and perhaps relate them to subdivisions in Bridger basin.

A. J. Eardley, 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 167. With recognition that Fowkes does not occupy a layered position between Knight and Almy, relation of Knight and Almy becomes a problem. In those localities where Veatch shows Knight resting directly on Almy, present writer [Eardley] has found it impossible to detect any real break. Apparently Almy is simply a basal unit of Knight and of no real stratigraphic significance. No means has been found of recognizing Almy outside of its type locality just north of Evanston.

U.S. Geological Survey currently designates the age of the Almy as earliest Eocene in Fossil basin (type area) on the basis of a study now in progress.

Named for Almy, a few miles north of Evanston, Uinta County, Wyo.

Alnwick Lake Beds[1]

Miocene, upper, or Pliocene: Eastern Colorado.

Original reference: W. Cross, 1894, U.S. Geol. Survey Geol. Atlas, Folio 7.

Occurs in valley of Oil Creek about Alnwick, Pikes Peak region.

Alofau Volcanics

Pliocene(?): Samoa Islands (Tutuila).

H. T. Stearns, 1944, Geol. Soc. America Bull., v. 55, no. 11, p. 1286 (table 1), 1289–1290, pl. 1. Include all thin-bedded, chiefly olivine-bearing aa and pahoehoe basalts and dikes, breccias, firefountain deposits, and trachyte forming Alofau Volcano. About 962 feet thick.

G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 151–152. Appear to overlap Olomoana volcanics and to be overlapped by Pago volcanic series. Pliocene(?); no fossils; age designation on basis of weathering and erosion.

Named for village of Alofau in center of volcano. Cover about 1½ square miles on east side of Fagaitua Bay at east end of island.

Alpena Limestone[1] (in Traverse Group)

Devonian: Northeastern Michigan.

Original reference: A. W. Grabau, 1902, Michigan Geol. Survey Rept. 1901, p. 175.

A. S. Warthin, Jr., and G. A. Cooper, 1935, Washington Acad. Sci. Jour., v. 25, no. 12, p. 526. Restricted to exclude "black Alpena" zone which is separated below as Killians limestone (new). Dock Street clay of Grabau (1902) is considered local clay facies of upper Alpena horizon. Underlies Norway Point formation (new). Included in Traverse group.

G. A. Cooper and A. S. Warthin, 1941, Washington Acad. Sci. Jour., v. 31, no. 6, p. 260. Overlies Newton Creek limestone (new).

G. A. Cooper and A. S. Warthin, 1942, Geol. Soc. America Bull., v. 53, no. 6, p. 879; G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, p. 1743–1744, chart 4. Further restricted. Lower 15 feet, which contains a Genshaw fauna, placed in that formation. Next division, which consists of 25 feet of yellowish to brown crystalline limestone, to which the name Alpena is restricted, consists of 79 feet of light-gray to white limestone. Above Alpena (restricted) occur 8 feet of blue clay shale, Dock Street clay of Grabau (1902), a lens confined to east side of Alpena, and classified with Alpena limestone. Overlying Dock Street and Alpena is Four Mile Dam limestone.

G. V. Cohee, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 28. Michigan Geological Survey considers Newton Creek limestone a member of Alpena limestone.

Named for exposures at Alpena, Mich.

Alpine Formation (in Lake Bonneville Group)

Pleistocene: West-central Utah.

K. C. Bullock, 1951, Utah Geol. and Mineralog. Survey Bull. 41, p. 21. Oldest of Lake Bonneville deposits. Gilbert (1890, U.S. Geol. Survey Mon. 1) used term Intermediate to refer to Lake stage represented by these deposits. Consists of a high proportion of fine-textured sediment, mostly silt. Sorting excellent and bedding distinct. Underlies Bonneville formation (new). 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. 17-20, pl. 1. Formation thickens southward from about 50 feet in vicinity of Lehi to about 100 feet near Provo. Underlies glacial outwash and in some places Provo formation; overlaps onto pre-Lake Bonneville alluvial fans.

Named for town of Alpine in northern Utah Valley.

Alpine Quartz 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.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 486, table 4. Plutonic sequence in southern San Diego County comprises (ascending) Viejas gabbro-diorite, Alpine quartz diorite, Harbison quartz diorite, Descanso granodiorite, and La Posta quartz diorite. Late Mesozoic.

Typical occurrence in general vicinity of Alpine, southern Peninsular Range.

Alpreston Quartzite[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.

A. M. Hanson, 1952, Montana Bur. Mines and Geology Mem. 33, p. 3. Mentioned in summary of work on Cambrian system in and near western Montana. Alpreston quartzite (Flathead quartzites) is oldest Cambrian in Elkhorn region. Succeeded by Starmount limestones.

Forms crest of hill west of Elkhorn, Jefferson County.

Alsate Shale[1]

Lower Ordovician: Southwestern Texas.

Original reference: P. B. King, 1931, Am. Assoc. Petroleum Geologists Bull., v. 15, no. 9, p. 1066, 1069-1070.

W. B. N. Berry, 1960, Texas Univ. Bur. Econ. Geology Pub. 6005, p. 6, 13 (table 1), 19-20, 106-107, 110, 117. Black shale that forms distinct break between blue-gray-weathering Marathon limestone and tan-weathering limestones and sandstones of Fort Pena formation. In Alsate Creek exposure in Marathon anticlinorium, conglomerate underlies black shale and was included in Alsate by King. Conglomerate is merely a lens; it can be traced into limestone at top of Marathon and should not included in Alsate. Thickness about 100 feet in Alsate Creek and in exposures on ridge east of road to Roberts ranch; thins to 85 feet 3 miles to southwest. Thinner in Dagger Flat anticlinorium and commonly occupies covered interval. Here is greenish-weathering black shale. Granular limestone layers containing *Oncograptus*, which King (1937, U.S. Geol. Survey Prof. Paper 187) described as part of formation, belong to overlying Fort Pena formation.

Named for Alsate Creek, which joins Pena Colorada Creek from west at Fort Pena, Colo. Well exposed in cut on creek 2½ miles west southwest of Fort Pena, near road to Roberts ranch, Brewster County.

Alsen Limestone[1] (in Helderberg Group)

Lower Devonian: Eastern New York.

Original reference: A. W. Grabau, 1919, Geol. Soc. America Bull., v. 30, p. 468–470.

Winifred Goldring, 1943, New York State Mus. Bull. 332, p. 184–190. Overlies Becraft and underlies Port Ewen, but Port Ewen is missing at Alsen (locality from which Alsen was named). Underlies Oriskany where Port Ewen is missing. Thickness 25 feet in quarry at Alsen. Has been considered basal part of Port Ewen.

Named for section at Alsen, Greene County, where it is well shown in the hills.

Alsobrook Member (of Pride Mountain Formation)

Alsobrook Formation (in Chester Group)[1]

Upper Mississippian: Northwestern Alabama and northeastern Mississippi.

Original reference: W. C. Morse, 1928, Jour. Geology, v. 36, p. 31–43.

W. C. Morse, 1936, Mississippi Geol. Survey Bull. 32, p. 11, 16, 21. Constitutes lowest formation in Chester series. Shown as comprising Cripple Deer sandstone or shale member above, Hargett sandstone or shale member, and unnamed limestone. Underlies Allsboro sandstone.

S. W. Welch, 1958, U.S. Geol. Survey Oil and Gas Inv. Chart OC–58. Basal member of Pride Mountain formation (new) in Colbert County, Ala., and Tishomingo County, Miss. Morse described sequence as consisting of limestone 1 to 10 feet thick, containing brachiopod *Productus inflatus* McChesney, and overlying green shale 70 to 80 feet thick, containing a sandstone bed of variable thickness in upper part. He named the sandstone Cripple Deer sandstone member of his Alsobrook. Name Alsobrook is herein reduced to member status and redefined to include only basal limestone and that part of shale below Morse's Cripple Deer sandstone. Thickness about 50 feet in type area; thins eastward to 3 feet or less in vicinity of Spring Valley in Colbert County. Underlies Tanyard Branch member (new); overlies Tuscumbia limestone. Upper Mississippian.

Named for Alsobrook Homestead and Alsobrook Bridge, located about 3 miles north of Allsboro, Ala., in sec. 10, T. 4 S., R. 15 W.

Alta Formation[1]

Permian: Southwestern Texas.

Original reference: J. A. Udden, 1904, Texas Univ. Min. Survey Bull. 8, p. 10–25.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 673, 674, pl. 2 (column 2). Composed largely of clastics. Underlies Cibolo formation; overlies Cieneguita formation.

D. L. Amsbury, 1958, Texas Univ. Bur. Econ. Geology Geol. Quad. Map 22. Oldest formation exposed in Pinto Canyon, Presidio County. Dark-gray thin-bedded mudstone forms about 80 percent of the 610 feet exposed in measured section. Underlies Pinto Canyon formation (new).

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

Alta Formation

Alta Andesite or Andesite Series

Oligocene(?): Western Nevada.

V. P. Gianella, 1936, Nevada Univ. Bull., v. 30, no. 9, p. 33, 52–54, pl. 1. Referred to as Alta andesite series. Breccias predominate in lower part of series; toward top are lavas and lesser amounts of breccia. Thickness about 3,600 feet. Contains Sutro tuff member. Overlies Hartford Hill rhyolite. Miocene. Series was previously named Forman andesites [volcanics].

D. I. Axelrod, 1949, (abs.) Geol. Soc. America Bull., v. 60, no. 12, pt. 2, p. 1935. Oligocene age indicated on basis of flora in Sutro tuff member.

G. A. Thompson, 1956, U.S. Geol. Survey Bull. 1042–C, p. 51–52. Formation consisting mainly of tuff-breccia, flow breccia, and lava flows. Contains sedimentary Sutro tuff member (present only in Comstock lode district), which ranges in texture from shale to conglomerate and forms discontinuous lenses at different stratigraphic horizons. Probably interfingers with overlying Kate Peak formation in some places, but rock types are not sufficiently distinctive to be absolutely sure of this relation; intruded by Davidson granodiorite. Oligocene(?).

Occurs in Silver City district, on eastern slope of Virginia Range, 12 miles north of Carson City. Named for exposures near Alta mine shaft [on Comstock lode].

†Alta Granodiorite[1]

Upper Cretaceous or Tertiary, lower: Utah.

Original reference: F. F. Hintze, 1913, New York Acad. Sci. Annals, v. 23, p. 85–143.

Crops out just east of Alta, in central Wasatch Mountains, Salt Lake County.

†Alta Shale[1]

Lower and Middle Cambrian: Central northern Utah.

Original reference: F. F. Hintze, Jr., 1913, New York Acad. Sci. Annals, v. 23, p. 104.

Named for its prominence at little town of Alta.

Alta Loma Sand

Pleistocene: Texas (subsurface).

N. A. Rose, 1943, Progress report on the ground-water resources of the Texas City area, Texas: Texas Board of Water Engineers, p. 3–5. Consists of massive sand bed ranging from about 100 to 350 feet in thickness. Composed principally of fine- to coarse-grained sand but contains lenses of clay and sandy clay. Sand dips southeastward at rate of 15 to 20 feet per mile. Underlies Beaumont clay; overlies Lissie sand.

Named for town of Alta Loma, Galveston County. Sand is well developed in all wells that have been drilled in this locality for city of Galveston water supply.

†Altamaha Formation[1] or Grit[1]

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

Original reference: W. H. Dall, 1892, U.S. Geol. Survey Bull. 84, p. 81–82, 157, 320.

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

Altamira Shale Member (of Monterey Formation)[1]

Miocene, middle and 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. 131.

W. P. Woodring, M. N. Bramlette, and W. S. W. Kew, 1946, U.S. Geol. Survey Prof. Paper 207, p. 16–33, 39–40, pls. 3, 4, 6–7, 10–B, 28. Basal member of Monterey in Palos Verdes Hills area. Includes thick bentonitic tuff, Portuguese tuff bed, and a thin pumice tuff, Miraleste tuff bed. Thickness about 1,000 feet in type region; about 600 feet on north slope of hills owing to overlap on schist basement. Underlies Valmonte diatomite member. Division between middle and upper Miocene is between middle and upper parts of Altamira.

Type region: On south slope of hills along and adjoining Altamira Canyon, Palos Verdes Hills, Los Angeles County.

Altamont Limestone[1] (in Marmaton Group)

Altamont Limestone Member (of Oologah Limestone)

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

Original reference: G. I. Adams, 1896, Kansas Univ. Geol. Survey, v. 1, p. 22.

L. M. Cline, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 29. Subdivided into two formations, Tina below and Worland. Occurrences in Iowa noted.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 38, pt. 11, p. 325–334. Further subdivided to include a middle member, Lake Neosho shale. Type exposure designated; thickness at type exposure about 19 feet.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 7–8; R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 96. Comprises (ascending) Amoret limestone (name Amoret limestone substituted for Tina limestone), Lake Neosho shale, and Worland limestone members. Overlies Bandera formation; underlies Nowata formation.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped as upper member of Oologah limestone in Rogers, Nowata, and Craig Counties.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 30–31, fig. 5. Comprises (descending) Worland limestone, Lake Neosho shale, and Amoret limestone members. Unit not previously recognized as formation in Iowa, but as result of studies made in Madison County it now appears valid formation for this area. Underlies Nowata shale; overlies Bandera shale. Maximum thickness about 13 feet. Marmaton group.

Type locality: Near center of west line of sec. 5, T. 33 S., R. 19 E., about 3.5 miles west of Altamont, Labette County, Kans. No exposures in vicinity of Altamont show whole Altamont formation.

Alto coal group (in Pottsville Formation)[1]

Pennsylvanian: Central northern Pennsylvania.

Original reference: C. A. Ashburner, 1880, Pennsylvania 2d Geol. Survey Rept. R.

In Alton Basin, Lafayette Township, McKean County.

Alto Formation[1]

Middle Devonian: Southwestern Illinois.

Original reference: T. E. Savage, 1920, Am. Jour. Sci., 4th ser., v. 49, p. 168–178.

J. M. Weller and G. E. Ekblaw, 1940, Illinois Geol. Survey Rept. Inv. 70, p. 16–19. Strata intervening between Grand Tower limestone (or Dutch Creek sandstone where that is absent) and Mountain Glen shale (or Springville shale where that is absent) have been referred by Savage (1920) to Misenheimer shale and Lingle and Alto limestones. Restudy of area suggests that recognition of these three formations may be neither stratigraphically logical nor practically feasible. Might be advisable to apply to them the name St. Laurent formation which is used for Devonian beds overlying Grand Tower limestone in southeastern Missouri.

A. S. Warthin, Jr., and G. A. Cooper, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 10, p. 1524–1525. At its type locality, contains at its top about 11 feet of hard brown irregularly bedded finely granular dolomitic sandy limestone with much brown chert. Below this is about 70 feet of dark-brown to dark-gray irregularly laminated silty to sandy shale, with a few 1-foot layers of sandstone and sandy limestone. Some of shales are dark enough to be confused with Mountain Glen black shale above, if it were not for intervening cherty limestone. Formation has been variously correlated with rocks of Hamilton age, but is here considered as entirely post-Hamilton. Subsurface data. Middle Devonian.

Named for exposure along a creek in NE¼ sec. 34, in Alto Township, Union County.

Altona Dolomite Member (of Blaine Gypsum)[1]

Permiam: Central Oklahoma.

Original reference: C. N. Gould, 1902, Oklahoma Geol. Survey 2d Bienn. Rept., p. 42, 48.

Named for Altona, western part of Kingfisher County.

Altonian Substage

Pleistocene (Wisconsinan): Illinois.

J. C. Frye and H. B. Willman, 1960, Illinois Geol. Survey Circ. 285, p. 1, 2 (fig. 1), 5–6. Wisconsinan stage of Lake Michigan lobe is subdivided into (ascending) Altonian, Farmdalian, Woodfordian, Twocreekan, and Valderan substages. Radiocarbon dates suggest an age of 50,000 to 70,000 radiocarbon years B. P. as beginning of Altonian. Altonian is judged to include half or more of total duration of Wisconsinan age. Includes Roxana silt and Winnebago drift (both new).

Named for city of Alton, in southwestern Illinois, located on bluff of Mississippi River valley below mouth of Illinois River.

Altoona Limestone[1]

Pennsylvanian: Southeastern Kansas.

Original reference: E. Haworth and W. H. H. Piatt, 1894, Kansas Univ. Quart., v. 2, p. 115–117.

Named for Altoona, Wilson County.

Altuda Formation

Altuda Shaly Member (of Capitan Limestone)[1]

Permian (Guadalupe): Western Texas.

Original reference: P. B. King, 1927, Am. Jour. Sci., 5th ser., v. 14, p. 217.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 655. Rank raised to formation.

Named for exposures in vicinity of Altuda section house [Brewster County].

†Altuda Granite[1]

Age(?): Western Texas.

Original reference: J. A. Udden, 1907, Texas Univ. Bull. 93, Sci. ser. No. 11, p. 70.

Covers an area of somewhat more than 1 square mile, 4 miles north of Mount Ord, southwest of Altuda, Brewster County.

Alturas Formation[1]

Pliocene, middle or upper: Northeastern California.

Original reference: Erling Dorf, 1933, Carnegie Inst. Washington Pub. 412, p. 6, 23.

D. I. Axelrod, 1944, Carnegie Inst. Washington Pub. 553, p. 264, 276 (table 25). Relatively horizontal strata; includes coarse, brownish tuffaceous sandstones and pebbly conglomerates, as well as lenses of white to gray tuffaceous shales and clays. Total thickness only a few hundred feet. Rests disconformably upon channeled and eroded surface of Upper Cedarville formation; overlain regularly by Warner basalt. Pliocene.

Flora collections made in vicinity of Rattlesnake Butte, about 4 miles east of Alturas, Modoc County.

Altyn Limestone[1] (in Ravalli Group)

Precambrian (Belt Series): Northwestern Montana, and southwestern Alberta and southeastern British Columbia, Canada.

Original reference: Bailey Willis, 1902, Geol. Soc. America Bull., v. 13, p. 316, 321.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc. America Bull., v. 48, no. 12, p. 1881–1884. Consists of dolomites, limestones, limy argillites, sandstones, and minor mud breccias, which form lower calcareo-magnesian division in Belt sediments in Glacier Park facies. Sediments show considerable variety in color, texture, and bedding; they contain mud cracks, ripple marks, and many beds of flat-pebble and edgewise conglomerates. Upper limit is base of Appekunny formation with which there is some intergradation; lower limit concealed beneath Lewis thrust. Thickness 2,180 to 2,480 feet. Includes (ascending) Waterton (Canada only), Hell Roaring (new), and Carthew (new) members. This definition includes Altyn of Willis (1902) and Daly's Waterton formation because no significant break exists between them.

C. P. Ross, 1949, (abs.) Washington Acad. Sci. Jour., v. 39, no. 3, p. 112. Included in Ravalli group. Underlies Appekunny argillite.

C. P. Ross, 1959, U.S. Geol. Survey Prof. Paper 296, p. 18–21, pls. 1, 2. Not exposed in Flathead region, and base has nowhere been recognized. Does not appear to be exposed in any other part of Montana. Commonly regarded as part of Ravalli group—a convenient procedure which is herein adopted provisionally. No evidence exists as to stratigraphic relations of the Altyn of Glacier National Park to basal components of Ravalli group in other parts of Montana or to underlying Prichard formation. Fenton's members discussed, but formation not subdivided in present report. Limestone forms Range extending about as far south as lat 48°20′ N. and northward past Canadian border. Here it immediately overlies Lewis overthrust, and much of it has been cut out by that fault. Also exposed in outlying blocks such as those in Divide and Chief Mountains and on either side of Waterton Lake.

Type locality: In cliffs of Appekunny Mountain, due north of Altyn, in Swift Current Valley, Glacier National Park. Entire section exposed only in Waterton Lakes Park, where it is complicated by faults and folds.

Alum Phyllite

Precambrian: Southwestern Virginia.

R. V. Dietrich, 1959, Virginia Polytech. Inst. Bull., Eng. Expt. Sta. Ser. 134, p. 75–84, pl. 1. Chiefly sericitic slate-phyllite. Main mass appears to lie conformably within Lynchburg gneiss (Lynchburg as used here may not be correlative of type locality Lynchburg). The Alum grades both upward and downward, through a few feet, into Lynchburg gneiss, except locally along its northern contact where it appears to grade into Little River gneiss (new).

Named for Alum Ridge district. Underlies a nearly 2-mile-wide belt that extends from near northwestern corner of Floyd County northeastward to Route 8.

Alum Bluff Group[1]

Alum Bluff Stage

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

Original reference: W. H. Dall, 1892, U.S. Geol. Survey Bull. 84, p. 112–113, 122–123, 157, 158, 320.

H. S. Puri, 1953, Florida Geol. Survey Bull. 36, p. 16 (table 1), 18 (fig. 2), 21–27, fig. 3 facing p. 18. Stage embraces all sediments of post-Tampa and pre-Choctawhatchee age, the middle Miocene of most authors, in Florida panhandle and their equivalents in Central and Western Gulf states. In Florida panhandle, includes Chipola, Shoal River, Oak Grove, and Hawthorn facies.

C. W. Cooke, 1954, Florida Geol. Survey Bull. 29, p. 18 (table), 136–144. Formations now included in group are (descending) Shoal River, Chipola, and Hawthorn (east of Apalachicola River). Oak Grove sand included in Shoal River formation. Group consists predominantly of micaceous sand, sandy clay, fuller's earth, and limestone. Conformably overlies Tampa limestone, or, where Tampa is absent, Ocala limestone or Suwannee limestone forms the bedrock. Unconformably underlies Duplin marl or Pliocene or Pleistocene deposits.

Named for exposures at Alum Bluff on east side of Apalachicola River, Liberty County, Fla.

†Alum Bluff series[1]

Miocene, middle and upper: Northwestern Florida.

Original reference: D. W. Langdon, 1891, Georgia Geol. Survey 1st Rept. Prog., p. 91–97.

Alum Cave[1] Limestone Member (of Petersburg Formation)

Pennsylvanian: Western and southwestern Indiana.

Original reference: W. N. Logan, 1929, Indiana Dept. Conserv. 11th Ann. Rept., p. 30–34.

C. E. Wier, 1950, U.S. Geol. Survey Coal Inv. Map C–1. Allocated to member status in Petersburg formation. In Jasonville quadrangle, Clay, Greene, and Sullivan Counties, consists of gray impure hard limestone. Normally separated into two beds by 1 to 6 inches of calcareous shale; lower 1 or 2 inches of lower bed is shaly and fossiliferous. Thickness 4 to 6 feet. Underlies Dugger formation (new); overlies a black shale unit which overlies Coal V.

Derivation of name not stated.

Alumonogui Agglomerate

See Arumonogui (Almongui) Agglomerate.

Alum Rock Rhyolite

Post-Cretaceous: Northwestern California.

M. D. Crittenden, Jr., 1951, California Div. Mines Bull. 157, p. 47–48, pls. 1, 3. Pale-colored aphanitic rock; strongly jointed; more or less silicified. Fresh surfaces range in color from nearly white to brownish red or purple. Intruded into Cretaceous Oakland conglomerate and Berryessa formation (new). Known only to be post-Cretaceous, but by analogy with Leona rhyolite of the Oakland, it is more likely post-Orinda and possibly Quaternary.

Area: San Jose-Mount Hamilton area in Coast Ranges about 50 miles southeast of San Francisco. Mapped area is on west slope of Diablo Range. Rhyolite is intrusive body about 1,000 feet wide and 400 feet long which crops out in lower Alum Rock Canyon.

Alverson Andesite Lava

Miocene: Southeastern California.

T. W. Dibblee, Jr., 1954, California Div. Mines Bull. 170, chap. 2, p. 22. Dark-brown basic andesite. About 400 feet thick in Alverson Canyon and about 700 feet thick at east end of Coyote Mountains where it is associated with tuff and breccia. Overlies Split Mountain conglomerate and older basement rocks in western foothills of Coyote Wells Valley, in Coyote Mountains, and in Fish Creek Mountains; in some areas underlies the Fish Creek gypsum (new) and (or) Imperial formation.

Type locality: Alverson Canyon, Imperial Valley region.

Alverson Canyon Formation

Miocene(?): Southeastern California.

L. A. Tarbet and W. H. Holman, 1944, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 28, no. 12, p. 1781–1782. Nonmarine unassorted sediments and associated basic igneous flows and tuffaceous sediments unconformably overlying all older rocks. Unfossiliferous. Thickness as much as 700 feet. Overlies Split Mountain formation (new); underlies Imperial formation.

L. A. Tarbet, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 2, p. 260, 261 (fig. 40). Because Alverson Canyon formation rests directly on basement complex, it may be equivalent in age to Split Mountain formation. However, Split Mountain probably predates volcanic activity prevalent in Alverson Canyon formation because no volcanic debris was observed in Split Mountain.

Imperial Valley area.

Alvord Formation[1]

Miocene, lower: Southeastern Oregon.

Original reference: W. D. Smith, 1926, Oregon Univ. Commonwealth Rev., v. 8, p. 207–214.

Typically exposed on east side of Alvord Valley, southern part of Harney County.

Alvord Creek Formation

Alvord Creek Beds[1]

Pliocene: Southeastern Oregon.

Original reference: R. E. Fuller, 1931, Washington Univ. Pubs. in Geology, v. 3, no. 1, p. 7–130.

D. I. Axelrod, 1944, Carnegie Inst. Washington Pub. 553, p. 225. Alvord Creek beds described by Fuller are here designated Alvord Creek formation. Lower Pliocene.

Howel Williams and R. R. Compton, 1953, U.S. Geol. Survey Bull. 995–B, p. 24–25. In mapped area (Steens and Pueblo Mountains), formation is restricted to narrow belt along foot of High Steens scarp bordering Pike and Little Alvord Creeks. Consists predominantly of well-stratified flat-lying white and pastel-tinted tuff, tuffaceous clay, and silt, with occasional interbeds of chert, opaline shale, and conglomerate; near mouth of Pike Creek includes a rhyolite flow. Thickness 500 feet; base not exposed. Unconformably underlies Pike Creek volcanic series; unconformably overlies pre-Tertiary rocks.

Probably named for occurrences near base of Steens Mountain scarp between Cottonwood Creek and Little Alvord Creek, Harney County.

Alvord Peak Basalt

Miocene: Southern California.

F. M. Byers, Jr., 1960, U.S. Geol. Survey Bull. 1089–A, p. 18–21, pls. 1, 2. Nonporphyritic basalt flow sequence. Thickness 300 to 400 feet at Alvord Peak. Conformably overlies Clews fanglomerate (new); northwestward, overlaps Clews as fanglomerate wedges out, and rests on plutonic rocks and granodiorite porphyry dikes of basement complex. Underlies Spanish Canyon formation (new) or Barstow formation where Spanish Canyon is missing. Assigned to middle Miocene or older on basis of middle Miocene vertebrate fossils in lower part of overlying Barstow.

Named for Alvord Peak, Alvord Mountain quadrangle, San Bernardino County.

Amador Group

Middle and Upper Jurassic: East-central California.

N. L. Taliaferro, 1942, Geol. Soc. America Bull., v. 53, no. 1, p. 89–90. Amador group substituted for preoccupied name Tuolumne. Consists of clastic sediments and volcanics which are strongly folded and frequently faulted. Thickness less than 5,000 to more than 15,000 feet. Underlies Mariposa [slates].

N. L. Taliaferro, 1943, California Div. Mines Bull. 125, p. 282–284, 303, 306 (fig. 2), 307 (fig. 3). On Cosumnes and Calaveras Rivers, divisible into two formations: Cosumnes below and Logtown Ridge agglomerates (both new). Thickness on Cosumnes River immediately west of Mother Lode Highway 7,100 feet; thicker to west and acutely folded. On Merced River, divisible into five formations: lower volcanics (thickness unknown, and base not exposed), pillow basalts (1,200 feet), Hunter Valley cherts (950 feet), Penon Blanco volcanics (about 9,000 feet), and Agua Fria (3,500 feet). Complete correlation of sections not established, but Logtown Ridge and Penon Blanco are correlated and pillow basalts and Hunter Valley cherts are equivalent to part of Cosumnes formation. Batholithic intrusions of granodiorite and diorite common, as are plugs, sills, and dikes of basic and ultrabasic rocks. Younger than Calaveras and older than Mariposa. Nearly everywhere Amador grades upward into Mariposa; north of Middle Fork of American River, Mariposa overlaps Amador. Occurs as long narrow belts, either flanking western Calaveras or rising as overturned anticlines from beneath Mariposa; overturning is commonly toward west, axial planes of folds dipping eastward at angles of 60° to 70°. Exact age of Amador not known but believed to be from upper Middle to lower Upper Jurassic. Type sections designated. On various geologic folios, group of rocks here called Amador has been mapped as Calaveras, Mariposa, "diabase and porphyrite," amphibolite schist, and quartz amphibolite.

G. R. Heyl and J. H. Eric, 1948, California Div. Mines Bull. 144, pt. 1, p. 51–53, pl. 7. Series of schists and greenstone in Newton mine area (near Jackson, Amador County), tentatively correlated with Jurassic Amador group described by Taliaferro (1942), subdivided into four formations (descending): Mountain Spring volcanics, Dufrene slate, Newton Mine volcanics, and Sunnybrook volcanics. Section described exposed in western part of area from Mariposa slate eastward along Mountain Spring Creek to Newton mine. In general rocks dip steeply eastward; in some places beds are vertical; graded bedding suggests that rocks lie on western, overturned limb of major anticline and become progressively older toward east. Approximate thickness of section 2,057 feet.

J. H. Eric, A. A. Stromquist, and C. M. Swinney, 1955, California Div. Mines Spec. Rept. 41, p. 10–11, pls. 1, 2. Described in Angels Camp and Sonora quadrangles, Calaveras and Tuolumne Counties, where it includes Cosumnes and Logtown Ridge formations. Middle or Upper Jurassic.

Type section for northern end of group is on Cosumnes River, Eldorado and Amador Counties; for southern end, on Merced River. Named for exposures along Cosumnes River, Amador County.

Amalia Formation

Tertiary, middle or upper: Northern New Mexico and southern Colorado.

P. F. McKinlay, [1955], New Mexico Bur. Mines Mineral Resources Bull. 42, p. 16–18, pl. 1. Includes interbedded arkosic sedimentary rocks, basalt flows, and rhyolite tuffs. Beds and flows are often lenticular and irregular. Thick flows of olivine basalt occur near base. These are overlain by beds of siltstone, tuff, and pumice, 50 to 200 feet thick. A 50- to 150-foot layer of welded tuff lies above the siltstones. This unit is silicified and forms conspicuous outcrops for more than 7 miles along strike. Welded tuff is overlain by 200 to 600 feet of semiconsolidated sandstones and conglomerates. The total exposed thickness approximately 2,000 feet.

Upper beds of formation grade into, or are overlain by, thick Tertiary gravels. South and east of Costilla, Amalia overlain unconformably by Quaternary-Tertiary basalt flows. Amalia lies above andesite and andesite tuffs. South of Rito de los Cedros, appears to overlap onto Precambrian granite and metamorphic rocks.

Named for Amalia [N. Mex.] post office which lies on west side of Costilla Valley, 5 miles southeast of town of Costilla. Unit is best exposed east of the Rio Costilla, 4 or 5 miles south of Costilla, N. Mex., and on north side of canyon formed by Rito de los Cedros.

Amana Beds

Devonian: East-central Iowa.

S. W. Stockey, 1933, (abs.) Pan-Am. Geologist, v. 60, no. 1, p. 78. Incidental usage.

M. A. Stainbrook, 1945, Geol. Soc. America Mem. 14, p. 7–8. Described as a thick body of shales overlying Cedar Valley limestone. Encountered in wells.

Apparently occur at surface only between Middle and High Amana communities in Iowa County.

Amargo Formation

Jurassic: Southern California.

H. S. Gale, 1946, California Jour. Mines and Geology, v. 42, no. 4, p. 358. Group of altered volcanic rocks and minor intrusive bodies. Evidently unmelted remnants of rocks that were intruded by quartz monzonite, apparently portions that floated on the upper surface of the granitoid batholithic magma during its intrusion.

Occurs in low hills beginning less than 1 mile southeast of the Baker and Western mines. Lies on both sides of paved road that connects the mines with the settlement, formerly called Amargo, but now called Boron [Mohave Desert region, Kern County].

Amargosa chaos

Post-Miocene(?): Southeastern California.

L. F. Noble, 1940, (abs.) Geol. Soc. America Bull., v. 51, no. 12, pt. 2, p. 1936; 1941, Geol. Soc. America Bull., v. 52, no. 7, p. 963–978, pl. 3. Name applied to rocks of overthrust plate of Amargosa thrust. These rocks are broken into innumerable blocks and slices, which are thrust over one another to form an extremely complex mosaic. Chaos is divided into Virgin Spring, Calico, and Jubilee facies, each characterized by certain kinds of rock. The thrust and chaos are folded into several plunging anticlines of northwesterly trend, along whose crests earlier Precambrian rocks below the thrust are exposed. Unconformably underlies Funeral fanglomerate.

Virgin Spring area, in Black Mountains east of Death Valley. Features similar to Amargosa thrust and chaos occur throughout an area of at least 8,000 square miles that borders and includes Death Valley trough.

Amargosan series[1]

Early Tertiary: California.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 52, 78.

Best exposed in Amargosa Desert and in Furnace Canyon near Death Valley.

Amarillo sandstone[1]

Jurassic(?): Northeastern New Mexico.

Original reference: C. R. Keyes, 1905, Am. Jour. Sci., 4th, v. 20, p. 424.

Derivation of name not given.

Amasa Formation (in Baraga Group)

Precambrian (Animikie Series): Northwestern Michigan.

Stephen Royce, 1936, Lake Superior Min. Inst. Proc. 29th Ann. Mtg., p. 78, 81, 86, 97. One of the iron-bearing formations of Lake Superior region. Separated by conglomerate from overlying Upper Huronian slates; associated with contemporaneous volcanics, called Hemlock greenstone, at its base.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 30 (table 1), 36–37. Included in Baraga group (new); Animikie series. Lies stratigraphically between Hemlock formation and Michigamme slate. Occupies same stratigraphic position as Fence River formation (new), but direct equivalence not yet proved. Contains wide variety of rocks—pyritic slate, ferruginous slate and quartzite, chert, and cherty hemotitic iron-formation. Aggregate thickness about 1,500 feet.

Occurs in Iron County on western Menominee Range.

Amawalk Granite

Upper Ordovician(?): Southeastern New York.

T. W. Fluhr, 1948, Rocks and Minerals Mag., v. 23, no. 8, p. 699. Shown on map legend as underlying Croton Falls diorite and overlying Thomaston granite.

Vicinity of New York City.

Amazonia Limestone Member (of Lawrence Shale)

Amazonia Limestone Bed (in Lawrence Shale)[1]

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

Original reference: H. Hinds and F. C. Greene, 1915, Missouri Bur. Geology and Mines, v. 13, 2d ser., p. 31, 170, 179.

R. C. Moore, 1936, Kansas Geol. Survey Bull. 22, p. 158–159. Amazonia limestone member occurs about 24 feet below top of Lawrence shale at Amazonia, at Heumader quarry, 1½ miles northwest of St. Joseph, Mo., and near Wathena, Kans. Thickness 9 feet at type locality; 13 feet near St. Joseph and Wathena; thins southward.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 68 (fig. 24), 72. Typically light-gray dense hard limestone occurring about 25 or 30 feet below top of Lawrence shale. Separated from underlying Ireland sandstone member by unnamed shale and sandstone interval. Thickness ranges from featheredge to about 13 feet. In southern outcrop area, it averages about 1.5 feet.

Type locality: Amazonia, Andrew County, Mo.

Amboy stoneware clay[1] (in Raritan Formation)

Cretaceous: Northeastern New Jersey.

Original reference: Heinrich Ries, H. B. Kümmel, and G. N. Knapp, 1904, New Jersey Geol. Survey, v. 6, p. 168–172.

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, 67. Varies in color from light gray through darker grays to nearly black with considerable amount of carbonaceous material. Thickness 0 to 30 feet. Where present, forms impermeable layer between Old Bridge sand member (new) of Raritan and Magothy formation.

Named for occurrence at South Amboy, Middlesex County.

Amchitka Formation

Tertiary or older: Alaska.

H. A. Powers, R. R. Coats, and W. H. Nelson, 1960, U.S. Geol. Survey Bull. 1028–P, p. 533–536, pl. 69. Water-laid beds of volcanic breccia and some thin-bedded fine-grained tuff, all interbedded with pillow flows of lava. Andesitic to latitic in composition. Tilted, jointed, and slightly metamorphosed in many areas. Thickness several thousand feet. Overlain with angular unconformity by tuff and conglomerate of Banjo Point formation (new) and lava and conglomerate of Chitka Point formation (new). Oldest recognized rocks on island. Geologic age unknown but must be at least as old as early Tertiary inasmuch as overlying Banjo Point rocks are of early middle Tertiary age.

Type section: Exposed along south coast from South Bight westward to long 179°18′ E., Amchitka Island (Aleutian Islands). Makes up northern part of western third, and most of eastern fourth of island; small isolated exposures at and west of Cyril Cove.

Amelia-Goochland Quartz Monzonite Gneiss[1]

Precambrian: Central Virginia.

Original reference: A. A. Pegau, 1932, Virginia Geol. Survey Bull. 33, p. 15, 20–22, pl. 1.

Occurs in Amelia, Goochland, Powhatan, and southern Louisa Counties.

American Falls Lake Beds[1]

Pleistocene, upper: Southeastern 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 (table), 69–72, pl. 6. Report discusses ground-water resources of Snake River Plain. American Falls lake beds are younger than Cedar Butte basalt and older than Madson basalt. Consist of a sedimentary member and a basalt member. Thickness about 150 feet.

Type locality: Bluffs along Snake River from American Falls Dam, Power County, to narrows, a distance of about 5 miles.

American Flat Basalt

Quaternary: Western Nevada.

V. P. Gianella, 1936, Nevada Univ. Bull. 30, no. 9, Geology and Mining Ser. no. 28, p. 33, 76–77, pl. 1. Flow of dark-gray to almost black-olivine basalt about 25 feet thick. Underlies alluvium. Stratigraphically above Knickerbocker andesite (new).

G. A. Thompson, 1956, U.S. Geol. Survey Bull. 1042–C, p. 59–60. Replaced by McClellan Peak olivine basalt. Name American Flat preoccupied.

Occurs in Silver City district in Virginia Range, 12 miles north of Carson City. Largest body of basalt is in extreme southeastern part of American Flat.

American Flat Latite[1]

Miocene: Southwestern Colorado.

Original reference: W. Cross and E. Howe, 1907, U.S. Geol. Survey Geol. Atlas, Folio 153.

F. D. Spencer and M. I. Erwin, 1953, U.S. Geol. Survey Circ. 258, p. 8 (fig. 1). Chart shows American Flat latite in sequence above Silverton volcanic series and below Potosi volcanic series.

Occurs in vicinity of Ouray.

American Fork Formation[1]

Lower(?) Cretaceous: Central southern Montana.

Original reference: E. Douglass, 1909, Carnegie Mus. Annals, v. 5, p. 269–288.

Occurs near American Fork of Musselshell River, Sweetgrass County.

American Lakes Glacial Substage

American Lakes Till

Pleistocene (Wisconsin): Central Colorado.

D. F. Eschman, 1952, (abs.) Geol. Soc. America Bull., v. 63, no. 12, pt. 2, p. 1380. Time of latest of four glacial advances in area. Minor advance resulting in deposition of formless deposits of fresh drift. Followed Silver Creek advance (new).

D. F. Eschman, 1955, Jour. Geology, v. 63, p. 201 (fig. 2), 206–207, pl. 2. Deposits of substage mapped as American Lakes till. Pebbles in till are fresh, and no weathered profile evident. Surface of drift area sparsely strewn with large boulders of rock types present in cirque head wall. Deposits are more recent than those of Silver Creek substage but not so recent as some deposits not definitely connected with a glacial advance and referred to as post-American Lakes in age.

Named for American Lakes, at head of Middle Fork Michigan River, North Park. Two rock steps immediately below lakes are covered with deposits of substage. Deposits also present in hanging valley below Lake Agnes and near head of Silver Creek.

American Nettie Quartzite[1]

Upper Cretaceous: Southwestern Colorado.

Original reference: J. D. Irving, 1905, U.S. Geol. Survey Bull. 260, p. 56.

Probably named for a mine.

American Ravine Andesite Porphyry

Miocene(?): Western Nevada.

V. P. Gianella, 1936, Mining and Metallurgy, v. 15, no. 331, p. 299 (table 1). Incidental usage.

V. P. Gianella, 1936, Nevada Univ. Bull., v. 30, no. 9, p. 33, 44–45, 50–52, pl. 1. Light-gray felsitic hornblende andesite about 500 feet thick. Underlies Hartford Hill rhyolite; overlies fanglomerate, monzonite, or metamorphic rocks. Eocene.

F. C. Calkins, 1944, Outline of the geology of the Comstock lode district, Nevada: U.S. Geol. Survey, p. 16–17; F. C. Calkins and T. P. Thayer, 1945, Geologic map of the Comstock lode district (1:24,000): U.S. Geol. Survey. Intrusive into Hartford Hill rhyolite and probably into Alta andesite. Miocene(?).

G. A. Thompson, 1956, U.S. Geol. Survey Bull. 1042-C, p. 52, pl. 3. Distinguished only in Comstock lode district.

Occurs on eastern side of Virginia Range, near Virginia City.

†Americus Beds[1]

Pennsylvanian: Eastern Kansas.

Original reference: L. C. Wooster, 1905, The Carboniferous rock system of eastern Kansas.

Named for Americus, Lyon County.

Americus Limestone Member (of Foraker Limestone)[1]

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

Original reference: M. Z. Kirk, 1896, Kansas Univ. Geol. Survey, v. 1, p. 80.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 43 (fig. 17), 49, 51 (fig. 19). Basal member of Foraker limestone. Underlies Hughes Creek shale member; overlies Oaks shale member of Hamlin shale. Commonly two limestone beds separated by shale. Thickness ranges from 6 to 22 feet. Wolfcampian.

M. R. Mudge and R. H. Burton, 1959, U.S. Geol. Survey Bull. 1068, p. 14 (table 2), 53-56. Described in Wabaunsee County, Kans. Limestone formerly called Houchen Creek south of Pottawatomie County does not correlate with type section in Nebraska, but coalesces with Americus limestone member in Wabaunsee County. This limestone has distinctive type of algae in lower part of Americus that can be traced north into Pottawatomie and Jackson Counties. Americus formerly consisted of one or two beds of limestone 12 or more inches thick in lower part, 4 to 8 feet of gray fossiliferous shale in middle part, and bed of gray limestone 18 or more inches thick in upper part. In this report, upper contact of Americus is restricted to top of lower one or two beds of limestone. This places upper bed of limestone, which is absent in some places, and beds of shale in Hughes Creek shale member. Lower part of Americus is redefined to include algal bed heretofore referred to as Houchen Creek limestone in Chase County (Moore, Jewett, and O'Connor, 1951, Kansas Geol. Survey, v. 11, pt. 1) and in Lyon County (O'Connor, 1953, Kansas Geol. Survey, v. 12, pt. 1). In southern part of Wabaunsee County, Americus now consists of three beds of limestone separated by two beds of shale, but northward lower shale bed pinches out and lower bed of limestone coalesces with, and becomes part of, middle bed of limestone in northern part of county. Shale that lies above algal limestone was called Oaks shale member in Chase County (Moore, Jewett, and O'Connor, 1951) and in Lyon County (O'Connor, 1953). In Wabaunsee County, this is lower shale bed of Americus. Underlies Hughes Creek shale member; overlies Hamlin shale member of Janesville shale.

Named for exposures near Americus, Lyon County, Kans.

Ames cyclothem

Pennsylvanian (Conemaugh Series): Southeastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 94 (table 11), 134-140. Embraces interval between Harlem cyclothem, below, and Gaysport cyclothem (new) above. Thickness about 17 feet. Includes (ascending) Ames shale and (or) sandstone, Ames underclay, Ames coal, and Ames limestone members. In area of this report, Conemaugh series is discussed on a cyclothemic basis; 15 cyclothems are named. [For sequence, see Mahoning cyclothem.]

Type section: About center of Ames Township, Athens County (locality 8984, map 16).

Ames Limestone Member (of Conemaugh Formation)[1]

Ames Limestone (in Conemaugh Group)

Upper Pennsylvanian: Eastern Ohio, eastern Kentucky, southwestern Maryland, southwestern Pennsylvania, and northern West Virginia.

Original reference: E. B. Andrews, 1873, Ohio Geol. Survey, v. 1, p. 235, 271, 296.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 43, pl. 9. Correlation chart shows occurrence in eastern Kentucky.

R. E. Lamborn, 1951, Ohio Geol. Survey, 4th ser., Bull. 49, p. 31–32. Described in eastern Ohio as a dark bluish- to greenish-gray limestone. Thickness varies from a few inches to a maximum of about 15 feet. Lies below Gaysport limestone in some areas. In this report, the Conemaugh is treated as a series.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 71–72, table 1. Top member of Harlem cyclothem.

J. J. Burke, 1958, Science, v. 128, no. 3319, p. 302. Occurs 172 feet above Nadine limestone (new) and 126 feet above Carnahan Run shale (new) in Armstrong County, Pa.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 54–55. Described in Morgan County as member in Conemaugh series. Thickness 10 inches to 3½ feet. Occurs about middle of series and about 140 to 160 feet below Pittsburgh (No. 8) coal. Above Harlem coal and Harlem shale member; separated from Gaysport limestone member by unnamed shale and sandstone members.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 94, 138–140. In this report [Athens County], Conemaugh is described on a cyclothemic basis. Ames limestone, Ames coal, Ames underclay, and Ames shale and (or) sandstone are classified as members of Ames cyclothem (new). Ames limestone is about 200 feet above Upper Freeport (No. 7) coal and 180 feet above Pittsburgh (No. 8) coal.

R. R. Dutcher and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 69, 71, 77. Referred to as Ames limestone in Conemaugh group.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Conemaugh formation as mapped includes Mahoning sandstone near base, Ames limestone in middle of sections, and Brush Creek limestone in lower part of section.

Named for exposures near Amesville, Ames Township, Athens County, Ohio.

Ames Monzodiorite[1]

Mississippian(?): Central New Hampshire.

David Modell, 1936, Geol. Soc. America Bull., v. 47, no. 12, p. 1895, 1901–1902, pl. 1. Listed in chronology of White Mountain Magma series as older than Endicott diorite (new) and younger than Gilmanton monzodiorite (new). Described as gray medium-grained monzodiorite composed primarily of feldspar and hornblende, with some biotite.

M. P. Billings, 1956, Geology of New Hampshire, pt. 2, Bedrock geology: Concord, New Hampshire State Plan. Devel. Comm., p. 73. Included in a discussion of White Mountain plutonic-volcanic series of Mississippian(?) age.

On shore of Lake Winnipesaukee, northwest of Ames Station, in Belknap Mountains.

Ames Red Bed (in Conemaugh Formation)[1]

Pennsylvanian: Northern West Virginia and western Pennsylvania.

Original reference: C. K. Swartz, 1922, Maryland Geol. Survey, v. 11, pl. 6.

Occurs at Morgantown, W. Va., and at Latrobe, Pa.

Ames Shale (in Conemaugh Formation)[1]

Pennsylvanian: Northern West Virginia.

Original reference: R. V. Hennen and D. B. Reger, 1913, West Virginia Geol. Survey Rept. Marion, Monongalia, and Taylor Counties, p. 289.

Probably named for occurrence in limestone identified as Ames limestone.

Ames shale and (or) standstone

See Ames cyclothem.

Ames Knob Formation[1]

Silurian: Central southern Maine.

Original reference: G. O. Smith, E. S. Bastin, and C. W. Brown, 1907, U.S. Geol. Survey Geol. Atlas, Folio 149, p. 4.

W. T. Forsyth, 1953, Report of the State Geologist 1951–1952, p. 45. Incidental mention in discussion of Ellsworth schist in Blue Hill. Contains Niagaran fossils.

Named for exposures on shore of Southern Harbor, northwest of Ames Knob, which lies one-half mile west of village of North Haven, Knox County.

Amherst Schist[1]

Pre-Triassic: Central Massachusetts, northern Connecticut, and southwestern New Hampshire.

Original references: B. K. Emerson, 1898, U.S. Geol. Survey Geol. Atlas, Folio 50; 1898, U.S. Geol. Survey Mon. 29, p. 218, 219, 222, 224–225.

M. E. Willard, 1951, Bedrock geology of the Mount Toby quadrangle, Massachusetts: U.S. Geol. Survey Geol. Quad. Map [GQ–8]. In Mount Toby quadrangle, Amherst is quartz-muscovite-biotite schist that locally has been so silicified and pegmatized as to change it into a massive gneissic granitelike rock. Extensive area north of Amherst that was mapped earlier by Emerson as Williamsburg granodiorite and interpreted by him as an intrusive igneous body is altered Amherst schist. Pre-Triassic.

Exposed in Mount Warner and across Amherst, Mass.

Amherstburg Formation (in Detroit River Group)

Amherstburg Dolomite Member (of Detroit River Dolomite)[1]

Middle Devonian: Western Ontario, Canada, southeastern Michigan, and northern Ohio.

Original reference: W. H. Sherzer and A. W. Grabau, 1909, Geol. Soc. America Bull., v. 19, p. 542.

Wilber Stout, 1941, Ohio Geol. Survey, 4th ser., Bull. 42, p. 41–42. Referred to Detroit River group in Ohio where it is basal unit of group and underlies Lucas formation.

G. M. Ehlers, 1950, (abs.) Geol. Soc. America Bull., v. 61, no. 12, pt. 2, p. 1455–1466. In revised classification of Detroit River group, Amherstburg dolomite is noted as overlying Sylvania sandstone and underlying Lucas dolomite.

K. K. Landes, 1951, U.S. Geol. Survey Circ. 133, p. 2 (fig. 2), 7–14. Redefined to include Sylvania sandstone, where present, as basal sandstone member of formation. Includes Filer sandstone lentil (new). Except for Sylvania and Filer sandstones, Amherstburg is limestone or dolomite. The only evaporites within the formation are occasional nodules of anhydrite observed in cores from wells drilled in the basin. Beds assigned to Amherstburg in central part of basin agree with fauna, stratigraphic position, and lithologic character of Amherstburg at its type locality. Noncherty limestone or dolomite beneath evaporites and above the Bois Blanc formation on north flank of Michigan basin, and heretofore described by the writer [Landes, 1945] as upper part of the Bois Blanc, is now considered to be Amherstburg. Basal formation of Detroit River group. Underlies Lucas formation. Overlies Bois Blanc formation.

Named for fact that it forms bottom of eastern channel of Detroit River opposite Amherstburg, Ontario.

Amicalola Gneiss

Precambrian: North-central Georgia.

A. S. Furcon and K. H. Teague, 1945, Georgia Geol. Survey Bull. 51, p. 31–34, pl. 3. Term Amicalola gneiss is used to define that part of Precambrian basal complex [of this area] which contains much altered sedimentary rocks and which is characterized by deposits of massive kyanite. Locally replaces term Carolina gneiss. On north, underlies beds of Oglethorpe formation (new); on south and east, terminated by Dawsonville shear zone; western boundary marked by Marble Hill overthrust.

Mapped in parts of Cherokee, Pickens, Gilmer, and Dawson Counties. Lies between Tate and Dawsonville so that a line connecting these towns divides area into about equal parts.

Amity limestone (deposit)

Age not stated: Eastern Oregon.

J. E. Allen, 1946, Oregon Dept. Geology and Mineral Industries G.M.I. Short Paper 15, p. 11. Mentioned in report on limestone deposits in Willamette Valley. One and possibly two limestone lenses that strike north and dip a few degrees west. Only a few feet thick. Lower contact covered. Limestone is interbedded with fine-grained white fossiliferous tuff which is in turn overlain by light-colored tuffaceous sandstone. Fossils indicate marine origin.

Occurs 3 miles south of Amity, Polk County, in foothills of Eola Hills about 1 mile east of Pacific Highway (U.S. 99W) in NE¼ sec. 9, T. 6 S., R. 4 W., W. M., at elevation of about 225 feet.

Amity Member (of Cattaraugus Formation)

Amity 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, p. 1744, chart 4. Upper Devonian. In column occurs above Panama conglomerate and below Salamanca. Geographically extended to southwestern New York.

I. H. Tesmer, 1954, Hobbies, v. 35, no. 2, p. 30, 33. Member of Cattaraugus formation in southwestern New York where it overlies Panama conglomerate member and underlies Saegerstown member. Derivation of name given.

Name derived from Amity Township, located in Erie County, Pa.

Ammonoosuc Volcanics[1]

Middle Ordovician: Northwestern New Hampshire, north-central Massachusetts, and Vermont.

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

J. B. Hadley, 1949, Bedrock geology of the Mount Grace quadrangle, Massachusetts: U.S. Geol. Survey Geol. Quad. Map. Geographically extended into Massachusetts, where it underlies Clough formation.

M. P. Billings, 1956, The geology of New Hampshire, pt. 2, Bedrock geology: Concord, New Hampshire State Plan. Devel. Comm., p. 7 (fig. 3), 17–19, 94–98, geol. map. Ammonoosuc volcanics present in four zones, chiefly in western part of state. Belt that extends northeast from Woodsville includes type locality. Second belt northeast of Monroe correlated with Ammonoosuc volcanics because of its lithology and stratigraphic position above Albee formation. Third belt, extending northeast from 3 miles east of Haverhill, correlated because of its lithology and repetition of entire stratigraphic sequence from Albee to Littleton. Fourth belt extending whole length of the state, correlated because of its lithology and repetition of startigraphic sequence, from Ammonoosuc formation through Littleton. In area southwest of Littleton, where both top and bottom of formation are present. Ammonoosuc volcanics are about 2,000 feet thick, but extensive folding makes precise determination difficult. In belt that extends north from Massachusetts to Maine, formation is thinner because only top is exposed above Oliverian plutonic series. Four miles southwest of Randolph thickness is about 5,000 feet. Summary of arguments for and against correlations with other units. Assigned to Upper Ordovician(?) on geologic map, but formation may be Middle Ordovician.

L. M. Hall, 1959, Vermont Geol. Survey Bull. 13, p. 15 (fig. 4), 17–19. Described in southeast corner of St. Johnsbury quadrangle, Vermont and New Hampshire. Overlies Albee formation. Older than Waits River formation. Middle or Upper Ordovician.

W. M. Cady, 1960, Geol. Soc. America Bull., v. 71, no. 5, p. 544–545, 551, 554, pl. 1. Discussion of stratigraphic and geotectonic relationships in northern Vermont and southern Quebec. Ammonoosuc volcanics assigned to Middle Ordovician.

Type locality: In district bounded on north by Slate Ledge School and Partridge Lake and on south by Youngs Pond (Ogontz Lake) and Tinkerville, N.H. Locality name taken from old Ammonoosuc mining district, northwest of Ammonoosuc River between Woodsville and Littleton.

Amnicon Formation (in Oronto Group)[1]

Precambrian: Northwestern Wisconsin.

Original reference: F. T. Thwaites, 1912, Wisconsin Geol. Nat. History Survey Bull. 25, p. 50, 54.

S. A. Tyler and others, 1940, Geol. Soc. America Bull., v. 51, no. 10, p. 1474–1479. Thwaites assumed that Eileen sandstone (in Oronto group) lay below Amnicon sandstone on basis of distribution of outcrops and strike and dip. Eileen at type locality is not in contact with any other formation of Oronto series but is separated by unexposed interval of almost 1½ miles from Amnicon formation. Therefore relation of Eileen and Amnicon is not definitely known at type locality, and sequence postulated by Thwaites is only one of several possible explanations of relation of these two sandstones. Lithological and heavy-mineral evidence suggest that Eileen sandstone belongs above the Amnicon and includes beds on Middle River and Fish Creek sections that Thwaites classes as lower Orienta (in Bayfield group). The Eileen, which resembles Bayfield group of sandstones, is probably basal Orienta, and Amnicon arkose is upper Freda. Thickness of Amnicon as given by Thwaites—5,000 feet—included in his estimate of thickness of Freda. Hence, Oronto group revised to exclude Eileen and Amnicon sandstones.

Exposed on Fish Creek, near Ashland, and on Middle and St. Louis Rivers in Douglas County.

Amoeba Lake Graywackes, Slates, and Tuff

Precambrian (Knife Lake Series): Northeastern Minnesota.

J. W. Gruner, 1941, Geol. Soc. America Bull., v. 52, no. 10, p. 1583 (table 1), 1603–1605. Differs only slightly from "well-banded Knife Lake" slates and graywackes (unit 5 of series) in that they contain more graywacke and considerable tuffaceous material. Gradational bedding common; interstratified lenses of conglomerate. Highly folded. Thickest sediments, 4,000 to 5,000 feet, occur in segment of Knife Lake snyclinorium whose axis passes through Amoeba Lake. Overlie massive arkosites; underlie Kekekabic Lake tuffs, agglomerates, and slates (new). In this report, Knife Lake series is divided into 20 members. Table of approximate chronological sequence (ascending) shows Amoeba Lake graywackes as unit 9 occurring above pink andesite conglomerates and agglomerates and below Ensign Lake green slates, tuffs, and graywackes (new).

Sediments named after Amoeba Lake where they are best exposed. Report covers a belt in eastern Vermilion district more or less parallel to international boundary.

Amole Arkose or Group

Lower Cretaceous and (or) Upper Cretaceous: Southeastern Arizona.

W. H. Brown, 1939, Geol. Soc. America Bull., v. 50, no. 5, p. 710 (fig. 2), 713, 716–720, pl. 1. Series of gray to pink coarse-grained arkose, interbedded with shales and a few limestone beds; characterized by rapid and repeated changes in rock type; interbedded shales are usually silvery gray. Few of the limestone units are more than 2 feet thick, and most of them are very thin bedded and range in color from blue gray to black. Unconformably underlies Cat Mountain rhyolite (new); conformably overlies Recreation redbeds (new) into which it grades through a zone about 75 feet thick. Thickness of formation about 2,275 feet [measured near the Ranger Station]. Similarity in some limestone beds suggests repetition in the section, but this could not be proved. Top of Cretaceous is apparently not exposed in range but is cut off either by erosion, as in measured section, or by overthrust sheet.

W. B. Fergusson, 1959, Arizona Geol. Soc. Guidebook 2, p. 44 (fig. 4), 46–47. In southern parts of Tucson Mountains, Kinnison (1958, unpub. thesis) estimated that clastic sediments similar to Amole arkose are more than 5,000 feet thick. At least part of this section was mapped by Brown (1939) with his volcanic unit. Kinnison divided southern section into four formations and suggested that term Amole be elevated to group status. Base of group rests on Permian limestone with a limestone conglomerate. Because there is an angular unconformity within Amole group, Kinnison suggests that group may include two sequences of lithologically similar clastic rocks separated by andesite-pebble conglomerate and the Recreation red beds.

J. E. Kinnison, 1959, Arizona Geol. Soc. Guidebook 2, p. 48 (fig. 5A), 49, 50, 51 (fig. 5B), 54, 55, 149 (fig. 28). Group includes Recreation red beds of Brown (1939) and, possibly andesitic volcanic rocks (Kinnison, 1958) whose exact stratigraphic positions are unknown. Age of group probably Lower and Upper Cretaceous, and some strata may be as young as early Tertiary. Group underlies Tucson Mountain chaos.

D. L. Bryant and J. E. Kinnison, 1954, (abs.) Geol. Soc. America Bull., v. 65, no. 12, pt. 2, p. 1235. Paleontological evidence suggests that Amole arkose and underlying Recreation redbeds are most probably Lower Cretaceous and are not wholly Upper Cretaceous as previously designated.

Area: Tucson Mountains, southeastern Arizona. Amole arkose crops out chiefly on western side of southern part of range and extends north to Amole Peak, where it is cut off by granitoid intrusives. Northeastern part of belt extends across and around eastern side of peak.

Amole Granite

[Upper Cretaceous and (or) Tertiary] (Laramide): Southeastern Arizona.

W. H. Brown, 1939, Geol. Soc. America Bull., v. 50, no. 5, p. 710 (fig. 2), 721–722. Granite occupies western side of exposed part of a stock west of Amole Peak. Occurs in three different topographic positions which govern its appearance on weathered outcrops. On fresh surfaces, rock is pink speckled with black. On weathered surfaces, it is light tan to drab. Along its southern margin, granite is clearly intrusive into Cretaceous sedimentary rocks. It is not in contact with Tertiary volcanic rocks, but metamorphosed Cretaceous adinoles and hornfels occur in conglomerate at base of Tertiary volcanic rocks on cliff south of Safford Peak. This seems to indicate that granite is Laramide in age.

Area: Tucson Mountains, southeastern Arizona. City of Tucson is located at east base of central part of range.

Amole Latite

[Upper Cretaceous and (or) Tertiary] (Laramide): Southeastern Arizona.

W. H. Brown, 1939, Geol. Soc. America Bull., v. 50, no. 5, p. 710 (fig. 2), 725–726, pl. 1. An intrusive on top of Amole Peak. Occurs in series of roughly east-west fingers extending eastward from [Amole] quartz monzonite. Latite is intrusive as sills into Cretaceous sedimentary rocks. It shows extreme variety. Commonest is dense felsitic rock with inconspicuous phenocrysts of quartz and feldspar and abundant xenoliths of arkose and other Cretaceous sedimentary rocks. Elsewhere, rock is coarsely felsitic and so full of fine-grained inclusions that it closely resembles invaded arkoses. No gradational contacts with [Amole] quartz monzonite have been found.

Area: Tucson Mountains, southeastern Arizona. City of Tucson is located at east base of central part of range.

Amole Quartz Monzonite

[Upper Cretaceous and (or) Tertiary] (Laramide): Southeastern Arizona.

W. H. Brown, 1939, Geol. Soc. America Bull., v. 50, no. 5, p. 710 (fig. 2), 723–725. Belt of gray quartz monzonite about 1 mile wide and 4 miles long. Occurs to west and northwest of Amole Peak and circles northeasterly part of Amole granite (new). Best exposure is in steep arroyo heading about 1,000 feet west of Amole Peak and extending northward.

Area: Tucson Mountains, southeastern Arizona. City of Tucson is located at base of central part of range.

Amoret Limestone Member (of Altamont Formation)

Pennsylvanian (Des Moines Series): Western Missouri, south-central Iowa, eastern Kansas, and northeastern Oklahoma.

J. G. Grohskopf and Earl McCracken, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 10, p. 17. Mentioned as basal member of Altamont formation. Underlies Lake Neosho shale member. Name credited to L. M. Cline and F. C. Greene.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 7–8. Name Amoret suggested as substitute for Tina, which is abandoned because type Tina proved not to be Altamont. Type locality designated.

L. M. Cline and F. C. Greene, 1950, Missouri Geol. Survey and Water Resources Rept. Inv. 12, p. 18–21. At type locality, consists of three gray limestone beds and a thin greenish-gray shale bed; thickness about 5 feet. Varies in thickness and lithology in short distances. Overlies Bandera shale. Reference is made to an underclay as part of Amoret cyclothem. Occurrence in Madison County, Iowa, noted.

R. D. Alexander, 1954, Oklahoma Geol. Survey Circ. 31, p. 15, 16 (fig. 2). Occurs in Oklahoma where it is shown as a limestone [bed] within Altamont member of Oologah formation.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 31, fig. 5. Represented in Madison County by thin layer of fresh-water limestone nodules in matrix or red underclay that is continuous with Neosho Lake shale member above. Amoret is not present farther south in Iowa. Maximum thickness exposed in Madison County 10 inches.

Type locality: Two miles south of Amoret, Bates County, Mo., in sec. 33, T. 40 N., R. 33 W.

Amos Wash Member (of Supai Formation)

[Permian]: Central Arizona.

R. L. Jackson, 1951, Plateau, v. 24, no. 2, p. 86–88. Shown on stratigraphic section as overlying Naco formation and underlying Big "A" sand facies of Supai. Name credited to S. S. Winters.

Type locality and derivation of name not stated. Winters (1951, Plateau, v. 24, no. 1) described, but did not name, members of the Supai along Amos Wash, 15 miles west of White River, Fort Apache Reservation.

Amsden Formation[1]

Amsden Formation (in Montchauve Group)

Mississippian and Pennsylvanian: Wyoming and Montana.

Original reference: N. H. Darton, 1904, Geol. Soc. America Bull., v. 15, p. 394–401.

H. W. Scott, 1935, Jour. Geology, v. 43, no. 8, pt. 2, p. 1017 (table 3), 1020–1023. In its type locality, consists of those beds that occur between top of Madison limestone and base of Tensleep formation. Originally considered Pennsylvanian in age; Branson and Greger (1918, Geol. Soc. America Bull., v. 29, no. 2) have shown Amsden of Wind River Mountains to be Mississippian. In south-central Montana, Amsden rests upon erosional surface developed on Madison limestone. In area between Three Forks and Townsend, Amsden is separated from Madison by series of fossiliferous sandstones, shales, and limestones that attain thickness as great as 1,200 feet in central Montana. Group of strata between Amsden and Madison in central Montana has been designated Big Snowy group (new). In central Montana, Amsden underlies Ellis formation (Upper Jurassic). Section measured on southeast corner of Quadrant Mountain (type section of Quadrant) shows Amsden formation (beds 1–7) 109 feet thick; underlies Quadrant formation (beds 8–21); overlies Madison limestone.

C. C. Branson, 1937, Jour. Paleontology, v. 11, no. 8, p. 650–660. Restricted at base to exclude unit herein named Sacajawea formation. At measured section on Bull Lake Creek, Wyo., Lower Amsden consists of 21 feet of unfossiliferous laminated limestone possibly of Chester age; Upper Amsden consists of 80 feet of sandstone overlain by 96 feet of limestone, sandstone, and shale. Underlies Tensleep sandstone.

C. C. Branson, 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1201, 1223. Discussion of Pennsylvanian of central Wyoming. Tensleep sandstone of Darton is only locally recognizable as lithologic unit and is not a true stratigraphic unit. No boundary can be drawn to separate it from Amsden formation, and fauna of upper part of Amsden is indistiguishable from that of Tensleep sandstone. Name Tensleep is herein retained as name of a formation which includes entire Pennsylvanian sequence in central Wyoming; that is, Tensleep sandstone of Darton, upper part of Amsden, and some unnamed beds above Tensleep. Measured sections show that the Tensleep overlies Sacajawea formation, or Sacajawea(?), or unnamed beds of Chester(?) age.

E. B. Branson and C. C. Branson, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 132. Discussion of Wind River Mountains area. Tensleep as herein defined includes upper part of Amsden of Darton and name Amsden is dropped.

M. L. Thompson and H. W. Scott, 1941, Jour. Paleontology, v. 15, no. 4, p. 350. Scott's (1935) section on Quadrant Mountain revised. Beds 3–21 are Pennsylvanian and are included in Quadrant formation; beds 1–2 are Mississippian and are referred to Sacajawea(?) formation. Name Amsden deleted from section.

G. W. Berry, 1943, Geol. Soc. America Bull., v. 54, no. 1, p. 18–19, 21 (fig. 5). Amsden, in Three Forks area, overlies Madison formation and underlies Quadrant formation. Lower part, which is probably equivalent to Sacajawea, contains an upper Mississippian fauna comparable to that of Brazer limestone; beds in upper 100 feet contain fossils generally considered Pennsylvanian.

E. S. Perry and L. L. Sloss, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 10, p. 1293–1295. Branson (1937, 1939) and Thompson and Scott (1941) recognized that the Amsden, as defined by Darton, included strata of both Pennsylvanian and Mississippian age. They placed all Pennsylvanian strata in the Tensleep (Quadrant) and established Sacajawea formation to include lower beds bearing a Ste. Genevieve fauna. Between redefined Tensleep and Sacajawea are unnamed strata bearing a Chester fauna. These latter beds may be traced throughout central Montana and much of Williston basin, overlapping truncated edges of Big Snowy strata and transgressing peninsula area devoid of both Big Snowy and Sacajawea sediments along Montana-Wyoming border. Name Amsden should be retained for these strata in Montana and Williston basin; if name Amsden is not retained, then new term must be coined for these strata.

H. W. Scott, 1945, (abs.) Geol. Soc. America Bull., v. 56, no. 12, pt. 2, p. 1195. *Millerella* zone occurs about middle of formation.

P. T. Walton, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 8, p. 1296, 1301–1302. Amsden, in Judith basin area, consists of two members: lower sequence of red and pink shales and mudstone, red coarse poorly sorted ferruginous sandstones, and locally thin beds of grayish-green and buff fine-grained limestone; upper sequence of marine fossiliferous limestone contining interbedded red, maroon, and purple shale. In places, where pre-Ellis erosin has not cut too deep, a thin sequence of yellow, pink, and purple clay shale lies above the marine limestone section. Overlies erosional surface truncating Heath and Otter shales; underlies Ellis formation. Mississippian and Pennsylvanian (Morrow).

J. D. Vine and W. J. Hail, Jr., 1950, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 108. Where exposed along northern flank of Little Belt Mountains, the Amsden ranges in thickness from about 500 feet to more than 900 and rests with apparent conformity on Otter formation. Unconformably underlies Ellis group which in this area commonly consists only of Swift formation.

L. R. Laudon and J. L. Severson, 1953, Jour. Paleontology, v. 27, no. 4, 512 (fig. 2d). Discussion of crinoid fauna from Mississippian Lodgepole formation. Columnar section shows Amsden formation overlying Mission Canyon formation. Pennsylvanian.

W. F. Scott and P. C. Wilson, 1953, (abs.) Geol. Soc. America Bull., v. 64, no. 12, pt. 2, p. 1554. Sacajawea formation restricted vertically to include only red-bed sequence at base of Amsden and extended laterally throughout area where red beds are recognizable. Term Amsden should be retained for limestones and dolomites between Sacajawea (restricted) and typical sandstone of Tensleep or its equivalents.

C. A. Burk, 1954, Jour. Paleontology, v. 28, no. 1, p. 1–16. Review of fossils identified from Amsden formation indicates a Pennsylvanian rather than Mississippian age for the Amsden in Wyoming.

J. D. Love, 1954, Tentative diagrammatic correlation of Tensleep, Amsden, Casper, and Hartville formations in Wyoming: Wyoming Geol. Assoc.

Guidebook 9th Ann. Field Conf. Chart shows that Darwin sandstone member of Amsden overlies type Sacajawea formation at Bull Lake.

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 at Cherry Creek, Wind River Mountains. Six new collections of fossils from lower part of Amsden place Mississippian-Pennsylvanian boundary more than 48 feet and less than 63 feet above Madison limestone. Lower faunas are Chesteran in age, and upper faunas are tentatively dated Atokan. Name Sacajawea formation is rejected for Mississippian beds at Cherry Creek. Presence of two sandstones in Amsden, both of which have been called "Darwin sandstone" is inferred. Amsden at Cherry Creek contains beds that are specifically excluded farther north in Wind River Mountains. Thus, there is dual usage of name Amsden. Solution of problem lies in type area of formation. If typical Amsden contains both Mississippian and Pennsylvanian faunas, Cherry Creek section is also typical Amsden, and Love's (1954) restricted Amsden should be renamed. Conversely, if type Amsden lacks Sacajawea fauna, restricted Amsden is proper, and Cherry Creek section should be renamed.

R. K. Hose, 1955, U.S. Geol. Survey Bull. 1027–B, p. 49, pl. 6. Formation, in Crazy Creek area, Johnson County, Wyo., overlies Madison limestone and underlies Tensleep sandstone. Thickness about 250 feet. Corals in lower part of formation range from late Mississippian to early Pennsylvanian.

P. A. Mundt, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 8, p. 1918–1919, 1928–1929. In central Montana, so-called "Amsden" formation consists of three lithologic divisions: an upper dolomite unit, a middle brownish limestone unit, and a lower sequence of red shale and sandstone beds. Dolomite unit is lithologically, stratigraphically, and paleontologically equivalent to carbonate part of Amsden at its type locality in Wyoming. Amsden dolomite overlaps toward the south the underlying brown limestone and red shale beds and also formations of Big Snowy group. Unconformably(?) underlying Amsden dolomite of Atokan age is brown ostracodal limestone unit which is probably of Chester age but may be all or in part early Pennsylvanian. This brown limestone was named Alaska Bench formation by Freeman (1922), and his terminology is recommended herein. Thickness 33 feet along Durfee Creek, Fergus County; top of section eroded.

V. L. Freeman, E. T. Ruppel, and M. R. Klepper, 1958, U.S. Geol. Survey Bull. 1042–N, p. 498–499, 550, pl. 42. In Townsend Valley, Broadwater and Jefferson Counties, Mont., Amsden formation, which is probably separated from Mission Canyon limestone by erosional unconformity, includes rocks of both Mississippian and Pennsylvanian age. Consists of red calcareous siltstone with medial unit of gray carbonate rock and grades into Quadrant formation. Thickness 259 feet in Limestone Hills.

L. S. Gardner, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 2, p. 344–346. Big Snowy group revised to include (ascending) Kibby sandstone, Otter, Heath, Cameron Creek, and Devils Pocket formations. Various parts of Big Snowy group (revised) have been correlated with Amsden formation of northern Wyoming and southern Montana. The two sequences represent same general interval of geologic time, from end of Madison to beginning of Tensleep. They occupy distinct basins separated by a divide, toward which Amsden rocks thin and vanish from the south and Big Snowy rocks thin and vanish from the north. Scott (1935) used Amsden formation in central Montana for rocks (Cameron Creek formation and Alaska Bench limestone) lying above Heath formation. Very few dependable correlative ties have been found between Big Snowy rocks of central Montana and Amsden rocks less than 50 miles away in southern Montana. Mundt (1956) shifted name Amsden from rocks to which it was assigned by Scott and applied it to entirely different rocks of Atokan age. In present report, it is preferred to give these rocks separate formational names and discontinue term Amsden in central Montana.

R. P. Willis, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 1942 (fig. 2), 1962–1963. This paper concurs with Scott and Wilson's (1953) proposals of applying name Sacajawea to persistent predominantly red shale unit (including Darwin sand) formerly referred to as "lower Amsden." Term Amsden then is restricted to the overlying predominantly cherty carbonate sequence. Term Amsden (restricted) is used in central Montana area to refer to carbonate sequence underlain by Tyler formation, or older rocks where Tyler is absent. Unit is overlain either by Tensleep sandstone, Minnelusa formation of Williston basin, or strata of Ellis group. Maximum thickness 400 feet (south end of Judith basin). Divisible into two units: lower, predominantly Alaska Bench limestone member, and unnamed upper part referred to as dolomite member. Pennsylvanian (Morrowan-Atokan). Name Amsden (restricted) could possibly be extended into Williston basin region.

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 northern Utah, western Wyoming, northwestern Colorado, and southeastern Idaho. Suggested that Quadrant and Casper formational names be abandoned and Tensleep-Amsden-Sacajawea terminology extended to include strata formerly referred to by these names and that term Sacajawea be accepted as formational name applicable to red clastic sequence between Madison limestone, or equivalent, and Amsden carbonates.

Named for Amsden Branch of Tongue River, west of Dayton, Sheridan County, Wyo.

Amsterdam Limestone (in Black River Group)[1]

Amsterdam Limestone (in Trenton Group)

Middle Ordovician: Eastern New York and western Vermont.

Original reference: R. Ruedemann, 1910, New York State Mus. Bull. 138, p. 72.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 259–260, pl. 2. Included in lower part of Trenton group and discussed under formations of Rockland age. At Manny Corners, underlies Larrabee member (new) of Glens Falls formation and overlies Lowville formation. Dark-gray medium-textured limestone. Thickness about 11 feet. At Crown Point, 16 feet of Amsterdam beds overlie 27 feet of Chaumont and underlie 16 feet of Isle la Motte. Typical section given.

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 sandstone, Trenton limestone, Canajoharie shale) is revised to read Potsdam sandstone, Galway formation (new), 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. Amsterdam is 3 feet thick in area instead of 50 feet as previously indicated. Where Lowville is absent, the Amsterdam overlies Gailor dolomite.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2 (column 15). Shown on correlation chart as underlying Isle la Motte limestone in western Vermont and Lake Champlain area.

Typical section in quarry one-half mile east of Manny Corners, 3 miles east-northeast of Amsterdam, Montgomery County, N.Y.

Anacacho Limestone[1]

Anacacho Limestone (in Taylor Group)

Upper Cretaceous (Gulf Series): Southwestern Texas.

Original reference: R. T. Hill and T. W. Vaughan, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 2, p. 240.

D. L. Frizzell, 1954, Texas Univ. Bur. Econ. Geology Rept. Inv. 22, p. 46–47. Foraminifera described. Anacacho limestone listed in Taylor group.

Named for Anacacho Mountains, Kinney County, which are capped by the formation.

Anadarche Conglomerate (in Hoxbar Formation)[1]

See Anadarche Member (of Hoxbar Formation).

Anadarche Limestone (in Hoxbar Formation)[1]

See Anadarche Member (of Hoxbar Formation).

Anadarche Member (of Hoxbar Formation)[1]

Anadarche Member, Beds, or Limestone (in Hoxbar Group)

Pennsylvanian (Missouri Series): Southern Oklahoma.

Original reference: C. W. Tomlinson, 1928, Oklahoma Geol. Survey Bull. 40Z, p. 15–16.

C. W. Tomlinson, 1929, Oklahoma Geol. Survey Bull. 46, p. 43–44. Described as Anadarche member of Hoxbar formation. Includes Anadarche conglomerate and Anadarche limestone of Tomlinson (1928). Consists of dense hard bluish-gray limestone as much as 20 feet thick at top and limestone conglomerate as much as 10 feet thick at base. Thickness 100 to 200 feet. Lies 500 to 800 feet above Crinerville member and 400 to 600 feet below Daube limestone member. Type locality designated.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, p. 697, chart 6 (column 37). Correlation chart shows Anadarche limestone in Hoxbar group.

C. W. Tomlinson and William McBee, Jr., 1959, *in* Ardmore Geol. Soc., Petroleum geology of southern Oklahoma—a symposium, v. 2: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 6 (fig. 2), 42–43. Anadarche referred to as Anadarche beds or member of Hoxbar group. Thickness 100 to 200 feet. Lies 400 to 500 feet above Crinerville beds or member and some 400 feet below Daube limestone member. Includes basal sandstone or conglomerate, medium shale, and capping limestone.

Type locality: On Anadarche Creek one-eighth mile south of NW cor. sec. 35, T. 5 S., R. 2 E. [Carter County].

Anahuac Formation

Anahuac Stage

Oligocene, upper, or Miocene, lower: Subsurface in Louisiana and Texas.

J. B. Eby, 1943, Oil Weekly, v. 111, no. 4, p. 22–23. Wedge of dark-greenish shale. Ranges in thickness from about 1,600 feet in southeast corner of [Jackson] county to featheredge in northwest section of county.

A. C. Ellisor, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 9, p. 1355–1368. Includes *Discorbis*, *Heterostegina*, and *Marginulina* zones. Lies between basal sands of Fleming above and subsurface Frio below. Type well and locality designated.

A. D. Warren, 1957, Gulf Coast Assoc. Geol. Soc. Trans., v. 7, p. 223 (fig. 1), 225–227. In southwestern Louisiana, sediments of Anahuac stage are almost identical to type section in Texas. Stage consists, for most part, of shales with some sand in west and central parts of south Louisiana and of limestone and calcareous clastics in eastern part of State. Younger than Frio stage. Either upper Oligocene or lower Miocene; age is controversial. In reference well for stage, Anahuac sequence is about 3,500 feet thick.

H. C. Goheen, 1959, Gulf Coast Assoc. Geol. Soc. Trans., v. 9, p. 91–103. Formation in southern Louisiana subdivided to include Erath member (new). Upper Oligocene or lower Miocene.

Type locality: Anahuac oil field, 5 miles east of town of Anahuac, Chambers County, Tex. Type well: Humble Oil and Refining Co. Middleton No. 1. Formation present in well from 5,890 to 6,984 feet. Reference well: Humble Oil and Refining Co. E. E. Wild No. 1, Jefferson Davis Parish, La.

Anakeesta Formation (in Great Smoky Group)

Precambrian (Ocoee Series): Southeastern Tennessee.

P. B. King and others, 1958, Geol. Soc. America Bull., v. 69, no. 8, p. 955 (table 1), 959–960. Consists mainly of dark-gray or black silty argillaceous rocks, variously metamorphosed. Interbedded are thick beds of lighter gray coarser feldspathic sandstone. Many of the lighter beds form single layers in the darker rocks, but some form units of considerable thickness that are classed as tongues of Thunderhead sandstone. Overlies and intertongues extensively with the Thunderhead; individual tongues do not exceed 2,000 feet in thickness but range through a stratigraphic interval of nearly 5,000 feet. East of Thunderhead Mountain where there is no intertonguing, the Anakeesta forms unbroken unit about 4,500 feet thick, underlain by Thunderhead sandstone and overlain by a similar but unnamed sandstone.

Named for Anakeesta Ridge, a high spur between Mount Le Conte and Newfound Gap, Sevier County. Typically exposed along U.S. Highway

441 from base of the ridge up to the gap. Occurs well back in Great Smoky Mountains where it crops out in narrow steep-sided ridges and craggy pinnacles. A synclinal belt extends westward from Mount Sequoyah to meridian of Gatlinburg, most of belt being north of State-Line divide. Farther west, formation appears in homoclinal sequence in head drainages of the prongs of Little River.

Anaktuvuk Group[1]

Lower Cretaceous: Northern Alaska.

Original reference: F. C. Schrader, 1902, Geol. Soc. America Bull., v. 13, p. 245.

P. S. Smith, 1913, U.S. Geol. Survey Bull. 536, p. 55 (table), 82–84. Discussion of Noatak-Kobuk region. Anaktuvuk group consists of sandstones with subordinate shales and conglomerates. Estimated thickness 2,000 feet. Probably contemporaneous with Koyukuk group. Probably Lower Cretaceous.

Named for Anaktuvuk River on which it occurs.

Anaktuvuk River Glaciation

Pleistocene (pre-Wisconsin): Central northern Alaska.

R. L. Detterman, 1953, *in* T. L. Pewe and others, U.S. Geol. Survey Circ. 289, p. 11, 13 (table 1). Four Quaternary glacial advances recognized in Sagavanirktok-Anaktuvuk district. Anaktuvuk, the oldest, succeeded by Sagavanirktok glaciation (new). Evidence for glaciation consists of quartzitic conglomerate boulders on hills 500 to 600 feet above Anaktuvuk River and drift preserved as low subdued tundra-covered morainal hills that occupy area of 100 square miles along the river.

Renamed Anaktuvuk River Glaciation in order to retain name Anaktuvuk for group.

In Sagavanirktok-Anaktuvuk region.

Analomink Red Shale[1]

Upper Devonian: Northeastern Pennsylvania.

Original reference: Bradford Willard, 1935, Geol. Soc. America Bull., v. 46, no. 8, p. 1206.

Bradford Willard, 1936, Geol. Soc. America Bull., v. 47, no. 5, p. 588. Local unit of 100 feet of red beds at its type locality. White (1881) mistook it for his much younger New Milford red shale, from which it is separated by beds probably equal to lower Chemung and upper Portage. Valuable only for recognizing base of Delaware River formation.

Type locality: Analomink, Monroe County.

Anamosa Dolomite[1]

Silurian (Niagaran?): Central eastern Iowa.

Original reference: S. Calvin, 1895, Iowa State Univ. Bull. Lab. Nat. History, v. 3, no. 3, p. 186, 189.

Named for Anamosa, Jones County.

Anarchist Series[1]

Late Paleozoic: Southern British Columbia, Canada, and north-central Washington.

Original reference: R. A. Daly, 1912, Canada Geol. Survey Dept. Mines Mem. 38, maps 10, 11, 12.

A. C. Waters and Konrad Krauskopf, 1941, Geol. Soc. America Bull., v. 52, no. 9, p. 1358–1364, pl. 1. Heterogeneous group of greenstones, phyllites, quartzites, chlorite schists, crystalline limestone, and partially metamorphosed conglomerates. Subdivided into three units termed Lower, Middle, and Upper Anarchist series. Total thickness unknown; sections over 5,000 feet thick, apparently without duplication, include only a part of 1 of the 3 divisions. Older than Colville batholith. Shown on map legend as unconformably underlying Triassic limestone.

Daly mapped Anarchist series around Anarchist Mountain, British Columbia.

Anastasia Formation[1]

Pleistocene: Florida.

Original reference: E. H. Sellards, 1912, Florida Geol. Survey 4th Ann. Rept., p. 18.

G. G. Parker and C. W. Cooke, 1944, Florida Geol. Survey Bull. 27, p. 65–67. Formation as herein defined includes coquina, sand, sandy limestone and shelly marl of pre-Pamlico Pleistocene age that lies along both Florida east and west coasts. This excludes surficial sand of Pamlico age. Upper part of formation is contemporaneous with Miami oolite, upper part of Key Largo limestone, and Coffee Mill Hammock marl member of Fort Thompson formation, all of which might be considered as facies of Anastasia. Formation is wedge shaped, thin toward the interior and thick toward coast, where it may be as much as 60 feet thick. On west coast is a thin irregular deposit extending from Marco Island as far north as Tampa Bay; greatest thickness probably not more than 10 feet. Merges with upper marine members of Fort Thompson in Caloosahatchee River valley.

Typically exposed on Anastasia Island; also in cut made by Florida East Coast Railway on Tomora Creek, near Ormon, and along coast at Rockledge.

Anaverde Beds

Miocene: Southern California.

O. P. Jenkins, 1938, Geologic map of California (1:500,000): California Div. Mines, sheet 4. Shown on geologic map legend as nonmarine sediments. No text.

This may or may not be same unit later defined as Anaverde Formation.

Anaverde Formation

Pliocene, lower to middle: Southern California.

R. E. Wallace, 1946, (abs.) Am. Geophys. Union Trans., v. 27, no. 4, p. 552. Mentioned as part of sediments occurring in trough of San Andreas rift between Palmdale and Elizabeth Lake.

R. E. Wallace, 1949, Geol. Soc. America Bull., v. 60, no. 4, p. 785, 790–792. Consists of pink to reddish conglomerate and arkose (at base), white to buff conglomerate and arkose, and about 1,000 feet gypsiferous shale at top. Thickness about 2,000 feet. Unconformably underlies Quaternary deposits; rests with depositional contact on granite. Derivation of name given. Name credited to C. L. Gazin (unpub. ms.).

L. F. Noble, 1953, Geology of the Pearland quadrangle, California: U.S. Geol. Survey Geol. Quad. Map [GQ–24]. Further described and noted as occurring only north of San Andreas fault.

This may or may not be same unit as Anaverde Beds (Jenkins, 1938).

Named from Anaverde Valley [Palmdale quadrangle].

Anawalt 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. 245.

Exposed at southwest edge of town of Anawalt, McDowell County.

Ancell Group

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., figs. 3, 11. Shown on columnar section as comprising (ascending) Kingdom, Daysville, Loughridge, and Harmony Hill formations. Underlies Platteville group; overlies Prairie du Chien group. Includes Glenwood subgroup.

Occurs in Dixon-Oregon area.

Ancha Formation (in Santa Fe Group)

Pliocene, upper, or Pleistocene: North-central New Mexico.

E. H. Baltz, Jr., and others, 1952, New Mexico Geol. Soc. Guidebook 3d Field Conf., p. 12, 15, 16, 17. Consists of poorly consolidated sandstone, siltstone, and conglomerate. Thickness 0 to 200 feet. Unconformably overlies Galisteo sandstone. Considered eastward extension of Puye gravel.

Brewster Baldwin and F. E. Kottlowski, 1955, New Mexico Bur. Mines Mineral Resources Scenic Trips to the Geologic Past, no. 1, p. 8, 21, 24, geol. map. Formation rests on westward-sloping surface that cuts across tilted Tesuque formation. Mapped near Canada Ancha west of city of Santa Fe.

Brewster Baldwin, 1957, New Mexico Geol. Soc. Guidebook 7th Field Conf., p. 115–121. Included in 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. Distinction between Tesuque and Ancha formations in Santa Fe area is based largely on westward dip and somewhat better consolidation of the former. In Buckman area, Ancha appears to intertongue with Puye gravel and with river gravel that has been assigned by some workers to the ancestral Rio Grande.

A. E. Disbrow and W. C. Stoll, 1957, New Mexico Bur. Mines Mineral Resources Bull. 48, p. 5 (table 1), 28–29. In Cerrillos area, underlies Cuerbio basalt. Thickness 0 to 350 feet. Early Pleistocene(?).

Ming-Shan Sun and Brewster Baldwin, 1958, New Mexico Bur. Mines Mineral Resources Bull. 54, p. 7 (table 1), 18, 22–23, pl. 1. Discussion of Cienga area, Santa Fe County. Formation forms blanket of silt, sand, and gravel that is now being eroded from Cienguilla limburgite and earlier rock units in area. Thickness commonly less than 100 feet. On west side of area, covered by and interbedded with flows of olivine-bearing basalt; locally gravel rests on top of flows. Basalt tuff present about 20 feet below lowest flow, and, though tuff mapped separately in Santa Fe area, it is not distinguished from Ancha formation in area of this report. Formation and basalt flows tentatively dated as early Pleistocene, but they might be Pliocene in age.

Named in vicinity of Santa Fe. Derivation of name not stated. Canada Ancha is shown on topographic map of Agua Fria quadrangle, west of Santa Fe.

Anchor Limestone Member (of Monte Cristo Limestone)[1]

Anchor Member (of Monte Cristo Dolomite)

Lower Mississippian: Southeastern Nevada and southeastern California.

Original reference: D. F. Hewett, 1931, U.S. Geol. Survey Prof. Paper 162, p. 10, 17.

J. C. Hazzard, 1951, (abs.) Geol. Soc. America Bull., v. 62, no. 12, pt. 2, p. 1503; 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 5, p. 880, 881, 883 (fig. 2). Geographically extended into Nopah Range, Inyo County, Calif., where it consists essentially of limestone with minor amounts of shale and chert. Thickness 622 feet. Underlies Bullion limestone member; overlies Dawn limestone member.

Charles Deiss, 1952, U.S. Geol. Survey Bull. 973–C, p. 115–116, pl. 13. Described in Sloan district, Nevada, where it is 65 to 75 feet thick and consists of thin-bedded (2 to 18 inches) buff and pale-gray dolomite with nodules of gray and tan chert in irregular layers. Overlies Dawn member; underlies Bullion member.

D. F. Hewett, 1956. U.S. Geol. Survey Prof. Paper 275, p. 42. Described in Ivanpah quadrangle (California-Nevada) where it commonly consists of several thick layers of light-bluish-gray limestone that contains layers of chert nodules. Overlies Dawn limestone member; underlies Bullion dolomite member.

Named for exposures in region of Anchor mine, Goodsprings quadrangle, Nevada.

Anchor Silt

Pleistocene, lower: Southern California.

P. U. Rodda, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 11, p. 2478–2481, 2489–2490. Consists largely of massive buff-colored fine sands and silts with thin irregular beds of cobble gravel. Maximum thickness 60 feet; base not exposed. In disconformable contact with overlying Medill sand (new).

Area is near hilltop on Overland Avenue, about 1,000 feet south of National Boulevard, and 1 mile southwest of Castle Heights area, in Cheviot Hills, Los Angeles. Named for exposures on Anchor Avenue.

Anchor Mine Tongue (of Mancos Shale)[1]

Upper Cretaceous: Eastern Utah.

Original reference: C. E. Erdmann, 1934, U.S. Geol. Survey Bull. 851, p. 36–38.

R. G. Young, 1955, Geol. Soc. America Bull., v. 66, no. 2, p. 180 (fig. 2), 190. Figure 2 shows Anchor Mine tongue of Mancos intertonguing with Sego member of Price River formation. Erdmann reported series of coal-bearing rocks in Anchor Mine tongue and named most conspicuous unit Anchor Mine coal. In present study, coal-bearing bed in Anchor Mine tongue was not noted. These beds lie above upper sandstone tongue of Sego member. Proposed herein to use Erdmann's name Anchor Mine coal for the main coal bed in Sego member of Price River.

Exposed at Anchor mines, Book Cliffs coal field.

Ancon Hill Rhyolite or Dacite

Miocene: Panama.

[T. F. Thompson], 1943, Panama Canal, Spec. Eng. Div., 3d Locks Proj., pt. 2, chap. 3, p. 25. Dense porphyritic much-jointed hard light-gray material. Pre-Pliocene.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 323. Rock is dacite. Miocene.

Forms rocks at Ancon Hill, located between towns of Panama and Balboa.

Anderdon Limestone Member (of Lucas Formation)

Anderdon Limestone Member (of Detroit River Dolomite)[1]

Middle Devonian: Western Ontario, Canada, southeastern Michigan, and northwestern Ohio.

Original reference: W. H. Sherzer and A. W. Grabau, 1908, Science, new ser., v. 27, p. 408.

G. M. Ehlers, 1950, (abs.) Geol. Soc. America Bull., v. 61, no. 12, pt. 2, p. 1455–1466. Considered an uppermost formation in Detroit River group. Overlies Lucas dolomite. Middle Devonian.

G. M. Ehlers, E. C. Stumm, and R. V. Kesling, 1951, Devonian rocks of southeastern Michigan and northwestern Ohio, p. 5, 8 (fig. 2), 11, 12. Geographically extended into Ohio where it is shown as underlying Dundee limestone. Thickness about 24 feet. Type locality stated.

U.S. Geological Survey classifies the Anderdon as member of Lucas Formation.

Named for exposure in Anderdon (Brunner, Mond Canada, Ltd.) quarry about 1¼ miles north of Amherstburg, Ontario.

Anderson Clay[1] (in Conemaugh Formation)

Pennsylvanian: Ohio.

[Original reference]: Wilber Stout and others, 1923, Ohio Geol. Survey, 4th ser., Bull. 26, p. 452–456.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 40. Member of Conemaugh series. In Morgan County, Anderson clay is developed subjacent to Anderson coal in some exposures. Beds range in thickness from 2 inches to maximum of 1½ feet and consist of gray to tan, subplastic to plastic clays and clay shales.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 121. Anderson underclay member of Anderson cyclothem. Average thickness 2⅔ feet in Athens County. Normally lies directly below Anderson coal, although the coal may be reduced to paper thinness. In northern Appalachian region, the clay is known as (Lower) Bakerstown or Thomas clay. Overlies Bloomfield limestone member. Conemaugh series.

Takes its name from overlying Anderson coal.

Anderson cyclothem

Pennsylvanian (Conemaugh Series): Southeastern Ohio.

N. K. Flint, 1949, Ohio Acad. Sci. [Guidebook] 24th Ann. Field Conf., p. 16. Incidental mention in road log.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 66–68, table 1, geol. map. Includes (ascending) Anderson shale, 15 feet; Bloomfield limestone (absent in Perry County); Anderson coal; and Portersville shale and limestone, 3 to 8 feet. Occurs below Barton cyclothem and above Wilgus 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), 118–123. In Athens County, includes (ascending) Bakerstown shale and (or) sandstone, Bloomfield limestone, Anderson underclay, Anderson coal, and Portersville shale and limestone. In this report [Athens County], Conemaugh series is described on cyclothemic basis; fifteen cyclothems are named. [For sequence see Mahoning cyclothem.]

Exposed in Perry County.

Anderson Phyllite[1] (in Snowy Range Series)

Precambrian: Southeastern Wyoming.

Original reference: E. Blackwelder, 1926, Geol. Soc. America Bull., v. 37, p. 620, 622, 641.

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.

In Medicine Bow Mountains. Named for old Anderson mining prospect on Libby Creek, near contact of this formation with Nash marble series.

Anderson Sandstone

Anderson Sandstone (in Pottsville Group)[1]

Pennsylvanian: Eastern Tennessee.

Original reference: A. Keith, 1896, U.S. Geol. Survey Geol. Atlas, Folio 33.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 18). Shown on correlation chart as overlying Scott formation and including strata from Pilot Knob sandstone up to top of Pennsylvanian.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [Folio], p. 1. Name Anderson formation discontinued. In new classification presented, sediments formerly described as Anderson are redefined and included in Cross Mountain and Vowell Mountain groups (both new).

J. K. Englund, 1957, U.S. Geol. Survey Coal Inv. Map C–39. Youngest Pennsylvanian in mapped area [Scott and Campbell Counties, Tenn.]. Overlies Scott shale. [Pottsville group not used in this report.]

U.S. Geological Survey has discontinued use of Pottsville Group in Tennessee.

Named because of its frequent occurrences in Anderson County.

Andorno Formation

Upper Triassic: North-central Nevada.

R. R. Compton, 1960, Geol. Soc. America Bull., v. 71, no. 9, p. 1388, pl. 1. Phyllite interbedded with persistent thin beds of quartzite, dolomitic quartzite, dolomite, and limestone. Thickness 7,000 to 8,000 feet. Overlies Singas formation (new) with contact gradational; underlies Mullinix formation (new) with contact gradational.

Type area: On high ridges that separate drainage of Andorno, Buffalo, Stone House, and Wash O'Neill Creeks, Santa Rosa Ranges, Winnemucca region.

Andover Granite[1]

Carboniferous: Northeastern Massachusetts.

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

W. R. Hansen, 1956, U.S. Geol. Survey Bull. 1038, p. 39–40. Term Gospel Hill gneiss proposed for mass of granitic rocks that Emerson (1917) mapped as variant of Andover granite but that is considered in this report [Hudson and Maynard quadrangles] as granitized product of Nashoba (new) and Marlboro formations.

Occupies large area around Andover.

Andrada Formation

Permian: Southeastern Arizona.

E. D. Wilson, 1951, Arizona Bur. Mines Bull. 158, Geol. Ser. 19, p. 50. Listed in stratigraphic sequence in Empire Mountains. Consists of shale, marl, limestone, and gypsum, 300 to 1,500 feet thick. Underlies Snyder Hill formation; overlies Naco limestone. Permian.

R. E. Thurmond, W. E. Heinrichs, Jr., and E. D. Spaulding, 1954, Mining Eng., v. 6, no. 2, p. 198 (fig. 1). Shown on generalized columnar section of Mineral Hill area as Andrada (Manzano) formation. Thickness about 400 feet. Underlies Snyder Hill formation; overlies Naco limestone. Permian.

D. L. Bryant, 1955, Dissert. Abs., v. 15, no. 7, p. 1224. Defined to include rocks between Horquilla (Pennsylvanian) and Scherrer (Permian) formations in western part of area where distinctive characters of Earp, Colina, and Epitaph formations are lost.

First described in Empire mining district, Empire Mountains, southeast of Tucson. Derivation of name not given.

Andrecito Member (of Lake Valley Formation)

Mississippian (Osage): Southern New Mexico.

L. R. Laudon and A. L. Bowsher, 1949, Geol. Soc. America Bull., v. 60, no. 1, p. 11 (fig. 4), 12–13, passim. Proposed for basal member of Lake Valley formation (redefined). At type section, consists of approximately 35 feet of thin-bedded gray fossiliferous limestone grading upward into thin-bedded dark-gray somewhat cherty limestone. Varies in thickness and lithology throughout area of exposure; thickens northward from type section to over 75 feet in Rich Rim and thins again toward north end of range; maximum thickness approximately 270 feet in Cooks Mountains. At type section, underlies Alamogordo member and unconformably overlies Caballero formation; overlies various units of the

Devonian in areas where Caballero is missing—either Contadero formation or Box member of Percha shale.

Type section: Along south wall of Andrecito Canyon in San Andres Mountains in NW¼ sec. 8, T. 18 S., R. 4 E.

†Andrew shale (in Douglas Formation)[1]

Pennsylvanian: Northwestern Missouri, southwestern Iowa, and eastern Kansas.

Original reference: C. R. Keyes, 1899, Am. Geologist, v. 23, p. 306.

Named for Andrew County, Mo.

Andrew Bay Volcanics

Tertiary: Southwestern Alaska.

R. R. Coats, 1947, U.S. Geol. Survey Alaska Volcano Inv. Rept. 2, pt. 5, p. 77, 78, pl. 6. Thick accumulation of breccia, tuff-breccia, and lava flows; these rocks are products of an ancient volcano, herein called Andrew Bay Volcano. Maximum thickness about 1,000 feet; original thickness much greater. Considered younger than newly defined Zeto Point basalt porphyry (Mesozoic?): oldest volcanic rocks of "Mount Adagak" are banked against a sea cliff cut in Andrew Bay volcanics.

Andrew Bay volcanics make up ridge rising steeply from water's edge on east shore of Andrew Bay, northern Adak Island.

Andrews Schist[1]

Andrews Formation

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

Original reference: A. Keith, 1907, U.S. Geol. Survey Geol. Atlas, Folio 143.

G. W. Stose and A. J. Stose, 1944, Am. Jour. Sci., v. 242, no. 7, p. 377. Suggested stratigraphic sequence (descending): Murphy marble, Andrews schist, Nottely quartzite. Calcareous and ferruginous Andrews schist may be transitional beds between the quartzite and the marble.

G. W. Crickmay, 1952, Georgia Geol. Survey Bull. 58, p. 27. Included in Talladega series considered to be Precambrian.

V. J. Hurst, 1955, Georgia Geol. Survey Bull. 63, p. 53–54, pl. 1, geol. map. Redefined as formation. Metasedimentary sequence, 1,400 to 1,800 feet thick, that lies between Murphy marble [below] and Nottely quartzite. Base of sequence is a calcareous schist which corresponds to Keith's Andrews schist in Nantahala quadrangle but were mapped by Keith as part of Valleytown formation. Although formation contains rocks which were mapped by Keith (1907) and LaForge and Phalen (1913, Folio 187) as parts of other formations, its stratigraphic limits are same as those specified by Keith for Andrews schist.

Named for exposures in vicinity of Andrews, Cherokee County, N.C.

Androscoggin Formation

Androscoggin Gneiss and Schist

Androscoggin Series

Ordovician(?): Southwestern Maine.

L. W. Fisher, 1936, Am. Mineralogist, v. 21, no. 5, p. 323. Listed as Androscoggin gneiss and schist. Underlies Bates limestone (new); overlies Precambrian orthogneisses. Cambro-Ordovician(?).

L. W. Fisher, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 71. Seven formations in Lewiston area (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.

L. W. Fisher, 1938, (abs.) Geol. Soc. America Proc. 1937, p. 81. Five mappable units have been established in area formerly mapped as Precambrian in southwestern Maine. Sequence (ascending): Danville-Pejepscot (new) series, Taylor Brook injection gneiss (new), Androscoggin series, including Bates limestone and Deer Rips lime silicate gneiss, and Thorncrag-Sabbatus series.

L. W. Fisher, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 117–124, pl. 1, table 1 (facing p. 112). Formation includes four phases: highly injected biotite-garnet gneiss, lime-silicate gneiss, marble, and quartz-biotite schist. Thickness about 3,500 feet. Underlies Sabattus formation; overlies Taylor Brook formation. Quartz-biotite facies traced into Vassalboro formation between Litchfield and South Litchfield. Ordovician(?). Type locality designated.

Type locality: At City Rapids between Lewiston and Auburn [Androscoggin County].

Aneth Formation

Upper Devonian: Subsurface in Utah, Arizona, Colorado, and New Mexico.

R. L. Knight and J. C. Cooper, 1955, Four Corners Geol. Soc. Guidebook [1st] Field Conf., p. 56, 57, 58; J. C. Cooper, 1955, Four Corners Geol. Soc. Guidebook [1st] Field Conf., p. 61–63. Dark dolomite interval interbedded with varying amounts of gray, brown, and black shale, gray siltstone, and lighter dolomites. Thickness 170 feet in type well; occurs between depths of 8,161 and 8,331 feet. Thins gradually in all directions from a center just southwest of type well. Underlies McCracken sandstone (new); unconformity inferred. Overlies Ophir formation, contact unconformable.

Type section: Described from well core Shell Oil Company Bluff Unit No. 1 located in sec. 32, T. 39 S., R. 22 E., near the town of Blanding, Utah.

Angaur (older and younger) Limestone

Pleistocene or early Holocene: Caroline Islands (Angaur).

Risaburo Tayama, 1951, Tohoku Univ. Inst. Geology and Paleontology Short Papers no. 3, p. 102 (geol. map), 103, 105; 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 67, table 4 [English translation in library of U.S. Geol. Survey, p. 80]. Consists of two units referred to as Older Angaur and Younger Angaur limestone. Older limestone constitutes major part of Angaur terraces referred to as C_1 and C_2; white and porous, composed mainly of *Halimeda* limestone with some coral limestone. Younger limestone constitues lowest terrace C_3 and is exposed at altitude of 5 feet in limited areas along shore; hard limestone principally of *Halimeda* and corals. Younger than Palau limestone. Pleistocene and Recent.

Angaur Island, Palau group.

†Angelina series[1]

Tertiary: Eastern Texas.

Original reference: R. T. Hill, 1902, Franklin Inst. Jour., v. 154, no. 2, p. 153–154.

Probably named for Angelina County or Angelina River.

Angell Member (of Ballard Formation)

Pleistocene (Nebraskan): Southwestern Kansas.

C. W. Hibbard, 1958, Am. Jour. Sci., v. 256, no. 1, p. 55 (fig. 1), 57–58. Name applied to sand, gravel, and cobble member at base of Ballard formation. Thickness about 7 feet. Underlies Missler member; overlies Rexroad formation.

Type section: Sanders gravel pit, SE¼NW¼ sec. 7, T. 32 S., R. 28 W., Meade County. Name derived from old Angell Schoolhouse which was located in SE cor. NE¼ sec. 31, T. 32 S., R. 29 W.

Angel Lake Glacial Stage[1]

Pleistocene: Northeastern Nevada.

Original reference: E. Blackwelder, 1931, Geol. Soc. America Bull., v. 42, p. 918.

Ernst Antevs, 1945, Am. Jour. Sci., v. 243A, table 2 facing p. 24. Mentioned in discussion of Wisconsin glaciation.

Well displayed at Angel Lake, southwest of Wells, Elko County.

Angola Shale Member (of West Falls Formation)

Angola Shale[1]

Upper Devonian: Western New York.

Original reference: J. M. Clarke, 1903, New York State Mus. Handb. 19, p. 24, chart.

Wallace de Witt, Jr., and G. W. Colton, 1953, U.S. Geol. Survey Geol. Quad. Map GQ–30. Conformably underlies Pipe Creek member of Hanover shale. Gradational contact with underlying Rhinestreet shale. About 235 feet thick in Silver Creek quadrangle. Composed largely of medium- to light-gray even- to lumpy-bedded shale and blocky- to irregular-bedded mudstone. Interbedded are small amounts of fissile grayish-black and dark-brown shale; a few medium-light-gray muddy siltstones; some thin beds of medium-gray argillaceous limestone; many calcareous nodules and concretions.

J. F. Pepper, Wallace de Witt, Jr., and G. W. Colton, 1956, U.S. Geol. Survey Oil and Gas Inv. Chart OC–55. Reallocated to member status in West Falls formation (new). Overlies Rhinestreet member; in some areas, intertongues with Gardeau shale member; in some areas, overlies Nunda sandstone member; locally underlies Pipe Creek member of Hanover shale.

Named for Angola, Erie County, where it is exposed along Big Sister Creek.

Animas Formation[1]

Upper Cretaceous and Paleocene: Southwestern Colorado and northwestern New Mexico.

Original references: C. W. Cross, 1896, U.S. Geol. Survey Mon. 27, p. 217–219; J. H. Gardner, 1917, U.S. Geol. Survey Prof. Paper 101, p. 185–186.

C. H. Dane, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 24. Described on eastern side of San Juan Basin, N. Mex. Estimated thickness, 3,000 feet near New Mexico-Colorado line. Thins southward to about 1,200 feet in northwestern part of T. 25 N., R. 1 E. Divisible into lower part consisting chiefly of sandstone and conglomerate and an upper part consisting chiefly of soft sandstone and clay. Toward south, formation includes larger percentages of clays and sandy clays and grades laterally into lithologic unit consisting chiefly of softer beds which has been traced to south into sequence that has been mapped as undivided Puerco and Torrejon formations (Dane, 1936, U.S. Geol. Survey Bull. 860–C) in vicinity of Cuba. This lateral transition takes place gradually over distance of many miles, but some arbitrary division of nomenclature is necessary. Name Animas is extended only southward to Canyoncito de las Lleguas in T. 25 N., R. 1 E. Conformably overlies Fruitland formation in northern and northwestern part of basin; underlies Wasatch formation. Separation on lithologic grounds of the part of the Animas that is Cretaceous and the part that is Paleocene has not yet been made.

Harley Barnes, E. H. Baltz, Jr., and P. T. Hayes, 1954, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map OM–149. Described in La Plata and Montezuma Counties, Colo. Above Kirtland shale a sequence of purple and olive-drab rocks containing much volcanic debris was named, "Animas River beds" by Cross and Animas formation by Gardner (1917). Reeside (1924) divided sequence into McDermott formation and Animas formation. Reeside's typical section of the McDermott is herein subdivided as follows: lowest 95 feet of pebble-bearing sandstone and sandy shale is part of Kirtland shale, the overlying 127 feet of purplish beds is McDermott member, and top 106 feet is included in upper member (unnamed) of Animas. The two members are gradational, and aside from contrast in color, show no consistent lithologic distinction. The dominantly purple McDermott strata are best exposed on Animas River, where they intertongue with overlying greenish-gray olive-drab, and tan Animas strata. Northeastward from Animas River, the McDermott thins by intertonguing with upper member so that in area of Florida-Los Pinos divide the purple sediments are replaced by greenish beds. Where maroon and purple sequence is present in Colorado the formation consists of basal McDermott member and an upper member; elsewhere in Colorado the formation is not subdivided. Above Animas formation is sequence of tuffaceous shale and lenticular sandstone mapped by Reeside as Torrejon formation but herein called Nacimiento formation.

Typical exposures on Animas River below Durango, Colo.

†Animas interglacial epoch[1]

Pleistocene: Southwestern Colorado.

Original reference: W. W. Atwood and K. F. Mather, 1912, Jour. Geology, v. 20, p. 392–409.

Animas Valley Basalt

Pleistocene, upper, or Recent: Southwestern New Mexico.

Elliot Gillerman, 1958, New Mexico Bur. Mines Mineral Resources Bull. 57, p. 77–78, table 1, pl. 1. Dark-gray to dull-black fine-grained vesicular olivine basalt. Thickness estimated to be about 60 feet, undoubtedly not uniform. Part of flow covered by valley sediments.

Exposures confined to floor of western side of Animas Valley, along southeastern side of Peloncillo Mountains, Hidalgo County.

Animikie Group[1]

Animikie Series[1]

Precambrian: Ontario, Canada, and northern Michigan, northeastern Minnesota, and northern Wisconsin.

Original reference: T. S. Hunt, 1873, Am. Inst. Mining Engrs. Trans., v. 1, p. 331–395.

F. F. Grout and others, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 1021 (table 3), 1041–1051. Retained as group name in Minnesota because outcrops are well correlated with original Animikie locality and not well correlated with type locality of Huronian. Includes (ascending) Pokegama quartzite, Biwabik iron formation series, and Virginia slate. Unconformable above Algoman batholithic intrusives; unconformable below Keweenawan group.

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.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 30 (table 1), 33–35. Reinstated and given series rank in application to Michigan strata. Term Huronian, used in area for nearly 60 years, is not used here because of uncertainty of correlation with type Huronian of Canada; strata previously correlated with Huronian are now referred to Animikie on basis of accepted correlations with strata of Mesabi district of Minnesota, which have been traced into type Animikie of Thunder Bay area of Canada. Series divided into four groups (ascending): Chocolay, Menominee, Baraga, and Paint River. Series rests unconformably on eroded surface of lower Precambrian (post-Dickinson) granitic rocks; Animikie strata were deformed, metamorphosed, and intruded by dikes, stocks, and sills of gabbroic to granitic composition in a pre-Keweenawan orogenic interval.

F. F. Grout, R. P. Sharp, and G. M. Schwartz, 1959, Minnesota Geol. Survey Bull. 39, p. 20–29. In Cook County, group consists of Pokegama quartzite, Gunflint iron formation, and Rove formation. These units are correlated with Pokegama quartzite, Biwabik iron formation, and Virginia formation of Mesabi Range. Lies between Knife Lake group below, and Keweenawan group above.

Named for occurrence along Thunder Bay, north shore of Lake Superior, Ontario, Canada. Animikie is Indian same for Thunder Bay.

Anita Shale

Eocene, middle: Southwestern California.

F. R. Kelley, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 1, p. 3, 4, 5, 6–7. Thick unit of Eocene shales with subordinate beds of sandstone and some limestone nodules. At one or more horizons, includes red foraminiferal shale. Disconformably underlies Matilija sandstone; disconformably overlies Upper Cretaceous sandstone. Thickness about 600 feet.

T. W. Dibblee, Jr., 1950, California Div. Mines Bull. 150, p. 26, pls. 1, 2, 5, 6. Consists of about 1,000 feet of clay shale lying above Jalama formation (new). Relationship to the Jalama appears to be conformable, but in northerly exposures [Santa Ynez Range] the Anita rests unconformably on Jalama or older formations.

Type locality: On south side of Santa Anita Canyon 1 mile west of Big Bend [Santa Barbara County].

Ankareh Shale,[1] Formation, or Redbeds

Lower and Upper Triassic: Northeastern Utah. southeastern Idaho, and southwestern Wyoming.

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

J. S. Williams, 1945, Am. Jour. Sci., v. 243, no. 9, p. 474, 476, 477 (fig. 2). Name Ankareh shale restricted to those red beds between Thaynes limestone and unconformity below Higham grit in northeastern Utah. Name Red Wash formation proposed for red beds at eastern end of Uinta Mountains that are equivalent to Woodside, Thaynes, and Ankareh (restricted).

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), 1270, strat. sections. In western Uinta and central Wasatch Ranges, overlies Thaynes limestone and unconformably underlies Gartra member of Stanaker formation (both new). Thickness 862 to 1,400 feet. Summary of stratigraphic nomenclature in area.

Bernhard Kummel, 1953, Intermountain Assoc. Petroleum Geologists Guidebook 4th Ann. Field Conf., fig. 1 facing p. 48. In central Wasatch Mountains and western Uinta Mountains, subdivided into (ascending) Mahogany (new), Gartra grit. and Stanaker members.

Bernhard Kummel, 1954, U.S. Geol. Survey Prof. Paper 254–H, p. 166 (fig. 18), 178 (fig. 21), 179–180. As now used, name Ankareh is applied to different parts of post-Thaynes sequence in middle Rocky Mountains. In western Wyoming, applied to all strata between Thaynes formation and Nugget sandstone. In Utah, applied only to beds from Thaynes to Gartra grit. In Idaho, name Ankareh was abandoned by Mansfield (1927) although Gartra grit is probably equivalent to Higham grit and Higham grit is present in Ankareh in Wyoming. It is here proposed that Ankareh formation, as originally defined by Boutwell to include all strata between Thaynes and Nugget formations, be applied in northern Utah and western Wyoming and all formations that have been proposed for parts of this sequence be reduced to member rank. In eastern Uinta Mountains, Colorado Plateau nomenclature is used following Kinney and Rominger (1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 82). Wood shale is considered westward tongue of Ankareh formation as used in Wyoming. Stanaker formation and Gartra grit (Thomas and Krueger, 1946) are reduced to member status in Ankareh. Unit referred to Ankareh by Thomas and Krueger (1946) and Williams (1945) must be renamed. Name Mahogany member is here proposed for unit between top of Thaynes and base of Gartra member. Name Lanes tongue of Ankareh proposed for Sheep Creek section in Idaho. Main areas of outcrop and units present in each discussed briefly.

W. W. Rubey, 1958, U.S. Geol. Survey Geol. Quad. Map GQ–109. Ankareh redbeds mapped in Bedford quadrangle, Wyoming.

U.S. Geological Survey currently designates the age of Ankareh as Lower and Upper Triassic on the basis of a study now in progress.

Named for Ankareh Ridge, Park City district, Utah.

Anna Shale Bed (in Pawnee Limestone Member of Oologah Formation)

Anna Shale Member (of Pawnee Limestone)

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

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 38, pt. 11, p. 316–317, pl. 1. Lowermost member of Pawnee limestone. Includes a thin dark slabby limestone (at base) and a black platy and locally fissile shale. Thickness 3 to 11 feet. Underlies Myrick Station member; overlies Labette shale.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 6–7, fig. 1. Geographically extended into Missouri and reallocated to Pawnee formation. Unit now termed Anna shale had been included in Labette formation.

R. D. Alexander, 1954, Oklahoma Geol. Survey Circ. 31, p. 15, 16 (fig. 2). Occurs in Oklahoma where it is shown as a shale [bed] at base of Pawnee member of Oologah formation.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 32, fig. 5. Geographically extended into southwestern Iowa. As exposed in Madison County, upper bed is olive shale that weathers buff and contains fossil fragments; below this is dark-gray platy shale with light-gray fucoidal markings; lower shales are dark gray to black, hard, and slaty with thin gray lime concretions and bands in the upper part and are soft and clayey in lower part. Thickness 2.2 feet. Lowermost member of formation. Underlies Myrick Station limestone member; overlies Labette shale.

Type locality: North of center sec. 7, T. 27 S., R. 24 E., in Bourbon County, Kans., on Kansas Highway 7.

Annabelle Shale (in Monongahela Formation)[1]

Pennsylvanian: Northern West Virginia.

Original reference: R. V. Hennen and D. B. Reger, 1913, West Virginia Geol. Survey Rept. Marion, Monongalia, and Taylor Counties, p. 250.

At Annabelle, Marion County.

Annelly Gypsum Member (of Wellington Formation)

Permian: Southeastern Kansas.

W. A. Ver Wiebe, 1937, Wichita Municipal Univ. Bull., v. 12, no. 5, p. 5, 12. Consists of gypsum interbedded with lesser amounts of drab clays; both selenite and alabaster varieties of gypsum are present. Three prominent beds of gypsum commonly present, but locally, only two are present; in some places additional thin gypsum beds are interbedded with the clays. Thickness about 13 feet; at type locality, three beds of gypsum are exposed, each about 3 feet thick. Underlies Chisholm Creek shale member (new); overlies Geuda Springs shale member (new).

Type locality: High cliff on west branch of Whitewater River one-fourth mile south of Annelly, sec. 15, T. 24 S., R. 2 E., Harvey County.

Annie Creek Flows, Pumice Flows

Pleistocene to Recent: Southwestern Oregon.

Howel Williams, 1942, Carnegie Inst. Washington Pub. 540, p. 87–89, pl. 5 (fig. 2). Annie Creek flows (pumice flows) were products of glowing avalanches that swept down Munson Valley from Mount Mazama into Annie Creek. Glowing avalanches of pumice and scoria were part of final activity of Mount Mazama and followed what is termed main pumice fall.

Annie Creek flows southward from Crater Lake.

Annona Chalk[1]

Annona Chalk (in Taylor Group)

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

Original reference: R. T. Hill, 1894, Geol. Soc. America Bull., v. 5, p. 308.

L. W. Stephenson, 1937, U.S. Geol. Survey Prof. Paper 186–G, p. 133–146. Annona chalk, which in eastern Red River County is estimated to be 300 or 400 feet thick, is time equivalent of combined lower part of Taylor marl, Wolf City sand member, and Pecan Gap member of Lamar, Delta, and Fannin Counties. Phosphatic bed that forms base of Annona chalk north of White Rock, in Red River County, has been traced westward and found to be continuous with phosphatic bed at base of Taylor marl just above Gober tongue of Austin chalk in Lamar County. In southwestern Arkansas, Annona chalk and underlying Ozan formation are together the approximate time equivalent of Annona chalk in Red River County, Tex.

D. L. Frizzell, 1954, Texas Univ. Bur. Econ. Geology Rept. Inv. 22, p. 43–45. Annona chalk included in Taylor group. Pecan Gap chalk has been considered to be tongue of Annona chalk, with lower marl [east of Taylor group] and Wolfe City sand being lateral equivalents of lower part of Annona chalk (interpretation accepted here). Foraminifera described.

F. F. Mellen, 1958, Mississippi Geol. Survey Bull. 85, p. 29–40. Name Annona first projected into Mississippi into a part of Selma chalk by Shreveport Geological Society. In stratigraphic cross sections, projection was from Desha basin on north side of Monroe-Sharkey uplift and also within salt basin province south of Monroe-Sharkey uplift. Nomenclature and usage are set out in Gulf Cretaceous correlation chart (Shreveport Geol. Soc., 1945, v. 2, p. 480–481). In present study, it was assumed that stratigraphic studies and correlations of Annona section by Shreveport stratigraphers were essentially correct. It was upon this premise, that name Annona chalk was adopted to apply to a portion of lower part of Demopolis chalk. A 2-foot bed in upper part of Annona chalk as used herein has been traced over an area of all or part of more than 40 counties in Mississippi. This bed is herein named Coonewah, for outcrops in Coonewah Creek valley. Most data subsurface.

Named for outcrops about 2 miles northwest of Annona, Red River County, Tex.

Annsville Phyllite

Cambro-Ordovician: Eastern New York.

K. E. Lowe, 1947, Geol. Rev., v. 7, no. 1, p. 10. Near Tomkins Cove, both Wappinger limestone and associated Annsville phyllite (Hudson River series) trend southwest representing continuation of Cambro-Ordovician belt of sediments in Sprouts Brook (Peekskill) across Hudson River to northeast.

S. Schaffel, 1958, New York Geol. Assoc. Guidebook 30th Ann. Mtg., p. 2. Commonly dark bluish gray but may be black. Thickness uncertain because extent of isoclinal folding is not known. Conformably overlies Wappinger limestone. Youngest rock unit of Paleozoic age preserved in Peekskill Valley.

Probably named for occurrence in vicinity of village of Annsville, near Peekskill, Westchester County.

Annville Limestone[1]

Annville Formation (in St. Paul Group)

Middle Ordovician: Eastern Pennsylvania.

Original reference: B. L. Miller, 1925, Pennsylvania Geol. Survey, 4th ser., Bull. M–7, p. 124, 125, 133.

Carlyle Gray, April 1951, Pennsylvania Geol. Survey, 4th ser., Prog. Rept. 136, p. 12–15. Composed of two members: lower, thick-bedded high-calcium limestone; and upper, thin-bedded impure limestone. Total thickness more than 250 feet at western boundary of Berks County. Overlies Beekmantown limestone; underlies Jacksonburg formation. Formerly considered to be of Stones River age, but now correlated with "cement limestone" member of Jacksonburg. This correlation implies that Annville is in part Trenton and possibly in part Black River in age. Name Annville has been used as trade name.

C. E. Prouty, 1951, (abs.) Geol. Soc. America Bull., v. 62, no. 12, pt. 2, p. 1471. Annville limestone, heretofore a commercial term for cement limestone in Lebanon and adjacent counties, is defined and given formational status. Overlying "Leesport" will be renamed.

Carlyle Gray, 1952, Pennsylvania Geol. Survey, 4th ser., Prog. Rept. 140, p. 1, 3. Predominantly thick-bedded to massive crystalline high-calcium limestone. In eastern part of area, beds are blue, with some light-gray colors and pinkish gray. Light-gray and pinkish-gray colors dominant in west. Normal stratigraphic thickness about 240 feet; thins east of Myerstown to 20 feet at Womelsdorf. Underlies Myerstown limestone (new). Directly overlies Beekmantown group.

J. P. Hobson, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 12, p. 2720. Overlies Ontelaunee formation (new).

C. E. Prouty, 1959, Pennsylvania Geol. Survey, 4th ser., Bull. G–31, p. 6–12. Though Miller (1925) used name in formational sense (Annville limestone), it was apparently proposed as trade name. Overlies Beekmantown group throughout most of its extent, but, in Harrisburg area, overlies rocks similar to middle member of "Stones River." Underlies Myerstown limestone in all observed sections. Type section designated.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Mapped in St. Paul group.

Type section: Quarry at old Palmyra plant of H. E. Millard Limestone Company about 1½ miles northwest of Palmyra. Named for town of Annville, Lebanon County.

Anón Andesite-Diorite

Eocene, postearly 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. 113–115, geol. map. At type locality, shows needlelike phenocrysts of hornblende and square phenocrysts of plagioclase feldspar. Intrudes lower middle Eocene rocks of Jacaguas group. Postearly middle Eocene and probably premiddle Oligocene.

E. A. Pessagno, Jr., 1960, Caribbean Geol. Conf., 2d, Mayagüez, Puerto Rico, 1959, Trans., p. 85. Commonly light to medium gray in color with phenocrysts of plagioclase feldspar. Andesitic rather than dioritic in texture. Intrudes rocks of Guayabal group (new). Footnote states that Guayabal group is currently called Jacaguas.

Type locality: On Camino Anón at kilometer post K9HO and below in bed of Río Inabon. Name derived from Hacienda Anón, 1.65 kilometers northeast of Cerro Santo Domingo. Occurs in series of stocks extending from Barrio Guayahal in northwestern part of Río Descalabrado quadrangle to Barrio San Patricio in northwestern Ponce quadrangle.

Anson Formation

[Silurian]: West-central Maine.

A. R. Cariani, 1959, Dissert. Abs., v. 19, no. 10, p. 2577. Brown-mottled grits and arenaceous phyllites. Brown spots caused by oxidation of siderite. Position and formational status of Anson still in doubt. Correlates on basis of similar lithology with Vassalboro formation which is Clinton [Silurian] in age.

In Anson quadrangle.

Ansonia Granite

Pre-Triassic(?): Southwestern Connecticut.

M. H. Carr, 1960, Connecticut Geol. Nat. History Survey Quad. Rept. 9, p. 18–19, pl. 1. Light-gray biotite-muscovite granite gneiss. Cuts Hartland formation and Prospect gneiss.

Named for town of Ansonia, Naugatuck quadrangle.

Antelope Rhyolite[1]

Tertiary(?): Northwestern Arizona.

Original reference: C. Lausen, 1931, Arizona Bur. Mines Bull. 131, map.

Oatman district, Mohave County.

Antelope Shale

Upper Cretaceous: North-central California.

N. L. Taliaferro, 1954, *in* Northern California Geol. Soc. Spring Field Trip, [p. 6, 7], correlation chart, structure sections A, B, and C. Shown on correlation chart and structure sections as underlying Venado sandstone and overlying Salt Creek conglomerate (new). Beds vertical to overturned. Thickness 4,200 to 5,200 feet.

Klaus Kupper, 1956, Cushman Foundation Foram. Research Contr., v. 7, pt. 2, no. 152, p. 40–47. Description of Upper Cretaceous pelagic Foraminifera from "Antelope shale" of Taliaferro (1954). Kirby (1943, California Div. Mines Bull. 118) referred to these strata as Horsetown formation of Shasta group. J. Lawton (unpub. thesis) has proposed term Fiske Creek formation for "Antelope shale" which is junior homonym of Antelope formation (Miocene) of Kern County, described by Noble (1940 Am. Assoc. Petroleum Geologists Bull., v. 27, no. 3).

W. P. Irwin, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 10, p. 2287. If it is desirable that Shasta series be restricted to Early Cretaceous, base of conglomerate below so-called Antelope shale of

Taliaferro appears to be good choice for its upper limit and is so considered in this report.

Occurs in Rumsey Hills-Capay Valley-Wilbur Springs area on west side of Sacramento Valley.

Antelope Shale Member (of Monterey Formation)

Miocene, upper: Central California.

E. B. Noble, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 7, p. 1332 (fig. 1). Initially used as local name for a productive oil zone in Kern County.

R. R. Simonson and M. L. Krueger, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 10, p. 1611 (fig. 2), 1617, 1621 (fig. 4), 1627 (fig. 8). At surface, consists of siliceous well-bedded light-brown shale containing minor lenses of sandstone and limestone. Thickness about 2,400 feet. Unconformably underlies Santa Margarita formation; conformably overlies McDonald shale member of Monterey formation.

L. B. McMichael, chm., 1959, San Joaquin Geol. Soc. Guidebook Field Trip, May 9, road log, strat. profile, chart, map. Underlies Chico Martinez chert member (new) and overlies McDonald shale member in Chico Martinez Creek area. Thickness about 2,750 feet. McDonald shale, Antelope shale, and Chico Martinez chert members are equivalent to McLure shale member of Monterey.

Type locality not stated. Area under study was Crocker Flat landslide in central Temblor Range.

Antelope 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, 385, 386.

D. A. Zimmerman and G. D. Glover, 1956, Soc. Econ. Paleontologists and Mineralogists Permian Basin Sec. [Guidebook] Spring Mtg., p. 70. Variable sandstone, friable to hard, pure to clayey, with conglomerate and some clay. Underlies Indian Creek bed; overlies Comanche 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, Ricker, is in common use today, and that name has been restricted to base of Drake's Ricker bed.

Named for Antelope Creek, San Saba County.

Antelope Flats Member (of Wellington Formation)

Permian: North-central Oklahoma.

G. O. Raasch, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1928. Uppermost member of formation. Thickness 195 feet. Overlies Billings member (new).

Type locality and derivation of name not stated.

Antelope Valley Limestone (in Pogonip Group)

Lower and Middle Ordovician: Central Nevada.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 28–29. Name applied to uppermost formation in

Pogonip group. Dominantly thick-bedded or massive medium-gray or light-bluish-gray fine-grained limestone. Very little chert present. Cliff-forming units not uncommon. Locally contains thinner bedded zones, as at base of formation on Martins Ridge, where there is about 150 feet of rather thinly bedded argillaceous limestone. Here, formation not separable from underlying Ninemile formation (new) on basis of change from thinner bedded to thicker bedded limestone, but color change in thin-bedded rocks is distinctive. Thinner bedded limestones present near top of formation both in Antelope Valley and at Eureka. In this part of section, limestone tends to be flaggy or platy with tan argillaceous partings and mottlings, although limestone still retains medium-gray to light-bluish-gray color in bulk of unit. Thickness about 400 feet near Eureka; about 1,100 feet at Martins Ridge. In type area, underlies Copenhagen formation (new); in Eureka district proper, underlies Eureka quartzite.

Marshall Kay, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 12, p. 97 (fig. 3), 98 (fig. 4). In Toquima Range, overlies Stoneberger shale (new); underlies Caesar Canyon formation or Diana formation (both new).

U.S. Geological Survey currently designates the age of the Antelope Valley Limestone as Lower and Middle Ordovician on the basis of studies now in progress.

Named for occurrence in Antelope Valley region. Well exposed on Martins Ridge, linear northward-trending ridge that separates Copenhagen Canyon from Antelope Valley and is about 25 miles southwest of Eureka.

Antero Formation

Oligocene: 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), 63–67, 170–171, pl. 1. Lacustrine sediments with some associated delta and flood plain deposits and beds of volcanic ash and agglomerate. Beds contain layers and reefs of algal limestones. Thickness about 2,010 feet. Underlies Wagontongue formation (new); overlies Balfour formation (new).

Area: South and west of Hartsel in Tps. 12–15 S., Rs. 75–76 W.; occupies several long, narrow, and partly connected basins in the Precambrian north-northeast of Hartsel, in Tps. 10–11 S., Rs. 74–75 W., Park County.

Antes Shale (in Trenton Group)

Middle Ordovician (Mohawkian): Central Pennsylvania.

G. M. Kay, 1944, Jour. Geology, v. 52, no. 1, p. 3 (fig. 2); no. 2, p. 114. Comprises about 400 feet of dark, brownish-weathering shale lying between Coburn limestone and silty and arenaceous Reedsville shale. *Dicranograptus nicholsoni* (Hall) abundant near top of formation; *Tiarthrus eatoni* Hall common in underlying shales. Antes has been included in Reedsville in reports and maps of region.

Exposed along Antes Creek above Antes Gap, Clinton County.

Antes Gap Shale

See Antes Shale.

Anthony cyclothem

Pennsylvanian (Pottsville Series): Southeastern Ohio.

N. K. Flint, 1949, Ohio Acad. Sci. [Guidebook] 24th Ann Field Conf., p. 18. Incidental mention in road log.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 21–22, table 1, geol. map. Includes (ascending) Anthony shale and (or) sandstone, 7 feet thick; Sciotoville clay, 4 feet; and Anthony coal. Occurs below Huckleberry cyclothem and above Harrison formation. In area of this report, Pottsville series is described on a cyclothemic basis; 10 cyclothems are named (ascending): Anthony, Huckleberry, Quakertown, Bear Run, Vandusen, Lower Mercer, Flint Ridge, Middle Mercer, Bedford, and Tionesta.

Well exposed in Monday Creek Township along Little Monday Creek valley, in Temperance Hollow, and in headwater region of Turkey Run, Perry County.

Anthony Sandstone (in Hennessey Formation)

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 a projected cross section of upper Permian.

Anthony Shale or Sandstone

Pennsylvanian (Pottsville Series): Eastern Ohio.

R. E. Lamborn, C. R. Austin, and Downs Schaaf, 1938, Ohio Geol. Survey, 4th ser., Bull. 39, p. 70–80. Defined as shale which occupies interval extending upward from Anthony coal to base of Quakertown clay. Locally contains an iron ore above Anthony coal. Shale horizon has rather limited extent. Average thickness about 22 feet. Underlies Massillon shale; overlies Sciotoville clay.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 21–22. Anthony shale and (or) sandstone included in Anthony cyclothem.

Generally present on outcrop through Scioto, Jackson, Vinton, Hocking, Perry, Licking, and Muskingum Counties. Present in parts of Wayne, Summit, Trumbull, and Mahoning Counties.

Anthony Lake granodiorite

Lower Cretaceous(?): Northeastern Oregon.

W. H. Taubeneck, 1957, Geol. Soc. America Bull., v. 68, no. 2, p. 205–206, 235. Potash-poor granodiortie. Contemporaneous with Bald Mountain tonalite (new).

Occurs near Anthony Lake, Elkhorn Mountains [Grant County]. Granodiorite commences in zone approximately 2½ miles inward from contacts of Bald Mountain batholith and covers area of about 36 square miles.

Antietam Sandstone,[1] **Quartzite,** or **Schist** (in Chilhowee Group)

Antietam Formation

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. 41–42. Antietam quartzite described in Carroll and Frederick Counties. Occurs in foothills east side of Catoctin Mountain west of Frederick Valley, and in series of linear hills in eastern part of valley. In foothills of Catoctin Mountain, crops out in narrow belt about one-fourth mile wide which extends from Point of Rocks at Potomac River to Little Tuscarora Creek northwest of Frederick, where it is cut out by Triassic border fault. Quartzite throughout this belt is underlain by Harpers phyllite and overlain by Tomstown dolomite, in normal sequence. On east side of Frederick Valley, Antietam forms discontinuous line of low wooded hills from New Midway, where quartzite is overlapped by Triassic sedimentary rocks, southwestward to Potomac River. Quartzite here is unconformably overlain by Frederick limestone. Total thickness in belt west of Frederick Valley estimated about 300 feet. Lower Cambrian.

H. P. Woodward, 1949, West Virginia Geol. Survey, v. 20, p. 115–124. Referred to as sandstone or quartzite in West Virginia. Only outcrop is in Jefferson County where its length is about 14 miles and its width ¾ mile. Underlies Tomstown dolomite. Oldest fossiliferous formation in state. Estimated thickness 500 to 600 feet.

P. B. King, 1950, U.S. Geol. Survey Prof. Paper 230, p. 15 (fig. 5), 20–24, pl. 1. Described in Elkton area, Virginia, where it is assigned to Chilhowee group. Uniform thickness of about 800 feet. Divided into two members of about equal thickness. Lower member composed of white vitreous quartzite and contains worm tubes, or *Scolithus*. Forms prominent ledges up to 100 feet thick; between ledges are thinner bedded sandstone or quartzite, but greater part is formed by relatively less resistant buff or brown sandstone. Overlies Harpers formation; underlies Tomstown dolomite.

R. W. Chapman, 1950, Geol. Soc. America Bull., v. 61, no. 3, p. 193–194, 200–201. Described in Safe Harbor area, Pennsylvania, as Antietam schist. Grades upward into Vintage dolomite through zone roughly 10 feet thick.

Ernst Cloos, 1951, Maryland Dept. Geology, Mines and Water Resources Washington County [Rept. 14], p. 39. Referred to as Antietam sandstone. Occurs only in eastern Washington County in foothills of South Mountain and Elk Ridge.

D. M. Scotford, 1951, Geol. Soc. America Bull., v. 62, no. 1, p. 51–52, pl. 1. In Sugarloaf Mountain area, Antietam quarzite conformably overlies Harpers phyllite and underlies Frederick limestone. Crops out in two southeast-trending belts, 1 to 2 miles wide, along western part of area. Western belt is tight anticline which forms ridge above surrounding Frederick limestone. Eastern belt, which is discontinuous, is separated from western belt by limestone valley.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Mapped as Antietam formation.

Named for exposures near Antietam Creek, north of Potomac River, Washington County, Md.

Antioch Sandstone[1]

Permian: Central southern Oklahoma.

Original reference: D. A. Green, 1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 11, p. 1465, 1466.

Garvin County.

Antler Peak Limestone

Upper Pennsylvanian and Lower Permian: North-central Nevada.

R. J. Roberts, 1951, Geology of the Antler Peak quadrangle, Nevada: U.S. Geol. Survey Geol. Quad Map [GQ–10]. Name given to limestone beds whose principal exposures underlie Antler Peak and crop out in a belt trending diagonally across the range. Limestones are medium to thick bedded for most part and form prominent outcrops. Thickness at type section 625 feet; east of Copper Basin probably more than 800 feet. Unconformably underlies Edna Mountain formation (new); overlies Battle formation (new).

R. J. Roberts and others, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 12, p. 2824 (fig. 5), 2843, 2853, (fig. 11). Late Pennsylvanian to early Permian on basis of diversified fauna including fusulinids.

Type section: Antler Peak.

Antlers Sand[1] (in Trinity Group)

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

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

J. M. Forgotson, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 10, p. 2333 (fig. 2), 2335. Correlation chart of Trinity group shows Antlers sand, undifferentiated, in outcrop in southeastern Oklahoma. Antlers is referred to as having Paluxy-like lithology. Paluxy is not included in Trinity as defined in this study. Term Paluxy is restricted to sandstones and shales which are time-stratigraphic equivalent of, and are laterally continuous with, part of Walnut, which is lowest formation of Fredericksburg group.

L. V. Davis, 1960, Oklahoma Geol. Survey Bull. 86, p. 26, pl. 1. Forgotson (1957) has shown that type Paluxy is Fredericksburg. So-called Paluxy of McCurtain County is either upper part of Antlers sand or may be assignable to Rusk sand.

Named for Antlers, Pushmataha County, Okla.

†Antoine Dolomite[1]

Precambrian (lower Huronian): Northwestern Michigan.

Original references: C. R. Van Hise, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 3, p. 16, 17; 1899, U.S. Geol. Survey Mon. 36, p. XXV, XXVI.

Menominee district.

Antonio 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, 5.

Well displayed at north end of Manzano Mountains. Derivation of name not given.

Antonito 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, 5.

Exposed at southern extremity of Sandia Range. Derivation of name not given.

Antrim Shale[1]

Upper Devonian and Lower Mississippian: Michigan.

Original reference: A. C. Lane, 1901, Michigan Miner, v. 3, no. 1, p. 9.

A. S. Warthin, Jr., and G. A. Cooper, 1935, Washington Acad. Sci. Jour., v. 25, no. 12, p. 525. Overlies Squaw Bay limestone (new) of Traverse group.

W. A. Kelly and G. W. Smith, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 3, p. 460. In Afton-Onaway area, overlies Beebe School formation (new) of Traverse group.

G. V. Cohee, 1951, U.S. Geol. Survey Oil and Gas Inv. Chart OC–41, sheet 5. Consists of dark-gray to black hard thin-bedded brittle carbonaceous shale interbedded with some gray shale in lower part; contains some brown argillaceous limestone and dolomite. In eastern Michigan, thickens northward from 130 feet in Washtenaw County to 500 feet in Montmorency County; in western Michigan, underlies Bedford shale; in western Michigan, grades laterally into Ellsworth shale. Upper Devonian and Lower Mississippian.

Named for Antrim County in which shales are exposed.

Anvil 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, 505.

N. K. Huber, 1959, Econ. Geology, v. 54, no. 1, p. 104 (table 10), 106 (table 11), 107 (fig. 6). Overlies Pence member; underlies Pabst member of Tyler formation. Thicknesses (taken from drill holes) 22½ and 53 feet.

Named for Anvil mine east of Bessemer, Gogebic County, Mich.

Anvil Points Member (of Green River Formation)

Eocene: Northwestern Colorado.

J. R. Donnell, 1953, Rocky Mountain Assoc. Geologists Guidebook Field Conf. May 14–16, chart facing p. 17. Consists of low-grade marlstone, thin-bedded shales, and sandstones alternating with gray and brown shales. Algal bed in lower part. Thickness about 1,500 feet. Underlies Parachute Creek member; overlies Wasatch formation.

Exposed between Rifle and De Beque Canyon.

Anvil Rock Sandstone Member (of Lisman Formation)

Anvil Rock Sandstone Member (of Carbondale Formation)

Anvil Rock Sandstone Member (of McLeansboro Formation)[1]

Pennsylvanian: Western Kentucky and southeastern Illinois.

Original reference: D. D. Owen, 1856, Kentucky Geol. Survey, v. 1, p. 45, plate showing section of Lower Coal Measures.

E. J. Harvey, 1956, U.S. Geol. Survey Water-Supply Paper 1356, p. 64, 65–68. Reallocated to Lisman formation. In Henderson [Kentucky] area, underlies Madisonville limestone member; overlies No. 12 coal. In some localities, forms base of formation where No. 12 coal and Providence limestone member have been eroded.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 34, 48 (table 1), 54 (table 3). Member of Carbondale formation. In sequence listed, overlies Conant limestone member (new) and underlies Bankston Fork limestone member.

Named from bluff known as Anvil Rock [southwest of Henshaw near Ohio River] in Union County, Ky.

Anvil Spring Formation

Lower Permian: Southeastern California.

B. K. Johnson, 1957, California Univ., Pubs. Geol. Sci., v. 30, no. 5, p. 382–384, figs. 1, 3. Proposed to include carbonate rocks of Permian age in Manly Peak quadrangle and adjacent Wingate Wash quadrangle to east. Consists of light-gray to white limestones alternating with dark-gray limestones in beds a few feet thick; cherty beds and nodules in middle of section; shales and argillaceous limestones near top; fossiliferous. In Manly Peak quadrangle, has exposed thickness of about 3,600 feet and is divisible into two parts: lower, exposed at Striped Butte, is more than 2,200 feet; upper part, near western edge of area, about 1,400 feet. C. Wrucke, who is credited with name, measured thickness of 4,100 feet in Warm Spring Canyon where he subdivided formation into five members. Base not exposed in Manly Peak quadrangle. In fault contact with Precambrian east of quadrangle. Near Warm Spring, the Permian passes under Tertiary volcanic rocks; unconformably underlies Triassic andesite flows at east edge of quadrangle.

Named from Anvil Spring in Butte Valley, Manly Peak quadrangle, southern Panamint Range, Inyo County.

Anzar phase (of Santa Lucia Series)[1]

Paleozoic(?): Southern California.

Original reference: P. F. Kerr and H. G. Schenck, 1925, Geol. Soc. America Bull., v. 36, p. 470, 471, map.

San Benito County.

Apache 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 basalt rim on north side of Apache Canyon, eastern Union County.

Apache Formation

Miocene, upper: Southern California.

T. W. Dibblee, Jr., *in* Chester Stock, 1948, Southern California Acad. Sci. Bull., v. 46, pt. 2, p. 84. Buff-red sand, pebbly sand, and gypsiferous clays. Continental. Equivalent to Santa Margarita formation to west.

M. L. Hill, S. A. Carlson, and T. W. Dibblee, Jr., 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 12, p. 2999. Preoccupied name Apache replaced by Quatal formation.

Occurs in Apache Canyon, Ventura County, sec. 2, T. 8 N., R. 23 W., Mount Pinos quadrangle.

Apache Group[1]

Precambrian: Central Arizona.

Original reference: F. L. Ransome, 1903, U.S. Geol. Survey Prof. Paper 13.

N. E. A. Hinds, 1936, Carnegie Inst. Washington Pub. 463, p. 29–34. At and near Roosevelt Dam, comprises (ascending) Scanlan conglomerate, Pioneer shale, Barnes conglomerate, Dripping Springs quartzite, Mescal limestone, unnamed basalt, and Roosevelt member (new). Underlies Troy quartzite.

N. P. Peterson, 1938, Arizona Bur. Mines Bull. 144, Geol. Ser. 11, p. 8–9. In Mammoth mining area, Pinal County, Apache series (group) unconformably overlies Oracle granite (new).

E. D. Wilson, 1939, Geol. Soc. America Bull., v. 50, no. 7, p. 1113–1164. Group unconformably overlaps Yavapai group, Mazatzal quartzite, and granite in eastern Tonto basin area and the granite at southeastern end of Mazatzal Range. Does not appear farther northwest in central Arizona areas. Apache strata are younger Precambrian and are separated by unconformity from older Precambrian rocks. Discussion of Mazatzal revolution.

J. R. Cooper, 1950, Arizona Bur. Mines Bull. 156, Geol. Ser. 18, p. 31, 32 (fig. 13). In Johnson Camp area, Cochise County, comprises (ascending) Scanlan conglomerate, Pioneer shale, Barnes conglomerate, and Dripping Spring quartzite. Overlies Pinal schist, angular unconformity; underlies Bolsa quartzite, angular discordance not apparent in outcrops but regional relations indicate discordance of more than 2° in some parts of mountains.

N. P. Peterson, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–41. In Globe quadrangle, group comprises (ascending) Scanlon conglomerate, Pioneer formation, Barnes conglomerate, and unnamed basalt. Underlies Troy quartzite; overlies Pinal schist. Late Precambrian.

D. W. Peterson, 1960, U.S. Geol. Survey Geol. Quad. Map GQ–128. In Haunted Canyon quadrangle, comprises (ascending) Scanlan conglomerate, 6 inches to 12 feet thick; Pioneer formation, 300 to 450 feet; Barnes conglomerate, 6 inches to 30 feet; Dripping Spring quartzite, 350 to 500 feet; Mescal limestone, 250 feet; unnamed basalt, remnants of which may reach about 120 feet. Unconformably overlies Ruin conglomerate; disconformably underlies Troy quartzite. Upper Precambrian.

Named for exposures on west face of Apache Mountains.

Apache Limestone[1]

Permian: Western Texas.

Original reference: K. H. Crandall, 1929, Am. Assoc. Petroleum Geologists Bull., v. 13, p. 929, 939–940.

In Apache Mountains, southeastern Culberson County.

†Apache Sandstone[1]

Upper Cambrian: Arizona.

Original reference: D. Hager, 1924, Mining and Oil Bull., v. 10, p. 137.

Grand Canyon.

Apache Sandstone[1]

Upper Cretaceous: Eastern Colorado.

Original reference: C. S. Lavington, 1933, Am. Assoc. Petroleum Geologists Bull., v. 17, no. 4, p. 399.

J. M. Mitchell, John Greene, and D. B. Gould, 1956, *in* Rocky Mountain Assoc. Geologists Guidebook to the geology of the Raton Basin, Colorado, p. 131. Listed in catalog of stratigraphic names as Apache Creek sandstone member of Pierre shale.

In Walsenburg district.

Apache Creek Sandstone Member (of Pierre Shale)

Upper Cretaceous: Eastern Colorado.

See Apache Sandstone, Upper Cretaceous.

†Apalachicola Group[1]

Miocene, lower and middle: Northern Florida and southern Georgia.

Original reference: G. C. Matson and F. G. Clapp, 1909, Florida Geol. Survey 2d Ann. Rept., p. 67–69, table opposite p. 50.

Named for exposures along Apalachicola River in western Florida.

Apex Formation

Permian (Wolfcamp): Southern Nevada.

J. E. Welsh, 1960, Dissert. Abs., v. 20, no. 8, p. 3263. Limestones, sandstones, and siltstones which occur in basin facies northwest of structural lineament here designated Las Vegas hinge line. Contains fusulinids of early, middle, and late Wolfcampian.

Type locality and derivation of name not stated. Report discusses biostratigraphy of Pennsylvanian and Permian systems in southern Nevada.

Apex Till

Pleistocene: Southwestern Montana.

W. B. Hall, 1960, Billings Geol. Soc. [Guidebook] 11th Ann. Field Conf., p. 197–199. Till deposited during Marble Point stage (new). Thickness more than 100 feet in places. Average elevation of till 9,000 feet. Near Apex Point, till rests on steeply dipping Cretaceous volcanic shales and bentonites. In some areas, rests on welded tuffs of Pliocene(?) age. Episode represented by Marble Point and Apex tills is probably either early Wisconsin in age or slightly older.

Named for exposures at Apex Point, secs. 27 and 34, T. 9 S., R. 3 E., Gallatin County. Summits appear, but are unnamed, on U.S. Geological Survey Sphinx Mountain quadrangle topographic map. Summit labeled "Apex Point," 2 miles to south, and appearing on Hebgen Dam quadrangle, seems to be an error.

Apishapa Shale (in Colorado Group)[1]

Apishapa Shale Member (of Niobrara Formation)

Upper Cretaceous: Eastern Colorado.

Original reference: G. K. Gilbert, 1896, U.S. Geol. Survey 17th Ann. Rept., pt. 2, p. 567.

W. A. Cobban and J. B. Reeside, Jr., 1952, Geol. Soc. America Bull., v. 63, no. 10, chart 10b (col. 48). Shown on correlation chart as member of Niobrara formation. Overlies Timpas limestone member.

K. M. Waage, 1952, Colorado Sci. Soc. Proc., v. 15, no. 9, p. 375 (fig. 1). Thickness 400 feet in Denver-Golden area. Overlies Timpas limestone; underlies Pierre shale.

M. A. Jenkins, Jr., 1957, Rocky Mountain Assoc. Geologists Guidebook to the geology of North and Middle Park Basins, Colorado, p. 53. Believed that names Fort Hays and Smoky Hill have priority over terms Timpas and Apishapa; if used, would help standardize Niobrara terminology in west-central Colorado.

Named for Apishapa River.

Apison Shale[1] Member (of Rome Formation)

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

Original reference: C. W. Hayes, 1894, U.S. Geol. Survey Geol. Atlas, Folio 2; Folio 4.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 1, pl. 12; pt. 2, p. 44. Variegated shale. Mapped as a basal member of Rome. Underlies an unnamed sandstone-bearing member of Rome.

Named for exposures at Apison, James [now Hamilton] County, Tenn.

Aplington Formation

Lower Mississippian: Northern Iowa.

M. A. Stainbrook, 1950, Jour. Paleontology, v. 24, no. 3, p. 365–385. Dominantly dolomite with subordinate amount of shale and limestone at base. Thickness 25 to 30 feet. Beds formerly included in Sheffield shale. Underlies Chapin limestone; overlies Sheffield shale.

Type section: About one-half mile directly north of Aplington, Butler County, on west side of road. Formation crops out in narrow belt extending from south line of Cerro Gordo County to southwest corner of Butler County.

Apodaca Formation (in Green Canyon Group)

Pennsylvanian (Derry Series): Central New Mexico.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 27 (table 2), 31 (fig. 2), 32, 34, 36. Name applied to top formation of Green Canyon group. Consists of dense gray limestone with masses and lenses of chert, nodular limestone, calcareous shales, black to dark-gray calcareous siltstones, and greenish- to bluish-gray shales. Thickness increases from about 55 feet at type locality to over 150 feet in southern part of state where formation consists of essentially pure limestone. Underlies Hot Springs formation (new); overlies the Arrey formation (new).

M. L. Thompson, 1948, Kansas Univ. Paleont. Contr. 4, Protozoa, art. 1. p. 73 (fig. 8), 74. Underlies Fra Cristobal formation. Name replaces preoccupied Hot Springs formation.

Type section: Eight-tenths of a mile east of Derry, sec. 32, T. 17 S., R. 4 W., Sierra County. Named for Apodaca Creek, a west tributary of Rio Grande.

†Appalachian Group,[1] Series,[1] or System[1]

Paleozoic: Pennsylvania.

Original reference: H. D. Rogers, 1836. Pennsylvania Geol. Survey 1st Ann. Rept., p. 12–22.

†Appanoose Beds or Group

Pennsylvanian (Des Moines Series): South-central Iowa.

Original reference: H. F. Bain, 1896, Iowa Geol. Survey, v. 5, p. 378–394.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 31). Shown on Pennsylvanian correlation chart as a group comprising strata from unconformity below Mulky coal to base of Pleasanton [shale].

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2027–2028. Apparently abandoned in favor of Marmaton group. Appanoose includes some upper Cherokee strata and corresponds to Henrietta group as treated by Cline (1939) and redefined by McQueen (1943).

Named for development in Appanoose County.

Appekunny Argillite[1] } (in Ravalli Group)
Appekunny Formation }

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

Original reference: Bailey Willis, 1902, Geol. Soc. America Bull., v. 13, p. 316, 322.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc. America Bull., v. 48, no. 12, p. 1885–1887. Redefined to exclude Rising Wolf member which is placed in Grinnell formation. As redefined, formation includes following members (ascending): Singleshot, Appistoki, and Scenic Point (new). Consists of argillite interbedded with quartzite, conglomerate, and minor beds of argillaceous limestone; prevailingly green, greenish-gray to brownish, with some dull-red, white, and purplish beds; thin-bedded, with fine laminae; massive only in quartz conglomerates and quartzites; grades into adjacent formation. Thickness in east 2,500 to 5,300 feet; in west as much as 10,000 feet. Underlies Grinnell formation; overlies Altyn formation.

C. P. Ross, 1949, (abs.) Washington Acad. Sci. Jour., v. 39, no. 3, p. 112. Appekunny argillite included in Ravalli group.

C. P. Ross, 1959, U.S. Geol. Survey Prof. Paper 296, p. 21–27, pls. 1, 2. Middle formation of Ravalli group. Overlies Altyn limestone; underlies Grinnell argillite. Thickness 2,000 to 5,000 feet. Formation as whole consists of dark fine-grained sedimentary rock sufficiently uniform in character so that Willis gave it name of argillite. Lithologic variations exist in both Appekunny and overlying Grinnell to give support to the Fentons (1937) referring to units rather than argillites. The Fentons' members are discussed, but formation is not subdivided in present report. Tentatively concludes that rocks mapped during present investigation as belonging to Appekunny argillite correspond essentially to Appistoki member of the Fentons. On this basis, most of the Fentons' Scenic Point member may have been mapped with Grinnell, and their Singleshot member probably is not exposed in areas mapped for this report.

Excellent exposures occur on northeast spur of Appekunny Mountain, Glacier National Park, Mont. Forms irregular band in northeastern part of park just west of exposures of Altyn limestone that are associated with Lewis overthrust. Another band extends from Canadian border southeastward in western part of park until it joins band in northeastern part of park. Also exposed near Waterton Lake.

Appistoki Member (of Appekunny Argillite[1] or Formation)

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

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. 1886. Gray, green, olive-brown, and rusty-gray argillites in thin minor, but thick major, beds interbedded with thickly stratified greenish, white, or pink quartzites. Member intergrades with other members, yet preserves fairly well-marked limits. Thickness in Lewis Range 2,000 to 2,200 feet. Underlies Scenic Point member (new); overlies Singleshot member. Type locality designated.

C. P. Ross, 1959, U.S. Geol. Survey Prof. Paper 296, p. 21–27. Rocks mapped in present investigation as belonging to Appekunny argillite may correspond essentially to Appistoki member of Fenton and Fenton (1937).

Type locality: Appistoki Peak, near Two Medicine Lake, Glacier National Park, Mont.

Applegate Group

Applegate Series

Upper Triassic(?): Southwestern Oregon and northwestern California.

F. W. Libbey and others, 1942, Oregon Dept. Geology and Mineral Industries Bull. 17, p. 21. Mentioned as Applegate series. Names credited to F. G. Wells and P. E. Hotz.

F. G. Wells, P. E. Hotz, and F. W. Cater, Jr., 1949, Oregon Dept. Geology and Mineral Industries Bull. 40, p. 3–4. Assemblage of metamorphosed volcanic rocks with lens-shaped interbeds of quartzite, conglomerate, and marble. Thickness unknown but is probably to be measured in miles, although its apparent thickness may be exaggerated by faulting and closefolding. Underlies Upper Jurassic Galice formation with angular unconformity; no rocks that are known to be older than Applegate group are exposed in Kerby quadrangle, hence basement on which Applegate group accumulated is unknown. Derivation of name given.

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

F. G. Wells, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–89. Mapped in Medford quadrangle, Oregon-California. Upper Triassic(?).

Named after drainage basin of Applegate River [Kerby quadrangle, Oregon] where group is prevailing country rock.

Appleton Stage[1]

Pennsylvanian: Western Arkansas and central eastern Oklahoma.

Original reference: A. Winslow, 1896, New York Acad. Sci. Trans., v. 15, p. 51–52.

Probably named for Appleton, Pope County, Ark.

†Appomattox Formation[1]

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

Original reference: W. J. McGee, 1888, Am. Jour. Sci., 3d, v. 35, p. 125, 328–330.

Typically exposed on and near Appomattox River from its mouth to some miles west of Petersburg, Dinwiddie County, Va.

Apulia Member (of Tully Formation)

Apulia Shale[1] or Limestone[1]

Devonian: New York.

Original reference: T. A. Conrad, 1841, New York Geol. Survey 5th Ann. Rept., p. 31.

G. A. Cooper and J. S. Williams, 1935, Geol. Soc. America Bull., v. 46, p. 790–808. Member of Tully formation. Overlies Tinkers Falls member (new); overlies West Brook member (new). Type section designated.

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 Tully clastic facies, Apulia is represented by Laurens member.

Type section: In ravine adjacent to June's quarry, 1½ miles southwest of Apulia Station, Tully Township.

Aquaqua Formation

See Aguagua [Formation in Tapaliza Group or Member of Tapaliza Formation].

Aquashicola Formation[1]

Silurian: Northeastern Pennsylvania.

Original reference: B. L. Miller, 1911, Pennsylvania Topog. and Geol. Survey Rept. 4, p. 51.

Named for occurrence in valley of Aquashicola Creek.

Aqua Torres Formation

Permian: Southwestern New Mexico.

J. T. Stark and E. C. Dapples, 1946, Geol. Soc. America Bull., v. 57, no. 12, pt. 1. p. 1154–1155, 1171, pls. 1, 7. Consists of a thin basal conglomerate, a sequence of arkoses, red sandstones, red shales, nodular limestones, and at top gray massive limestone. Thickness about 80 feet. Underlies Abo formation; overlies Pennsylvanian rocks of Virgil age.

R. L. Bates, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 6, p. 1043, 1044. Suggested as being synonymous with Bursum formation and Red Tanks member of Madera limestone.

Exposed in the Arroyo Aqua Torres in southeast portion of mountains and also along Highway 60 east of the thrust faults.

Aquetuck lithofacies (of Leeds facies of Schoharie Formation)

[Devonian]: Eastern New York.

J. H. Johnsen, 1957, Dissert. Abs., v. 17, no. 10, p. 2247. Lower part of Leeds facies, upper part termed Saugerties lithofacies; composed of calcareous mudstone and calcareous siltstone with minor argillaceous limestone and calcareous sandy mudstone. Carries many chert nodules in upper mid-Hudson Valley; chert diminishes rapidly southward. Lower beds intertongue with upper Carlisle Center beds in parts of mid-Hudson Valley.

Type area not stated. Town of Aquetuck is in Albany County.

Aquia Formation[1] **or Greensand** (in Pamunkey Group)

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

Original reference: W. B. Clark and G. C. Martin, 1901, Maryland Geol. Survey, Eocene volume, p. 58.

R. R. Bennett and G. G. Collins, 1952, Washington Acad. Sci. Jour., v. 42, no. 4, p. 114–116. Overlies Brightseat formation (new).

C. W. Cooke, 1952, Maryland Dept. Geology, Mines and Water Resources Bull. 10, p. 22–23. In Prince Georges County, Md., name Aquia greensand is applied to Eocene deposits that intervene between Paleocene Brightseat formation and Nanjemoy formation. Term is equivalent to Aquia formation of Clark and Martin (1901). More specific term greensand is preferred to formation in this region because glauconite is dominant mineral and occurs throughout formation. Estimated thickness 100 feet. Aquia rests unconformably on Brightseat formation or overlaps on older formations.

A. R. Loeblich, Jr., and Helen Tappan, 1957, U.S. Natl. Mus. Bull. 215, p. 177 (fig. 28). Shown on correlation chart as Paleocene.

D. J. Cederstrom, 1957, U.S. Geol. Survey Water-Supply Paper 1361, p. 24, 25–26, pl. 2. Described in York-James Peninsula, Va., where it is exposed at surface near Richmond. Maximum thickness about 125 feet. No unconformity with underlying Mattaponi formation (new) in subsurface. Underlies Nanjemoy formation.

Type locality: Aquia Creek, Stafford County, Va.

†Aquia Creek Series[1]

Lower Cretaceous: Northeastern Virginia.

Original reference: L. F. Ward, 1895, U.S. Geol. Survey 15th Ann. Rept., p. 326.

Typically developed within vicinity of Aquia Creek, Stafford County.

†Aquia Creek Stage[1]

Eocene: Eastern Virginia and Maryland.

Original reference: W. B. Clark, 1895, Johns Hopkins Univ. Circ., v. 15, no. 121, p. 3.

Named for Aquia Creek, Va.

†Aquidneck Series or Shales[1]

Carboniferous: Southeastern Rhode Island and southeastern Massachusetts.

Original reference: A. F. Foerste, 1899, U.S. Geol. Survey Mon. 33, p. 348–364, pl. 31, map.

Forms almost whole of Aquidneck Island, near Newport, Newport County, R.I.

Aquinnah Conglomerate[1]

Pleistocene: Southeastern Massachusetts.

Original reference: J. B. Woodworth and E. Wigglesworth, 1934, Harvard Coll. Mus. Comp. Zool. Mem., v. 52, p. 160.

R. F. Flint, 1948, Geol. Soc. America Bull., v. 59, no. 6, p. 543. Discussion of beginning of Pleistocene in eastern United States. Inland along Coastal Plain, not only in South Atlantic States but occurring discontinuously from Cape Cod district to lower Mississippi River, are extensive areas of highly quartzose gravel and sand (and along Gulf Coast, silt and clay). These sediments, on Atlantic Coast at least, indicate selective weathering and deposition by streams. They have not been studied as a whole, but throughout long distances they appear to have same general character. They are known under various regional or local names, such as Citronelle formation, Bryn Mawr gravel, Beacon Hill gravel, Manetto gravel, and Aquinnah conglomerate.

Known to occur only at Gay Head Cliffs fold on Marthas Vineyard. Aquinnah is Indian name for Gay Head.

Arago Group[1] **or Formation**

Arago Series

Eocene: Southwestern Oregon.

Original reference: J. S. Diller, 1896, U.S. Geol. Survey 17th Ann. Rept., pt. 1, p. 458–462, 475.

W. H. Twenhofel, 1943, Oregon Dept. Geology and Mineral Industries Bull. 24, p. 3. Referred to as Arago series. Comprises Coaledo formation (above) and Pulaski formation. Unconformably underlies Miocene Empire formation; unconformably overlies Cretaceous Myrtle formation.

C. E. Weaver and others, 1944, Geol. Soc. America Bull., v. 55, no. 5, p. 589–590, chart 11. Formation originally named and described by Diller was later divided into lower, or Pulaski formation, and upper, or Coaledo formation, for purpose of distinguishing coal-bearing beds from noncoal-bearing beds. Arago formation used in original sense of Diller is 8,400 feet thick and consists of alternating members of brownish-gray sandy clay shales, medium- and coarse-grained sandstones, shaly sandstones, and occasional layers of conglomerate.

C. E. Weaver, 1945, Washington [State] Univ. Pubs. in Geology, v. 6, no. 2, p. 31–46, pls. 2, 3, 4, 5, 10. Redescribed in Coos Bay area as formation. Divided into three unnamed members. Total thickness 8,370 feet; base not exposed. Consists of shale and sandstone. Underlies Bassendorf formation.

F. G. Wells, P. E. Hotz, and F. W. Cater, Jr., 1949, Oregon Dept. Geology and Mineral Industries Bull. 40, p. 16. Prong of Arago group extends southward into southwestern corner of Kerby quadrangle, where it is exposed for 5 miles along east side of canyon of Illinois River. Beds in this area are referred to as Arago formation because here they cannot be identified with subdivisions of group. Formation is assemblage of lenticular bodies of sandstone and conglomerate in nearly equal amounts with thin interbeds of shale. Characterized by poor sorting, crossbedding, and abrupt lateral and vertical variations. Maximum thickness 500 feet, on ridge south of Indigo Creek; thins rapidly toward east, wedging out completely in less than one-half mile; thins southward to about 250 feet near mouth of Silver Creek. Overlaps Dothan formation.

Well exposed at Cape Arago, Coos Bay quadrangle.

Arakabesan Member (of Ngeremlengui Formation)

Eocene, upper, or Oligocene: Caroline Islands (Palau).

U.S. Army Corps of Engineers 1956, Military geology of Palau Islands, Caroline Islands: U.S. Corps of Engineers, Far East, p. 48–49, pl. 8. Volcanic breccia, volcanic conglomerate, and tuff, with related dikes, sills, and flows. Maximum thickness 4,000 feet or more in Ngardmau area; about 3,000 feet on Arakabesan Island; on north end of Arekalong Peninsula may be as much as 2,000 feet. Uppermost member of formation; overlies Medorm member (new).

Type section: On Arakabesan Island. Extends as broken strip along west coast of Babelthuap Island from village of Ngardmau on Ngardmau Bay south-southwest nearly to village of Medorm. Present on north end of Arekalong Peninsula and on the two islands just north. Composes Malakal Island.

Arapaho Glacial Stage

Pleistocene (middle Wisconsin): North-central Colorado.

R. L. Ives, 1937, (abs.) Colorado Univ. Studies, v. 25, no. 1, p. 75; 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1059–1060. Covers interval between River and Monarch glacial stages (both new).

Area: Monarch Valley, in Grand County.

Arapahoe Formation[1]

Arapahoe Conglomerate Member (of Laramie Formation)

Upper Cretaceous: Eastern Colorado.

Original reference: G. H. Eldridge, 1888, Colorado Sci. Soc. Proc., v. 3, pt. 1, p. 97.

C. H. Dane and W. G. Pierce, 1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 10, p. 1309–1312, 1320. Dawson arkose merges northward into Arapahoe and Denver formations along foothills of Front Range. Dawson and Arapahoe along this belt overlie, with erosional irregularity, Laramie formation.

R. W. Brown, 1943, Geol. Soc. America Bull., v. 54, no. 1, p. 65–86. Discussion of Cretaceous-Tertiary boundary in Denver basin, Colorado. Stratigraphic and paleontologic evidence shows that Laramie formation, Arapahoe formation, and Cretaceous parts of Denver formation and Dawson arkose comprise a unit correlative with Lance formation and its equivalents. Proposed that Laramie be redefined to include all Upper Cretaceous sequence between top of Fox Hills and base of Paleocene and that term Arapahoe as Arapahoe conglomerate member of Laramie be retained for conglomerate immediately overlying present Laramie formation.

S. O. Reichert, 1956, Geol. Soc. America Bull., v. 67, no. 1, p. 107–112. Discussion of post-Laramie stratigraphic correlations in Denver basin. Proposed that (1) Laramie-Arapahoe contact remain as originally defined by Emmons, Cross, and Eldridge (1896, U.S. Geol. Survey Mon. 27); and (2) Arapahoe-Denver contact be placed at widespread erosional disconformity at base of lowest, thickest, and most prominent basalt-andesite pebble conglomerate bed in Denver area, instead of at first appearance of andesitic debris as proposed by Emmons, Cross, and Eldridge (1896). Arapahoe and Denver formations can be mapped throughout Denver basin, and these names should replace term "lower Dawson" of Dane and Pierce (1936).

Named for development in Arapahoe County.

Arapien Shale

Upper Jurassic: Central Utah.

S. L. Schoff, 1938, Ohio State Univ. Abs. Doctors' Dissert. 25, p. 377–378. Consists of drab calcareous shale with red patches and intercalated limestone, gypsum, and salt. Highly folded; thickness uncertain, probably between 4,000 and 11,000 feet. Underlies Indianola group (new).

E. M. Spieker, 1946, U.S. Geol. Survey Prof. Paper 205-D, p. 122, 123-125. Subdivided into Twist Gulch member above and Twelvemile Canyon member (both new). Underlies Morrison(?) formation. Type area designated.

C. T. Hardy, 1952, Utah Geol. and Mineralog. Survey Bull. 43, p. 1, 11-13, 14-22. Restricted to include only Twelvemile Canyon member. As restricted, thickness 3,000 feet.

Type area: Arapien Valley, which lies parallel to base of Wasatch Plateau about 6 miles southeast of Gunnison. Formation is typically, if not completely exposed, on west side of valley.

Arbuckle Limestone[1] or Group[1]

Upper Cambrian and Lower Ordovician: 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. Rank raised to group. Subdivided into (ascending) Fort Sill limestone, Royer marble (dolomite), Signal Mountain limestone, Chapman Ranch dolomite, McKenzie Hill limestone (new), Wolf Creek dolomite (new), Cool Creek limestone, Alden limestone (new), and West Spring Creek formation. Thickness about 9,000 feet. Underlies Simpson group; overlies Timbered Hills group (new).

C. E. Decker, 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1311-1321; 1939, Oklahoma Geol. Survey Circ. 22, p. 15, 16 (table 1), 20-23. Divided into nine formations, four of which are Upper Cambrian and five Lower Ordovician. Upper Cambrian formations (ascending): Fort Sill, Royer dolomite, Signal Mountain, and Butterly dolomite (substituted for Chapman Ranch as name for the upper dolomite, and Chapman Ranch placed as basal member of McKenzie Hill formation). Lower Ordovician formations (ascending): McKenzie Hill, Strange dolomite (replaces preoccupied Wolf Creek formation), Cool Creek, Kindblade (replaces preoccupied Alden), and West Spring Creek.

W. E. Ham, 1949, Oklahoma Geol. Survey Circ. 26, p. 19. Restricted to exclude four Cambrian formations which are included in newly defined Blue Creek Canyon group. This classification credited to E. A. Frederickson (unpub. thesis).

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped in eight formations. This subdivision follows Decker (1939) with exception that Strange formation is omitted.

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

Arcadia Clays (in Claiborne Group)[1]

Eocene, middle: Louisiana, Arkansas, Mississippi, and Texas.

Original reference: O. Lerch, 1893, Louisiana Geol. Survey, pt. 2, p. 85.

Named for Arcadia, Bienville County, La.

†Arcadia Marl[1]

Pliocene, lower: Southern Florida.

Original reference: W. H. Dall, 1892, U.S. Geol. Survey Bull. 84, p. 131-132, 157, 320.

Named for exposures near Arcadia, De Soto County, on Mare Branch, a tributary of Peace River, about 6 miles north of Arcadia.

Arcadia Member (of Trempealeau Formation)

Upper Cambrian (Croixan): Eastern Minnesota and western Wisconsin.

G. O. Raasch, 1952, Illinois Acad. Sci. Trans., v. 44, p. 147. Consists of 3-foot basal bed of edgewise conglomerate, flat pebbles of buff siltstone in a greensand matrix, that grades upward into lenticular strata of varied lithology, dominantly dolomitic siltstone. Thickness about 20 feet. Underlies St. Lawrence member; unconformably overlies Bad Axe member, Franconia sandstone.

C. A. Nelson, 1956, Geol. Soc. America Bull., v. 67, no. 2, p. 174–175. In basinward exposures, strata of Lodi member of St. Lawrence vertically succeed Black Earth dolomite member. Elsewhere Lodi occurs beneath Black Earth member as well as above it. At Arcadia, these strata beneath the dolomite are regarded by Raasch (1952) as type Arcadia member of Trempealeau. Except for content of *Osceolia* fauna, on which basis they were designated Arcadia member, these beds do not differ from strata above the dolomite.

Type locality: In roadcut and small quarry on State Highway 93, 1 mile east of Arcadia, Trempealeau County, Wis. Continuously extensive north of Black River valley in Wisconsin and Minnesota.

Arcadian Amygdaloid[1] (in Central Mine Group)

Precambrian (Keweenawan): Northern Michigan.

Original reference: L. L. Hubbard, 1898, Michigan Geol. Survey, v. 6, pt. 2, p. 78, 131, 132, 133, pl. 10.

Named for occurrence at Arcadian mine, Houghton County.

Arcadian Flow[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Named for occurrence at Arcadian mine, Houghton County.

Arcadia Park Formation[1] (in Eagle Ford Group)

Upper Cretaceous (Gulf Series): 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. 192–220. Discussion of paleontology of Eagle Ford group which comprises (ascending) Tarrant, Britton, and Arcadia Park formations.

W. L. Turner, 1951, Field and Laboratory, v. 19, no. 2, p. 51–65. Discussion of geology of Eagle Ford quadrangle, which contains type locality of Eagle Ford formation as well as Moreman's (*in* Adkins, 1932 [1933]) Arcadia Park formation. Moreman's classification of rocks exposed in Eagle Ford quadrangle not applicable for purposes of this study. Eagle Ford formation subdivided into three unnamed lithologic units.

Type locality: Arcadia Park Station, 7 miles west of Dallas, Dallas County.

Arcente Member (of Lake Valley Formation)

Mississippian (Osage): Southern New Mexico.

L. R. Laudon and A. L. Bowsher, 1941, (abs.) Tulsa Geol. Soc. Digest, v. 9, p. 73–75; 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 12, p. 2116, 2120 (fig. 7). Consists of thin evenly bedded gray relatively unfossiliferous shaly siltstone. Basal part over 50 percent shale; upper part slightly thicker bedded and less shaly. Thickness about 230 feet. Underlies Dona Ana member (new); overlies Alamogordo member (new).

L. R. Laudon and A. L. Bowsher, 1949, Geol. Soc. America Bull., v. 60, no. 1, p. 11 (fig. 4), 15. Overlies Tierra Blanca member (new). Thickness 230 feet in Sacramento Mountains; generally less than 25 feet in San Andres Mountains. Not present in Mimbres Range, Cooks Mountains, and Silver City area.

Type area: Deadman Canyon, sec. 3, T. 17 S., R. 10 E., near Alamogordo. Named for Arcente Canyon which traverses northern end of main anticlinal structure in which Lake Valley beds are exposed.

Arch Marble or Formation (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. Named in sequence of units mapped in James River synclinorium. Younger than Joshua schist (new) and older than Pelier schist (new).

W. R. Brown, 1953, Kentucky Geol. Survey, ser. 9, Spec. Pub. 1, p. 91 (fig. 1), 93. Fine-grained blue-gray micaceous marble, locally arenaceous. Thickness about 400 feet. Included in Evington group (new). Type locality designated.

G. H. Espenshade, 1954, U.S. Geol. Survey Bull. 1008, p. 16–17. Archer Creek formation (new) includes Arch marble and Joshua schist of Brown (1951, 1953).

W. R. Brown, 1958, Virginia Div. Mineral Resources Bull. 74, p. 8 (fig. 2). Age shown on columnar section as Lower Paleozoic(?).

Type locality: Vicinity of The Arch on Norfolk and Western Railroad, 1 mile east of Six Mile Station, Campbell County.

†Archer Beds[1]

Pliocene, lower: Northeastern Florida.

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

Named for exposures at Archer, Alachua County.

Archer Creek Formation (in Evington Group)

Paleozoic(?): South-central Virginia.

G. H. Espenshade, 1954, U.S. Geol. Survey Bull. 1008, p. 15 (table 1), 16–17. Green to blue-gray siliceous graphitic schist member, as much as 500 feet thick, forms lower part of formation; bluish fine- to medium-grained marble member, as much as 400 feet thick, lies in upper part of formation and is interbedded with graphitic schist member. Marble commonly forms valleys. Includes Joshua schist and Arch marble of Brown (1951, 1953). Underlies Mount Athos formation; overlies Candler formation.

Named for exposures along Archer Creek about 1½ miles above its confluence with James River. Exposed extensively along James River valley to southwest of Allen Creek, in neighborhood of Jack Mountain and Chestnut Mountain, and southeast of Evington [Campbell County].

Arch Point Basalt

Quaternary: Alaska.

G. C. Kennedy and H. H. Waldron, 1947, U.S. Geol. Survey Alaska Volcano Inv. Rept. 2, pt. 2, p. 13, pl. 2; 1955, U.S. Geol. Survey Bull. 1028–A, p. 8–9, pl. 3. One of three extensive lava-flow units filling old canyons and gullies carved in Belkofski tuff (new) and intrusive diorite stocks. Consists of thick lava beds that crop out south of known exposures of Black Point basalt (new). Overlain by Dushkin basalt (new). Sources of flows not exposed.

Well exposed on Arch Point south of Dushkin Lagoon, vicinity of Pavlof Volcano, Alaska Peninsula.

Arch Rock Granite

[Cretaceous]: Eastern California.

J. F. Evernden, G. H. Curtis, and J. Lipson, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 9, p. 2123 (fig. 1). Shown on map in paper dealing with potassium-argon dating of igneous rocks. Age shown on map legend as 95.3 millions of years. Oldest rock dated; older than Gateway granodiorite. [Calkins (1930, U.S. Geol. Survey Prof. Paper 160) referred to biotite granite of Arch Rock. Compiler was unable to locate reference to Arch Rock granite.]

Occurs in Yosemite National Park.

Archuleta shale[1]

Upper Cretaceous: Northwestern New Mexico.

Original references: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 260; 1915, Conspectus of geologic formations of New Mexico, p. 2, 5.

In San Juan region. Derivation of name not stated.

Archusa Marl Member (of Cook Mountain Formation)

Archusa Marl Member (of Wautubbee Formation)

Eocene: Eastern Mississippi.

E. P. Thomas, 1942, Mississippi Geol. Survey Bull, 48, p. 49–52. Defined as basal member of Wautubbee formation in eastern Mississippi. Interbedded marls and limestones. Thickness 45 to 60 feet; 48 feet at type locality; neither contact exposed. Underlies Potterchitto member (new), and where exposed contact is conformable and gradational; overlies Kosciusko formation, and where exposed contact is disconformable and sharply defined.

F. S. MacNeil, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 29. Assigned to Cook Mountain formation. Underlies Potterchitto sand member; overlies Sparta sand. Mississippi Geological Survey uses Wautubbee formation instead of Cook Mountain formation.

Type locality: Bluff beneath south end of bridge across Chickasawhay River on U.S. Highway 45, 2 miles south of Quitman, Clarke County. Named for Archusa Springs, a health resort.

Arcola Limestone Member (of Mooreville Chalk)

Arcola Limestone Member (of Selma Chalk)

Upper Cretaceous: Southeastern Alabama and northeastern Mississippi.

L. W. Stephenson and W. H. Monroe, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 12, p. 1655–1657. Defined as member of Selma chalk. Thin but persistent unit, consisting of layers of pure hard limestone, interbedded with chalk. Lies about 300 feet above base of Selma. Thickness about 29 feet.

R. H. Belt and others, 1945, Geologic map of Mississippi (1:500,000): Mississippi Geol. Survey; W. H. Monroe and D. H. Eargle, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 50. Reallocated to member status in Mooreville chalk. Unconformably underlies Demopolis chalk.

Type exposure: In bluff at old Arcola Landing on Warrior River, NE¼ sec. 4, T. 18 N., R. 3 E., Hale County, about 5 miles northeast of Demopolis, Ala. Unit has been traced from Bullock County westward through Alabama and northward through Mississippi nearly to Mooreville in Lee County.

Arcturus Limestone[1] **or Formation**

Permian: Eastern Nevada and western Utah.

Original references: A. C. Lawson, 1906, California Univ. Pub. Bull., Dept. Geology, v. 4, no. 4, p. 294; A. C. Spencer, 1917, U.S. Geol. Survey Prof. Paper 96, p. 26–28.

E. N. Pennebaker, 1932, Mining and Metallurgy, v. 13, no. 304, p. 164. Overlies Rib Hill formation (new). Most of Rib Hill was formerly included in Ely limestone.

R. K. Hose and C. A. Repenning, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 9, p. 2174–2178. Name Arcturus geographically extended into Confusion Range, Utah, where it replaces terms "Supai?," "Supai equivalents," and Supai sandstone. Consists of poorly indurated yellowish-gray calcareous sandstone with thin ledge-forming interbeds of dark-gray to tan limestone and dolomite. Total thickness uncertain; minimum thickness 2,700 feet, measured southeast of Indian Pass. Conformably overlies Ely limestone; underlies Kaibab limestone of Park City group. Fossils and stratigraphic position suggest formation is early to middle Permian. Pennebaker (1932), in report on Robinson (Ely) mining district, separated a predominantly sandstone unit of Permian age, which he named Rib Hill formation, from beds previously mapped at Rib Hill as Ely limestone by Spencer (1917). Spencer's description of Ely contains no reference to sandstone, yet Rib Hill area, which is underlain by sandstone, was mapped as Ely limestone. 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. 103–106. Arcturus limestone was defined by Lawson (1960) as a shaly limestone sequence stratigraphically underlying "Ruth Limestone" and overlying Ely limestone, in Robinson (Ruth) mining district. Lawson's failure to understand structural complexities within general Ruth area resulted in the naming of "Ruth" and "Ely" limestones, which later were proved equivalent by Spencer (1917). Lawson's original description of Arcturus limestone does not make clear to which unit he was referring, but there is little doubt that Lawson's Arcturus limestone did include those beds later referred to as "Rib Hill" by Pennebaker (1932). Additional work is necessary before formation can be further defined and its regional relationship fully understood. At present time, name Arcturus should be applied to those light-colored platy limestones and thin interbedded silts lying stratigraphically above Riepetown sandstone (name proposed to replace Rib Hill) and below Kaibab formation or Loray formation (new). Outcrops of Arcturus distributed over area of about 4,800 square miles.

W. B. Douglass, Jr., 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 182, 183. In southern Butte Mountains, White Pine County, Nev., Arcturus conformably overlies Carbon Ridge formation. Thickness variable due to angular unconformity at top of unit. Only 264 feet present on west side of range; estimated 2,500 to 3,000 feet present on eastern flank of mountains. Underlies Kaibab(?) formation.

Named for exposures on Arcturus mining claim, NW¼SW¼NE¼ sec. 15, T. 16 N., R. 62 E, White Pine County, Nev.

Arden Granite

Age not stated: Northern Delaware.

R. F. Ward, 1959, Geol. Soc. America Bull., v. 70, no. 11, p. 1427–1429, 1438–1439, pl. 1. Potassium feldspar-bearing rock which, in some places, has composition of true granite. Bordered on three sides by banded gneiss of Wilmington complex (new), and on east covered by Quaternary and Recent sediments.

Underlies approximately 4 square miles in vicinity of Arden, Newcastle County.

Ardian Series or Epoch

Lower Pennsylvanian: North America.

R. C. Moore and M. L. Thompson, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 3, p. 284, 286–292. Analysis of physical characters and paleontological features of Pennsylvanian rocks in North America leads to conclusion that stratigraphic cleavage at two positions within system has paramount significance. Three series recognized: Ardian-Lower Pennsylvanian, Oklan-Middle Pennsylvanian, and Kawvian-Upper Pennsylvanian. Ardian series includes Springeran and Morrowan rocks which are classed as stages. Thickness of sediments about 5,000 feet in type area where both Springeran and Morrowan stages are present. *Millerella* is only genus of fusulinids in Ardian, and Ardian may be designated as zone of *Millerella*. Rocks of Ardian age probably widespread in Appalachian region; seemingly most rocks referred to lower Pottsville are of Ardian age. Time equivalent is Ardian epoch.

Type sequence: Ardmore basin south of Arbuckle Mountains, southern Oklahoma. Name derived from first syllable of Ardmore.

Ardmore Bentonite Bed (in Pierre Formation)

Upper Cretaceous: Southwestern South Dakota.

R. C. Spivey, 1940, South Dakota Geol. Survey Rept. Inv. 36, p. 3, 23–34. Bentonite bed about 4 feet thick. Occurs near base of Pierre formation. Commercially important.

Named for exposures near Ardmore, Fall River County.

Ardmore cyclothem

See Ardmore Formation (in Cherokee Group)

Ardmore Formation (in Cherokee Group)

†Ardmore Limestone Member (of Cherokee Shale)[1]

Pennsylvanian (Des Moines Series): Northwestern and north-central Missouri, southern Iowa, and southeastern Kansas.

Original reference: C. H. Gordon, 1893, Missouri Geol. Survey Sheet Rept. 2, (v. 9), p. 20.

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. Admore 13th in sequence (ascending); occurs above Croweburg and below Bevier. Average thickness 5 feet. [For complete sequence see Cherokee group.]

L. M. Cline, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 53–54. Redefined to include all of limestones (and intervening shale members) between coal [lower Ardmore] and top of Ardmore of previous definitions. Missouri and Kansas Surveys have traced Ardmore toward southwest and showed it to be equivalent to Rich Hill limestone of southeastern Kansas and to Verdigris limestone of northeastern Oklahoma. Has been traced northwestward from Iowa-Missouri line for 135 miles into Iowa. Throughout this distance is best developed limestone in Cherokee group.

H. S. McQueen, 1943, Missouri Geol. Survey and Water Resources, 2d ser., v. 28, p. 83–89. Formation in Cherokee group. In Missouri overlies Tebo formation (new); underlies Bevier formation. Thickness as much as 17 feet.

R. C. Moore, 1949, Kansas Geol. Survey Bull. 83, p. 45. Cyclothem redefined to include Croweburg cyclothem of Abernathy (1937).

W. B. Howe, 1956, Kansas Geol. Survey Bull. 123, p. 72–74. Verdigris limestone (Smith, *in* Woodruff and Cooper, 1928) comprises bed or beds called Ardmore by Gordon (1893) in Missouri. Term Verdigris has had wider usage than Ardmore and for that reason was adopted at Nevada Conference (Searight and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 12) for limestone in Verdigris formation.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 34, fig. 5. Ardmore limestone, Cherokee group, is exceptionally widespread unit that maintains approximately same characteristics over wide area reaching from Oklahoma to Iowa. Consists of two thin gray limestones separated by thinly laminated dark-gray shale. Ardmore limestone of Iowa is Verdigris limestone of Kansas, Missouri, and Oklahoma, and may be equivalent of lower Oak Grove of Illinois.

Named for Ardmore, Macon County, Mo.

Arecibo Formation[1]

Tertiary: Puerto Rico.

Original reference: C. P. Berkey, 1915, New York Acad. Sci. Annals, v. 26, p. 10–17.

C. J. Maury, 1919, Am. Jour. Sci., v. 48, no. 285, p. 214 (chart). As shown on correlation chart, comprises (ascending) Lares, Aguadilla, and Quebradillas limestones. Upper Oligocene and lower and middle Miocene.

J. D. Weaver, 1956, *in* R. Hoffstetter and others, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2b, p. 316. Name not now in use.

Named for exposures in region about Arecibo.

Arendtsville Fanglomerate Lentil (in Gettysburg Shale)[1]

Upper Triassic: South-central Pennsylvania.

Original reference: G. W. Stose, 1929, U.S. Geol. Survey Geol. Atlas, Folio 225.

G. W. Stose and A. I. Jonas, 1939, Pennsylvania Geol. Survey, ser. 4, Bull. C–67, p. 115, 117. In type area in Adams County, the Gettysburg is predominantly a red shale and sandstone with interbedded hard gray to white sandstones in the Heidlersburg member and a coarse fanglomerate called Arendtsville fanglomerate lentil at top.

Forms large hills southwest and west of Arendtsville, Adams County, for which it is named.

Argenta limestone[1]

Pennsylvanian: Utah.

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

Derivation of name not stated.

Argentine Limestone[1] Member (of Wyandotte Formation)

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

Original reference: R. C. Moore, 1931, Kansas Geol. Soc. Guidebook 5th Ann. Field Conf., correlation chart.

R. C. Moore, 1949, Kansas Geol. Survey Bull. 83, p. 106 (fig. 20), 109–110. Mostly very fine grained light-bluish-gray limestone that weathers creamy white, grayish white, or light buff. Bedding thin and uneven; many layers distinctly nodular. Normally, thickest subdivision of Wyandotte formation. Average thickness 20 feet; 30 feet thick at Kansas City. Overlies Quindaro shale member; underlies Island Creek shale member, or, where this shale is absent, underlies Farley limestone member. Disappears south of Lane [Kansas] but is persistent northeastward in Missouri; identified in Iowa and southeastern Nebraska.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 25, fig. 5. Argentine member in Madison County is 18-foot sequence of two or three massive limestones separated by dark-gray to buff calcareous shales. Fossiliferous throughout with *Osagia* and brachiopods. Thickness 12 feet in Union County. Overlies Quindaro shale member; underlies Island Creek shale member.

Type exposure: In quarry south of 26th and Metropolitan Ave., Kansas City, Kans. Named for Argentine Railway Station.

†Arickaree Shale[1]

Upper Cretaceous: Northwestern Kansas.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 52.

Named for Arikaree River, Cheyenne County.

Arido sandstone[1]

Jurassic: Northeastern Arizona.

Original reference: C. R. Keyes, 1936, Pan-Am. Geologist, v. 65, no. 4, p. 303, 306.

Named for Arido Creek, in northern part of Navajo Reservation.

Arikaree Sandstone,[1] **Formation,** or **Group**

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

Original reference: N. H. Darton, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 4, p. 732, 735, 742, 743–748.

J. B. Hatcher, 1902, Am. Philos. Soc. Proc., v. 41, no. 169, p. 116–119. Redefined and used in group sense to include Monroe Creek above and Gering sandstones. Underlies Loup Fork group; overlies White River group.

C. B. Schultz, 1938, Am. Jour. Sci., 5th ser., v. 35, no. 210, p. 443–444. Suggests continued use of term Arikaree as group name. Redefined to include only Gering sandstone, Monroe Creek, and Harrison formations (the latter as defined by Hatcher 1902). Underlies Marsland formation (new).

A. L. Lugn, 1938, Am. Jour. Sci., 4th ser., v. 36, no. 213, p. 227 (table). Group includes Gering, Monroe Creek, and Harrison formations. Overlies White River group; underlies Hemingford group (new). Thickness 700 to 800 feet.

Billings Geol. Soc. [Guidebook] 2d Ann. Field Conf., 1951, p. 8 (correlation chart). Geographically extended into southeastern Montana.

Edward Bradley, 1956, U.S. Geol. Survey Water-Supply Paper 1368, p. 18–19, pl. 1. Arikaree group (formation in Niobrara County, Wyo.), as described in this report, includes all sediments of Miocene age. The sediments have been divided into Arikaree and Hemingford groups, but in this report these units are not differentiated and are mapped as Arikaree group. Underlies Ogallala formation.

A. F. Agnew, 1957, Geology of the White River quadrangle (1:62,500): South Dakota Geol. Survey. Formation consists of reddish-brown cross-bedded quartzose channel sandstone that is overlain by gray and pinkish unconsolidated tuffaceous quartzose sands. Top of Arikaree arbitrarily drawn at base of lowest pink fine-grained limestone bed. Thickness as much as 82 feet. Overlies Brule formation; underlies Mellette formation (new).

S. G. Collins, 1959, Geology of the Martin quadrangle (1:62,500): South Dakota Geol. Survey. Formation represented by Monroe Creek and Harrison members. Disconformably underlies Valentine formation.

W. D. Sevon, 1959, Geology of the Okreek quadrangle (1:62,500): South Dakota Geol. Survey. Thickness as much as 238 feet including Mellette facies. Underlies Valentine formation of Ogallala group; overlies White River group.

S. G. Collins, 1960, Geology of the Patricia quadrangle (1:62,500): South Dakota Geol. Survey. Group comprises (ascending) Sharps, Monroe Creek, and Harrison formations. Underlies Ogallala group, which here comprises (ascending) Valentine and Ash Hollow formations.

Name Arikaree is applied to formation because Arikaree Indians were at one time identified with area in which it is most largely developed. Well developed in face of Pine Ridge in Sioux County, Nebr., and Converse County, Wyo.

Arikareean Age

Miocene: 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 the Arikaree group of western Nebraska, Agate being the most typical locality, with the limits as redefined by Schultz (1938) but including Rosebud beds. Includes time between Whitneyan (Oligocene) and Hemingfordian (Miocene) ages. Report defines 18 provincial time terms, based on mammal-bearing units, for North American continental Tertiary. [For sequence see under Puercan.]

†Arizona Slates,[1] Arizonian Slate[1]

†Arizonan[1]

Precambrian: Southeastern Arizona.

Original reference: W. P. Blake, 1883, Eng. Mining Jour., v. 35, p. 254.

Exposed along sides of Queen Creek valley, west of town of Pinal, Gila County.

Arkadelphia Marl

Arkadelphia Marl (in Navarro Group)[1]

Upper Cretaceous: Southwestern Arkansas, northwestern Louisiana, and northeastern Texas.

Original reference: R. T. Hill, 1888, Arkansas Geol. Survey Ann. Rept. 1888, v. 2, p. 53–56, 188.

L. W. Stephenson and others, 1942, Geol. Soc. America Bull., v. 53, no. 3, chart 9. Arkadelphia marl shown on correlation chart of outcropping formations in southwestern Arkansas. Occurs above Nacatoch sand. Navarro group not used in this area.

C. A. Renfroe, 1949, Arkansas Geol. Survey Bull. 14, fig. 2 (facing p. 8). Arkadelphia formation shown on generalized columnar section of eastern Arkansas. Consists of light-gray calcareous shale, sparingly glauconitic; medium-gray finely micaceous fissile shale near base. Thickness 50 to 150 feet. Overlies Nacatoch formation; underlies Clayton "calcareous" Midway. Navarro group.

Typical outcrops are 2 to 3 miles northwest of Fulton, Hampstead County, Ark., and at numerous localities 5 to 7 miles north and northwest of Hope. It is possible that basal few feet of formation crops out, though not typically, at Arkadelphia.

†Arkansan series[1]

Pennsylvanian: Western Arkansas and eastern Oklahoma.

Original reference: C. R. Keyes, 1901, Iowa Acad. Sci. Proc., v. 8, p. 119–132.

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

†Arkansas Marls[1]

Miocene, upper, and Pliocene: Central southern Colorado.

Original reference: F. V. Hayden, 1869, U.S. Geol. Survey Colorado and New Mexico 3d Ann. Rept., p. 75–91.

Occupy entire valley of Arkansas River.

Arkansas Novaculite[1]

Devonian and Mississippian: Southwestern Arkansas and southeastern Oklahoma.

Original reference: A. H. Purdue, 1909, Slates of Arkansas: Arkansas Geol. Survey, p. 30, 39–40.

W. H. Hass, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 12, p. 2526–2541. Definition and description based on section at Caddo Gap, Montgomery County, Ark. Lower division: nearly white thick-bedded novaculite; some interbedded greenish-gray and dark-gray shale near base; thickness 466 feet; Lower or Middle Devonian. Middle division: dark-gray and greenish-gray shale; many dark-gray beds of novaculite; thickness 347 feet; Upper Devonian and Mississippian. Upper division: nearly white granular thick-bedded novaculite; thickness 127 feet; Mississippian. Underlies Stanley shale; overlies Missouri Mountain slate (Silurian).

L. S. Griswold (1892, Arkansas Geol. Survey Ann. Rept. 1890, v. 3) described trade name Arkansas stone and (or) novaculite in an economic report on whetstones and novaculites of Arkansas.

Named for quarries in Arkansas. Principal formation in Ouachita Mountains.

†Arkansas Sandstone[1]

Pennsylvanian and Permian: Central southern Colorado.

Original reference: F. M. Endlich, 1874, U.S. Geol. and Geog. Survey Terr. 10th Ann. Rept., p. 312.

Named for proximity to Arkansas River.

Arkill Limestone (in Saavedra Member of Lowell Formation)

Lower Cretaceous: Southeastern Arizona.

A. A. Stoyanow, 1949, Geol. Soc. America Mem. 38, p. 8, 11, 15. Slabby grayish-brown and buff arenaceous limestone. Fossiliferous. Thickness about 2 feet. Overlain by a soft white, in some places buff, sandstone. A buff sandstone separates the Arkill from underlying Barata limestone (new).

Type locality of Lowell formation is in southwestern flank of Bisbee anticline, southeast of Bisbee and east of Naco; standard section of Lowell is in Ninety One Hills.

Arkose Ridge Formation

Cretaceous: South-central Alaska.

F. F. Barnes and T. G. Payne, 1956, U.S. Geol. Survey Bull. 1016, p. 10–12. Assemblage of arkose, conglomerate, and shale more than 2,000 feet thick. Arkose is fine grained and conglomeratic in places, but conglomeratic feature nowhere predominates. Rocks are dark brown to gray and contain all essential constituents of granite. On north side of Arkose Ridge, formation believed to rest with sedimentary contact on granite of Talkeetna batholith; on south side of ridge, formation in fault contact with Chickaloon and Matanuska formations. Older than Chickaloon formation and possibly, at least in part, older than Matanuska formation. Upper Cretaceous(?).

U.S. Geological Survey currently designates the age of the Arkose Ridge as Cretaceous on the basis of a study now in progress.

Typically exposed on Arkose Ridge, northwest of Wishbone Hill. In belt extending along northern border of Matanuska Valley west of Chickaloon River.

Arkwright Group

Upper Devonian: Western New York.

I. H. Tesmer, 1954, Hobbies, v. 35, no. 2, p. 30, 31; 1955, New York State Mus. Sci. Service Circ. 42, p. 9–19. Succession of black and gray shales with some thin siltstone layers. Thickness 1,450 feet. Comprises Canadaway (lower) and Chadakoin formations; thus includes all rocks from base of Dunkirk shale to top of Ellicott shale. Underlies Conewango group; overlies Seneca group.

Name derived from Arkwright Township, Chautauqua County.

Arline Formation

Middle Ordovician (Mohawkian): Eastern Tennessee, northern Georgia, and southwestern Virginia.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 41–43, chart 1 (facing p. 130). Mostly cobbly weathering impure limestone containing considerable quantities of fine clastic material. Weathers to yellow-brown soil containing numerous silicified fossils. Thickness about 400 feet. Underlies Red Knobs formation (new); overlies Lenoir formation. Thin remnant underlies Effna calcarenites and reefs at Porterfield quarry, Virginia. Includes Fetzer tongue (new), which is recognized in Virginia, Tennessee, and Georgia. Interfingers with silty calcareous beds of Athens formation in southeastern Tennessee and with Rich Valley formation (new) at Marion, Va., and vicinity. Fingers of Arline appear in Tellico formation in belt along west front of Great Smoky Mountains. Occurs in area for which Porterfield stage is named. Name attributed to B. N. Cooper and G. A. Cooper.

Exposed almost in its entirety on both sides of valley of small stream tributary to Gallagher Creek, 2 miles southwest of railroad switch at Arline on Concord (TVA 138-SW) and Louisville (TVA 138-SE) quadrangles, Tennessee.

Arlington Formation[1]

Mississippian: 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, chart 5 (column 14). Underlies Shoofly formation (Pennsylvanian?); overlies Devonian Taylorsville formation.

P. A. Lydon, T. E. Gay, Jr., and C. W. Jennings, 1960, Geologic map of California Westwood sheet (1:250,000): California Div. Mines. Water-laid tuff and slate and minor andesitic metabreccia and metaconglomerate. Mapped with Permian marine sedimentary and metasedimentary rocks.

Named for Arlington Heights, Plumas County.

Arlington Gravel 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 of sand and gravel forming a thin veneer over a terrace cut mainly in the earlier Stillaguamish sand member (new). Underlies Marysville sand member (new).

Area: Snohomish County; contains Tps. 26-32 N. of the Willamette base line.

†Arlington Lake Beds[1] or Formation

Tertiary, late, and Pleistocene: North-central Oregon.

Original reference: E. T. Hodge, 1930, Monthly Weather Rev., v. 58, p. 405–441.

E. T. Hodge, 1938, Geol. Soc. America Bull., v. 49, no. 6, p. 869. Abandoned in favor of Shutler formation. Name Arlington preoccupied.

Town of Arlington is near Shutler, Gilliam County.

Armendaris Group

Pennsylvanian (Des Moines Series): New Mexico.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 41–49. Proposed for all rocks between top of Derry series below and base of Bolander group above. Entirely of marine origin and composed largely of gray to light-gray cherty limestone, with a few thin shale and sandstone beds scattered throughout. Subdivided into three formations (ascending): Elephant Butte, Whiskey Canyon limestone, and Garcia.

Type locality: In north end of Mud Springs Mountains in west end of Whiskey Canyon, in and on either side of westernmost box canyon in southwest part of sec. 1, T. 13 S., R. 5 W., Sierra County. Name is derived from large Armendaris Grant to east and northeast of Hot Springs.

Armendaris limestone[1]

Ordovician: New Mexico.

Original reference: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 259, 260.

Derivation of name not stated.

Armenia Limestone Lentil (of Oswayo Formation)[1]

Devonian or Carboniferous: Central northern Pennsylvania.

Original reference: H. S. Williams and E. M. Kindle, 1905, U.S. Geol. Survey Bull. 244.

Armenia Mountain section, Bradford County.

Armes Gap Sandstone (in Graves Gap Group)

Pennsylvanian (Pottsville Series): Eastern Tennessee.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [folio], p. 11, 19 pls. 2, 3, 4. Thickness near Armes Gap about 10 feet; 20 to 40 feet in Camp, Austin, Petros, and Fork Mountain quadrangles; from this area thins northward; 20 to 70 feet in a northwest-southeast belt through Lake City, Duncan Flats, Block, Norman and Huntsville quadrangles. Separated from underlying Indian Bluff group (new) by a shale interval as much as 300 feet thick that includes Jordan and Norman Pond coals; separated from overlying Roach Creek sandstone (new) by a shale interval as much as 130 feet thick that includes Pioneer coal.

Named from exposures in Armes Gap, north of Petros, Morgan County.

Armstrong Member (of Cuyahoga Formation)[1]

Armstrong Sandstone Member (of Cuyahoga Formation)

Mississippian: North-central Ohio.

Original reference: G. E. Conrey, 1920, Ohio Geol. Survey, 4th ser., Bull. 24, p. 54.

F. T. Holden, 1941, Illinois Acad. Sci. Trans., v. 34, no. 2, p. 172; 1942, Jour. Geology, v. 50, no. 1, p. 41 (table 2), 49, 50–51. Described as Armstrong sandstone member of River Styx conglomerate facies and Killbuck shale facies of Cuyahoga formation. In River Styx facies, Armstrong includes Rittman conglomerate submember.

E. J. Szmuc, 1958, Dissert. Abs., v. 18, no. 6, p. 2109. Overlies Rittman which is here raised to member status; underlies Wooster member (new) used in place of Black Hand which is here restricted. Lower Mississippian.

Named for exposures near village of Armstrong, Wayne County.

Armuchee Chert[1]

Lower and Middle Devonian: Northwestern Georgia.

Original reference: C. W. Hayes, 1902, U.S. Geol. Survey Geol. Atlas, Folio 78, p. 3.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Underlies Frog Mountain sandstone.

Named for exposures around Armuchee, Floyd County.

Armuelles Formation

Pleistocene: Panamá and Costa Rica.

R. A. Terry, 1941, Geog. Rev., v. 31, no. 3, p. 381 (fig. 5), 382. Conglomerate that passes upward into sandstones and shales. Overlies Charco Azul formation. Thickness more than 4,000 feet. Pleistocene.

A. A. Olsson, 1942, Bulls. Am. Paleontology, v. 27, no. 106, p. 160–161 (8–9); 1942, 8th Am. Sci. Cong. Proc., v. 4, p. 248–249. Beds consist principally of gray well-bedded foraminiferal shales and soft sandstones. Fossils described.

Typically exposed near Puerto Armuelles, Burica Peninsula. Extends into Costa Rica.

Arnheim Shale,[1] **Limestone,**[1] or **Formation** (in Richmond Group)

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

Original reference: A. F. Foerste, 1905, Science, new ser., v. 22, p. 150.

C. V. Theis, 1936, U.S. Geol. Survey Water-Supply Paper 677, p. 31 (table), 74. Unconformably underlies Fernvale formation and overlies Leipers limestone in south-central Tennessee.

Wilber Stout, K. V. Steeg, and G. F. Lamb, 1943, Ohio Geol. Survey, 4th ser., Bull. 33, p. 113. Formation in Ohio. Subdivided into Sunset member below and Oregonia member above. Underlies Waynesville formation; overlies McMillan formation. Richmond group.

C. W. Wilson, Jr., 1948, Tennessee Div. Geology Bull. 53, p. 11. In proposed changes of nomenclature for Ordovician system of central Tennessee, the Ohio name Arnheim is retained. In case its correlation with strata in Tennessee is seriously questioned, a local name should be applied. Richmond group.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 201–207. Described as dark-blue to blue-gray thin-bedded to massive argillaceous rubbly limestone in Tennessee. Thickness varies from 10 to 20 feet.

Overlies Leipers formation unconformably with single known exception of exposure at Clinton where it overlies Hermitage formation. Underlies Sequatchie formation in western exposures; in southeasternmost exposures is overlain by Fernvale limestone. Locally Chattanooga shale rests on Arnheim.

A. C. McFarlan and W. H. White, 1952, Kentucky Geol. Survey Bull. 10, p. 12. Oregonia member at base of formation in Kentucky.

J. B. Patton, T. G. Perry, and W. J. Wayne, 1953, Indiana Geol. Survey Field Conf. Guidebook 6, pl. 1. Arnheim formation in Maysville group shown on generalized stratigraphic column of Ordovician and Silurian rocks exposed in Jefferson and Switzerland Counties. Thickness 70 to 80 feet. Overlies Mount Auburn formation; underlies Waynesville formation of Richmond group. Cincinnatian.

W. C. Sweet and others, 1959, Jour. Paleontology, v. 33, no. 6, p. 1030. If reference section of the Cincinnatian, in Cincinnati region, be considered to include all strata between Point Pleasant (Cynthiana) beds and the Brassfield and their lateral equivalents, it is possible to recognize eight formational units in the sequence. These are (ascending) Eden, Fairview, McMillan, Arnheim, Waynesville, Liberty, Whitewater, and Elkhorn formations. The Arnheim, Waynesville, Liberty, Whitewater, and Elkhorn define the Richmond stage of the Cincinnatian.

Named for Arnheim, Brown County, Ohio.

Arnold Amygdaloid[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Named for occurrence in Arnold mine, Keweenaw County.

Arnold Flow[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Named for occurrence in Arnold mine, Keweenaw County.

Arnold Limestone (in Deese Group)

Arnold Member (of Deese Formation)[1]

Pennsylvanian (Des Moines Series): South-central Oklahoma.

Original reference: C. W. Tomlinson, 1928, Oklahoma Geol. Survey Bull. 40Z, p. 15.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 37). Shown on correlation chart as a limestone in Deese group.

C. W. Tomlinson and William McBee, Jr., 1959, *in* Ardmore Geol. Soc. Petroleum geology of southern Oklahoma—a symposium, v. 2. Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 6 (fig. 2), 32, 33. Occurs some 3,000 feet above base of Deese group (in maximum section). Includes a very fossiliferous thin-bedded limestone, more or less earthy and lumpy and interbedded with calcareous shale; with maximum aggregate thickness about 100 feet. Rocky Point conglomerate is about 1,400 feet above Arnold. Devils Kitchen conglomerate is 1,800 feet below Arnold.

Named for Arnold's Reef on Arnold Farm in sec. 33, T. 3 S., R. 1 E., north of Ardmore.

Arnoldsburg cyclothem

Pennsylvanian (Monongahela Series) : Southeastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 158 (table 13), 178–181. Embraces interval between Benwood cyclothem (new) below and Lower Union cyclothem (new) above. Includes (ascending) Fulton shale and sandstone, Arnoldsburg redbed, Arnoldsburg limestone, Arnoldsburg underclay, Arnoldsburg coal, and Arnoldsburg roof shale members. In its normal position between Benwood coal bed and Arnoldsburg sandstone, average thickness of cyclothem in Athens County is a little over 16 feet. Individual members do not regularly appear in section, and their thickness frequently exceeds average thickness of entire cyclothem. Where Benwood cyclothem is absent, base of Arnoldsburg is considered to lie above roof shale of Sewickley coal bed; where base of cyclothem is drawn at this position, its average thickness is 71 feet. Under these circumstances, Sewickley sandstone, Tyler redbed, and Benwood limestone members are placed in Arnoldsburg cyclothem. In area of this report, Monongahela series is discussed on a cyclothemic basis; 12 cyclothems are named. [For sequence see Pittsburgh cyclothem.]

Well developed in Athens County.

Arnoldsburg Limestone Member (of Monongahela Formation)

Arnoldsburg Limestone (in Monongahela Formation)[1]

Upper Pennsylvanian: Northern West Virginia and eastern Ohio.

Original reference: W. Stout, 1929, West Virginia Acad. Sci. Proc., v. 3, p. 140, 143.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 10). Shown on correlation chart as formation in Monongahela series. Underlies Uniontown limestone; overlies Benwood limestone.

R. E. Lamborn, 1951, Ohio Geol. Survey, 4th ser., Bull. 49, p. 37. In Jefferson County, Ohio, Arnoldsburg consists of several layers of gray to buff limestone interbedded with buff calcareous clay shale. Average thickness about 13 feet, more than half of which is calcareous shale. Limestone is overlain by about 30 feet of gray arenaceous shale. Overlies Fulton green shale.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 81. Arnoldsburg limestone and shale member of Monongahela series described in Morgan County. Occurs between Fulton green shale member and Arnoldsburg coal member, although Fulton is not recognized definitely in Morgan County. Thickness 25 to 35 feet.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 181. In this report [Athens Couty]. Monongahela series is described on a cyclothemic basis. Arnoldsburg limestone member is included in Arnoldsburg cyclothem (new). Thickness 13½ feet.

Named for its close association with the Arnoldsburg sandstone which occurs near Arnoldsburg, Calhoun County, W. Va.

Arnoldsburg redbed member

Pennsylvanian (Monongahela Series) : Eastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 158 (table 13), 180. Member of Arnoldsburg cyclothem in report on Athens County. Recognized only if Benwood cyclothem is intact. Average thickness 13 feet. Where Arnoldsburg cyclothem is considered to be at base of

Sewickley sandstone, the lateral equivalents of this unit are lost in Tyler redbed and Benwood limestone sections.

Named for Arnoldsburg cyclothem.

Arnoldsburg roof shale member

See Arnoldsburg cyclothem.

Arnoldsburg Sandstone Member (of Monongahela Formation)

Arnoldsburg Sandstone (in Monongahela Formation)[1]

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

Original reference: R. V. Hennen, 1911, West Virginia Geol. Survey Rept. Wirt, Roane, and Calhoun Counties, p. 57, 202, 505.

W. O. Hickok and F. T. Moyer, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 123, 124 (fig. 29). Geographically extended into Fayette County, Pa., where it is described as medium-grained soft gray-brown sandstone occurring in thin to medium beds. Average thickness about 10 feet. Underlies Uniontown limestone; overlies Benwood limestone.

R. E. Lamborn, 1951, Ohio Geol. Survey, 4th ser., Bull. 49, p. 37. Overlies Arnoldsburg limestone in Jefferson County, Ohio, and northwestern part of West Virginia.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 82. Arnoldsburg sandstone and shale member of Monongahela series described in Morgan County. Occupies stratigraphic position between overlying Uniontown limestone and underlying Arnoldsburg coal and (or) Arnoldsburg limestone. Consists of erratic development of sandstones and sandy shales ranging in thickness from 4 to 22 feet and averaging about 12 feet.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 158, 181. In this report [Athens County], Monongahela series is described on cyclothemic basis. Arnoldsburg shale and sandstone member is included in Lower Uniontown cyclothem (new). Arnoldsburg sandstone is represented as an olive-gray silty shale about 8 feet thick. Where Lower Uniontown coal is absent, Arnoldsburg sandstone is basal member of cyclothem. Underlies Ritchie redbed member (new).

Named for Arnoldsburg, Calhoun County, W. Va.

Arnoldsburg underclay member

See Arnoldsburg cyclothem.

Aromas Red Sands

Pleistocene, middle(?): West-central California.

J. E. Allen, 1946, California Div. Mines Bull. 133, p. 18 (fig. 2), 43–45, pls. 1, 2, 3. Dark-brown to red friable quartzose sandstone. Thickness 600 to 800 feet; 180 feet at type section. Underlie terrace gravels and alluvium; unconformably overlie all older formations with which they are in contact, successively overlapping upon Santa Lucia granite, San Lorenzo, Vaqueros, volcanics, and Pliocene rocks [Purisima formation].

Type section: In railroad cut 1 mile west of town of Aromas [Monterey County].

Aroostook Limestone[1]

Silurian: Northeastern Maine and western New Brunswick, Canada.

Original reference: H. S. Williams, 1900, U.S. Geol. Survey Bull. 165, p. 21, 44–45.

C. O. Nylander, 1940, Geological formations of the St. John River valley, northern Maine and New Brunswick: Caribou, Maine, p. 11–12 [privately printed]. Noted as occurring in western New Brunswick.

R. L. Miller, 1947, Maine Geol. Survey Bull. 4, p. 7, 10, pl. 2. Composed of three lithologic members: lower slate, middle ribbon limestone, and upper argillaceous limestone. Apparent thickness 18,000 feet; this may be excessive because structure of region is very complex. Underlies sequence of shale and slate (Ashland limestone and shale of former reports); overlies sandstone and conglomerate formation (Sheridan sandstone of former reports).

Occurs in eastern part of Aroostook County, Maine. The Aroostook River cuts the limestone from Wade Township to its junction with St. John River.

Aroostook Falls Diabase[1]

Age(?): Northeastern Maine.

Original reference: H. E. Gregory, 1900, U.S. Geol. Survey Bull. 165, p. 115, 175–177.

Named for occurrence at Aroostook Falls, Aroostook County.

Arp Member (of Queen City Formation)

Arp Sand (in Reklaw Formation)

Eocene (Claiborne): Northeastern Texas and Louisiana.

B. W. Blanpied and R. T. Hazzard, 1939, Shreveport Geol. Soc. Guidebook 14th Ann. Field Trip, p. 128 (correlation chart). Shown on correlation chart as Arp sand in Reklaw formation.

H. B. Stenzel, 1953, Texas Univ. Pub. 5305, p. 10 (fig. 3), 83–85. Described as member at base of Queen City formation. Consists of sands, silts, and thinly bedded, silty, carbonaceous shales. Thickness ranges from 48 to 75 feet. Underlies Omen sandstone member; overlies Marquez shale member, Reklaw formation. Type locality designated. Name credited to C. L. Moody.

C. R. Smith, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 10, p. 2520–2521. Member overlies Reklaw formation at alternate type locality of Queen City.

Type locality: Vicinity of Homer Lacey country store on road from Bell Church to Griffin, Henrys Chapel quadrangle. Named from town of Arp in southeastern Smith County, Tex., 6 miles north of mapped area.

Arpin Conglomerate and Quartzite[1]

Precambrian (upper Huronian): Central northern Wisconsin.

Original reference: S. Weidman, 1907, Wisconsin Geol. Nat. History Survey Bull. 16, p. 366.

Exposed immediately south of Arpin, Wood County.

Arrastre Complex

Arrastre Quartzite[1]

Middle Paleozoic(?): Southern California.

Original reference: F. E. Vaughan, 1922, California Univ. Pub., Dept. Geol. Sci. Bull., v. 13, no. 9, p. 344, 351, 353–365, map.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 471–472. Because Arrastre quartzite is closely involved with much granitic material, it might be better to call combination Arrastre complex. Younger than Cambrian, probably about Middle Paleozoic.

Named for Arrastre Creek, San Bernardino County.

Arrey Formation (in Green Canyon Group)

Pennsylvanian (Derry Series): New Mexico and western Texas.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 27 (table 2), 31 (fig. 2), 32–33, 35–36. Name used for the basal formation of the Derry series. At type locality, formation is composed of dense massive limestones, highly nodular limestones with irregular interbedded highly calcareous shales and very irregular masses and lenses of chert; northward from type locality, formation is more highly clastic, but southward it is essentially pure limestone. Thickness ranges from 32 feet at type locality to more than 300 feet in Hueco Mountains of western Texas. Underlies Apodaca formation (new).

Type locality: On west-facing slope of hill about three-fourths mile east of Derry, Sierra County, N. Mex. Name derived from village of Arrey on the west side of Rio Grande on Highway 85 about 4½ miles northwest of Derry.

Arriban series[1]

[Tertiary]: 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.

Derivation of name not stated.

Arrow Creek Member (of Colorado Shale)

Lower Cretaceous: Central Montana.

J. B. Reeside, Jr., and W. A. Cobban, 1960, U.S. Geol. Survey Prof. Paper 355, p. 8, 14 (fig. 8), 38, 39, 40, 41, 42, 43, 44. Consists of bentonite, tuff, and porcelanite. Thickness 40 feet in type area. Underlies Mowry member. In Teigen area, the bentonite is 2½ feet thick and is about 50 feet below Mowry member. Thickens northwestward, and top of member gradually approaches base of Mowry.

Type section: North side of Arrow Creek in sec. 23, T. 18 N., R. 10 E., Judith Basin County. Forms conspicuous white outcrop for 35 miles between Belt Butte and Stanford.

Arrowhead Limestone Member (of Monte Cristo Limestone)[1]

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).

D. F. Hewett, 1956, U.S. Geol. Survey Prof. Paper 275, p. 42. Commonly alternating layers of fine limestone several inches thick, and thin shale. Thickness about 10 feet. Overlies Bullion dolomite member; underlies Yellowpine member.

Named for Arrowhead prospect, sec. 9, T. 24 S., R. 58 E., Goodsprings quadrangle, Clark County, Nev.

†Arrowmink Arkosic Gneiss[1]

Precambrian: Southeastern Pennsylvania.

Original reference: F. Bascom, 1904, Am. Jour. Sci., 4th, v. 17, p. 143.

In Philadelphia region.

Arroyo Formation (in Clear Fork Group)[1]

Lower Permian (Leonard Series): Central Texas.

Original reference: J. W. Beede and V. V. Waite, 1918, Texas Univ. Bull. 1816, p. 45–46.

R. I. Dickey, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 42. Basal formation of Clear Fork group. Underlies Vale formation; overlies Lueders limestone. Thickness about 250 feet.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Shown on stratigraphic table as comprising (ascending) Rainey, Lytle, and Standpipe limestone members. Underlies Vale formation; overlies Lake Kemp formation.

R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80. Shown on composite columnar section of Permian rocks in Colorado River valley as overlying Lueders limestone.

Occurs on and near Los Arroyo 2¼ miles west of Ballinger, Runnels County.

Arroyo Hondo Formation

Eocene: West-central California.

H. E. Vokes, 1939, New York Acad. Sci. Annals, v. 38, p. 13 (table 1), 27–32. Name applied to strata that have been referred by various writers to Martinez, Meganos, and Tejon stages. Formation includes Cantua sandstone (at base), Ragged Valley shale (new), and an upper white sandstone member (unnamed) 100 to 300 feet thick. Unconformably underlies Domengine formation; uncomformably overlies Moreno formation.

Type section: Along the Arroyo Hondo, north of Coalinga [Fresno County].

Arroyo Hondo Shale Member (of Lodo Formation)

Eocene: West-central California.

R. T. White, 1938, (abs.) Geol. Soc. America Proc. 1937, p. 257. Upper member of Lodo formation (new). Overlies Cantua sandstone member.

R. T. White, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 10, p. 1725 (fig. 1), 1726 (fig. 2), 1735, 1738. Type section designated. Name credited to E. R. Atwill (unpub. paper read before 9th annual meeting of Pacific section of American Association of Petroleum Geologists). Atwill described Arroyo Hondo as a shale formation, with a white arkosic sandstone member at top, lying between Cantua sandstone and restricted Domengine. White found Arroyo Hondo shale genetically a part of Lodo formation, relegated its rank to a member, and excluded from it the white sandstone unit. Vokes (1939) used preoccupied term Arroyo Hondo to include most of Lodo formation and an unnamed sandstone unit between Lodo and Domengine. Vokes also proposed term Ragged Valley shale member to include most of Lodo shale, Cerros shale member, and Arroyo Hondo shale member, all of which were named and defined previous to his designation. Underlies Yokut sandstone (new).

J. E. Schoellhamer and D. M. Kinney, 1953, U.S. Geol. Survey Oil and Gas Inv. Map. OM–128. In Tumey and Panoche Hills area, Fresno County, member consists of 1,040 feet of gray claystone and minor amounts of interbedded siltstone and sandstone. Overlies Cantua sandstone member; where Cantua is not present, it is impossible to distinguish between Cerros and Arroyo Hondo members. Underlies Yokut sandstone.

Type locality: Arroyo Hondo Creek in S½ sec. 14, T. 17 S., R. 13 E. [Fresno County].

Arroyo Penasco Formation

Upper Mississippian: Northern New Mexico.

A. K. Armstrong, 1955, New Mexico Bur. Mines Mineral Resources Circ. 39, p. 3, 6–9. Proposed for the 20 to 150 feet of gray dense fine-grained to oolitic massive- to medium-bedded limestone occurring in Pinos and Penasco Canyons in Nacimiento Mountains. A fossiliferous chert zone some 15 to 20 feet thick occurs at top of formation. Unconformably underlies Pennsylvanian Log Springs formation (new); in some areas, unconformable below Sandia formation; uncomformably overlies Precambrian gneiss.

J. P. Fitzsimmons, A. K. Armstrong, and Mackenzie Gordon, Jr., 1956, Am. Asso. Petroleum Geologists Bull., v. 40, no. 8, p. 1935–1944. Underlies Sandia formation. Fauna described.

Type locality: SW¼SE¼ sec. 5, T. 16 N., R. 1 E., Cuba quadrangle. Named for arroyo 1 mile southeast of type section. Also exposed in San Pedro, Jemez, Sandia, and Sangre de Cristo Mountains.

Arroyo Seco Gravel[1]

Pleistocene: Northern California.

O. P. Jenkins, 1938, Geologic map of California (1:500,000): California Div. Mines, sheet 4. Incidental usage on map legend.

A. M. Piper and others, 1939, U.S. Geol. Survey Water-Supply Paper 780, p. 33, 49–55, pl. 1. A pediment gravel. Thickness as much as 19 feet. Underlies Victor formation (new); overlies gravel deposits of uncertain age; in some areas overlies Mehrten formation (new) and in others Laguna formation (new). [This is cited by Wilmarth as "in press."]

Named for Arroyo Seco land grant [along west front of Sierra Nevada] where formation is extensively preserved.

Artemisia Gravel[1]

Pleistocene: Great Lakes region, Ontario, Canada, and Michigan.

Original reference: W. E. Logan, 1863, Canada Geol. Survey Repts. 1843–1863, p. 887, 908–909.

Named for Artemisia Township, Ontario.

Arthur Limestone (in Carbondale 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, 5–6. Thin very fossiliferous limestone lying about 10 feet above Petersburg coal.

Occurs between Oakland City and Arthur, Pike County.

Artillery Formation

Eocene, lower(?): West-central Arizona.

S. G. Lasky and B. N. Webber, 1949, U.S. Geol. Survey Bull. 961, p. 14 (table 2), 16–22, pls. 1, 2. Consists of conglomerate, arkose, sandstone, shale, limestone, a little clay, some tuff, and a widespread basalt member. About 2,500 feet thick. Rests with angular unconformity upon rocks of Precambrian complex and Paleozoic(?) sediments. In some areas, unconformably underlies Miocene(?) volcanics; in other places, overlain by Chapin Wash formation, Cobwebb basalt, or Sandtrap conglomerate (all new); on east side of Bill Williams River, overlain by extensive gravel blanket, and in Santa Maria district by Quaternary(?) basalt. In central spur of Artillery Mountains, has been overthrust by Precambrian complex and Paleozoic(?) rocks. Silicified palm roots were collected from some of the limestone beds. Tentatively assigned to lower Eocene (p. 21). Plates 1 and 2 (geol. maps) show age as early Eocene(?).

Named for Artillery Mountains (Mohave County). Formation occupies broad tracts within mapped area and extends far beyond its borders, particularly northward along Big Sandy River and westward into Rawhide Mountains.

Artist Drive Formation

Oligocene and Miocene(?): Eastern California.

L. F. Noble, 1941, Geol. Soc. America Bull., v. 52, no. 7, p. 955–956. Comprises 1,000 feet or more of impure well-stratified ash beds that contain remains of fresh-water fish, conformably overlain by alternating basaltic and latitic flows, tuffs, and breccias that are more or less altered. Interlain with volcanics are basin deposits that range from fanglomerate to playa clay and algal limestone. Unconformably underlies Furnace Creek formation. Name credited to T. P. Thayer.

Typically exposed in west face of Black Mountains near Artist Drive in Death Valley.

Arumonogui (Almongui) Agglomerate

See Almongui Agglomerate.

Arundel Formation[1] or **Clay** (in Potomac Group)

Upper Cretaceous: Eastern Maryland.

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. 5–6. More specific name Arundel clay is preferred because formation consists almost entirely of clay. Unconformably underlies Patapsco formation; unconformably overlies Patuxent formation.

Gerald Meyer, 1952, Maryland Dept. Geology, Mines and Water Resources Bull. 10, p. 95, pl. 3. Gives thickness as much as 200 feet. Clay dips southeast at an average rate of about 45 to 50 feet per mile.

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

Named for Anne Arundel County.

Arusa Formation

See Aruza Formation.

Aruza Formation (in Tapaliza Group)

Aruza Member (of Tapaliza Formation)

Oligocene: Panamá.

Karl Sapper, 1937, Mittelamerika Handbuch der regionalen Geologie: Heidelberg, v. 8, Abt. 4a, no. 29, p. 132–133, 134 (correlation chart). Arusa formation shown on correlation chart below Aquaqua formation and above Clarita formation (both new). Upper Oligocene.

A. A. Olsson, 1942, 8th Am. Sci. Cong. Proc., v. 4, p. 234 (chart), 241. Tapaliza can be divided into an upper or Miocene part and a lower or Oligocene part, known respectively as the Aguagua and the Arusa.

R. A. Terry, 1956, California Acad. Sci. Occasional Paper 23, p. 36, 44. Referred to as Aruza formation.

W. P. Woodring, 1960, *in* R. Hoffstetter and others, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 324. Indicates correct spelling is Aruza.

Dareen area.

Arvada Formation

Pleistocene: Northeastern Wyoming.

L. B. Leopold and J. P. Miller, 1954, U.S. Geol. Survey Water-Supply Paper 1261, p. 8–10, 18, 31. Consists of highly weathered gravel or gravelly sand, generally stained red but containing many cobbles stained with a yellow or yellow-brown limonite. Disconformably underlies Ucross formation (new). Thickness up to 5 feet.

Type locality: At west abutment of highway bridge across Powder River on Highway 16, 3 miles north of Arvada, Wyo.

Arvison Formation

Lower Jurassic: Northern California.

A. F. Sanborn, [1953] Stanford Univ. Abs. Dissert., v. 27, p. 436–437. Fossiliferous strata conformably underlying Potem formation and unconformably overlying Modin formation.

A. F. Sanborn, 1960, California Div. Mines Spec. Rept. 63, p. 6, 11–14, pl. 1. Proposed for series of dominantly pyroclastic beds with minor andesitic flows, which are intermediate between Modin and Potem formations and which do not appear to be continuous with Bagley andesite of Diller. Bagley andesite, as traced from its type area into Big Bend region, overlies and is interfingered with basal beds of Potem formation. Because basal strata of Potem appear to lie between Bagley andesite and Arvison pyroclastic accumulations, new name is proposed for the lower beds. Thickness 5,090 feet in type area. Overlies Kosk member (new) of Modin formation.

Type area: Extends from point on Kosk Creek about 1¾ miles south of Arvison Flat to point about 1 mile north of Arvison Flat at contact with underlying Triassic beds, Big Bend quadrangle, Shasta County.

Arvonia Slate[1]

Upper Ordovician: Central Virginia.

Original reference: T. L. Watson and S. L. Powell, 1911, Am. Jour. Sci., 4th ser., v. 31, p. 36–43.

G. W. Stose and A. J. Stose, 1948, Am. Jour. Sci., v. 246, no. 7, p. 393–412. In central Virginia is not restricted to belt of commercial slate but includes a porphyroblastic facies of slate, called knotted slate. Underlies Bremo quartzite (new); overlies Peters Creek formation. Suggested that age may be Silurian or younger.

Exposed at Arvonia.

Asan Limestone

Aquitanian: Mariana Islands (Guam).

Risaburo Tayama, 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]. Hard red or white limestone that unconformably overlies Fena beds. Oligocene.

S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 18–19. Paleontologically same as Tagpochau limestone on Saipan. Aquitanian.

Type locality: Asan, Guam.

Asbury Clay[1]

Miocene, upper: Eastern New Jersey.

Original reference: H. B. Kummel and G. N. Knapp, 1904, New Jersey Geol. Survey, v. 6, p. 145.

Named for development just west of Asbury Park, Monmouth County.

Ashawa till[1]

Pleistocene: Iowa.

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

Ashawan[1]

Pleistocene: Iowa.

Original reference: C. R. Keyes, 1926, Pan-Am. Geologist, v. 45, p. 150–151.

Ashbed Amygdaloid (in Portage Lake Lava Series)

Ashbed Amygdaloid (in Ashbed Group)[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: A. R. Marvine, 1873, Michigan Geol. Survey, v. 1, pt. 2, p. 56, 58, 102, 116, 129, chart.

H. R. Cornwall, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–34. Included in Portage Lake lava series.

In old Ashbed mine, Keweenaw County.

Ashbed Flow[1] (in Portage Lake Lava Series)

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

W. S. White, H. R. Cornwall, and R. W. Swanson, 1953, U.S. Geol. Survey Geol. Quad. Map GQ–27. Included in Portage Lake lava series.

In old Ashbed mine, Keweenaw County.

†Ashbed Group[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: R. D. Irving, 1883, U.S. Geol. Survey Mon. 5, p. 172–173, 178, 186, pls. 17, 18.

W. S. White, H. R. Cornwall, and R. W. Swanson, 1953, U.S. Geol. Survey Geol. Quad. Map GQ-27. Name Portage Lake lava series (new) proposed to include Eagle River, Ashbed, Central Mine, and Bohemian Range groups of old reports; these subdivisions are quite arbitrary and depend on continuity of individual flows or conglomerate beds for validity. They are not useful for purpose of this report.

Occurs in old Ashbed mine, Keweenaw County.

Ashby 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. In Hogskin Valley, Elray and Lincolnshire formations comprise Ashby stage. Kay (1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8) places formations of this stage in his Chazyan, but this does not seem justified on paleontological grounds. Name credited to G. A. Cooper and B. N. Cooper.

Marshall Kay, 1958, Am. Jour. Sci., v. 256, no. 2, p. 93, 94, 95. Virginia sequence consists of Blackford (new), Ashby, Porterfield, and Wilderness stages. Place of Marmor stage is in dispute. Blackford and Ashby stages believed to be Chazyan, but not to constitute whole of that series. They are in a provincial series that is approximately the St. Paul group (Neuman, 1951).

Named from road intersection on Hogskin Creek, in northeast quarter of center subquadrangle of Maynardville (30′) quadrangle, Tennessee.

Ash Creek Group

Precambrian (Yavapai Series): Central Arizona.

C. A. Anderson and S. C. Creasey, 1958, U.S. Geol. Survey Prof. Paper 308, p. 9–10, pl. 1. Eastern of two major subdivisions of Yavapai series. Separated from western subdivision, the Alder group, by Shylock fault. Rocks consist of basaltic, andesitic, rhyolitic, and dacitic flows and pyroclastic rocks and thick sequence of tuffaceous sedimentary rocks containing interbeds of jasper-magnetite and chert. Divided into seven formations. Gaddes basalt (new) is oldest, and is overlain by Buzzard rhyolite (new). Shea basalt, dacite of Burnt Canyon, and Brindle Pup andesite (new), lenticular units about the same age, separate Buzzard rhyolite from younger Deception rhyolite. Grapevine Gulch formation (new) is younger than Deception rhyolite. Group perhaps 20,000 feet thick, not including base or top. Sum of maximum thickness of each formation is 23,500 feet, but because some volcanic formations are lenticular, a lower figure is more accurate estimate for group as a whole.

Named from Ash Creek, which cuts through a representative section south of Mingus Mountain, Jerome area, Yavapai County.

Ash Creek Series

Precambrian: New Mexico.

C. H. Hewitt, 1959, New Mexico Bur. Mines Mineral Resources Bull. 60, p. 12–13, 33, 53–57, 104–105, pls. 1, 12. Contains seven metasedimentary rock types grouped into four mappable units (not in stratigraphic sequence): sericite phyllite and andalusite-sericite schist; cordierite hornfels; spotted andalusite hornfels, biotite hornfels, and diopside quartzite; serpentine-carbonate rocks. Maximum exposed thickness approximately 5,800 feet. Younger than Bullard Peak series (new). Occurs as complex xenoliths or roof pendants in Burro Mountains granite.

Named for Ash Creek Canyon, Big Burro Mountains area. Underlies about 1½ square miles in secs. 9, 16, 17, 21, and 22, T. 18 S., R. 18 W., Grant County.

Asher Formation[1]

Permian: Central and southern Oklahoma.

Original reference: G. D. Morgan, 1924, Oklahoma Bur. Geology Bull. 2, p. 141–142, pls. 3, 27, map.

D. A. Green, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 12, p. 1519 (fig. 1). Shown on graphic section of "Wanette" time division of Permian sediments. Included in Pontotoc terrane. Gradational equivalent of Stratford shale.

Named for development at and west of Asher, Pottawatomie County.

Asherville Alluvium

Pleistocene(?): Southeastern Missouri.

Willard Farrar and Lyle McManamy, 1937, Missouri Geol. Survey and Water Resources 59th Bienn. Rept., app. 6, p. 38–41. Composed of reddish, angular sand grains, with a small amount of red to light-brown clay. Thickness varies from 18 to 80 feet. Overlies Powell(?) and Ripley formations and also loess.

Found in vicinity of Asherville in sec. 15, T. 26 N., R. 8 E., Puxico quadrangle [Stoddard County].

Ash Hollow Formation (in Ogallala Group)

Ash Hollow Member (of Ogallala Formation)

Ash Hollow Series or Formation

Pliocene: Western Nebraska, western Kansas, South Dakota, and southeastern Wyoming.

Henry Engelmann, 1876, *in* Appendix 1 *of* Report of explorations across the Great Basin of the territory of Utah for a direct wagon route from Camp Floyd to Genoa, in Carson Valley, in 1859, by Capt. James H. Simpson, Engineer Dept., U.S. Army: Washington, U.S. Govt. Printing Office, p. 260–262, 283. Near junction of North and South Forks of Platte River, first rocky strata were observed. They continue along South Fork, cropping out at intervals at one or the other side of river, and were found most developed in Ash Hollow where they attain thickness of over 250 feet. This series is composed of an alternation of loose, finely sandy, and of harder rocky strata, the latter consisting of fine or coarse drift-sand, generally cemented by carbonate of lime, forming more or less calcareous sandstones, and gritty, very impure limestones. Probably Pliocene-Tertiary. Fossilized seeds present in rocks near forks of Platte River. From Ash Hollow westward, strata gradually assume different appearance, and instead of being calcareo-arenaceous they become more purely arenaceous and, finally, argillo-arenaceous. This formation is older than Ash Hollow series. Term Ash Hollow formation used on page 283.

A. L. Lugn, 1938, Am. Jour. Sci., 5th ser., v. 36, no. 213, p. 223–224, 227. Name Ash Hollow formation applied to "mortar beds" of Ogallala group.

Thickness 100 to 250 feet. Underlies Sidney gravel formation; overlies Valentine formation.

A. L. Lugn, 1939, Am. Jour. Sci., v. 237, no. 6, p. 435–436; 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1260–1261. At type locality, where they overlie about 55 feet of Brule formation, beds belonging to Ash Hollow formation consist of layers of gravel, sand, silt, and fine sandy clay, with some beds of volcanic ash, all more or less indurated into hard caliche beds at regular intervals. Thickness 250 to 275 feet. Term Ash Hollow is not a new or even recent name as was supposed by Lugn (1938). Term Ash Hollow formation was applied to exactly same beds in Ash Hollow Canyon by Engelmann (1876).

M. K. Elias, 1942, Geol. Soc. America Spec. Paper 41, p. 139–145. Subdivided to include (ascending) Wray channel, Minnechaduza, and Feldt Ranch beds (all new).

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 18 (fig. 8), 19 (fig. 9), 20. Geographically extended into Kansas where it is considered member of Ogallala formation. Underlies Kimball member; overlies Valentine member.

A. L. Lugn and B. W. Brown, 1952, (abs.) Geol. Soc. America Bull., v. 63, no. 12, pt. 2, p. 1384. Geographically extended into southeastern Wyoming.

J. S. Carey and others, 1952, Kansas Geol. Survey Bull. 96, pt. 1, p. 9–13, 27. In Norton County, Kans., includes (ascending) Calvert ash bed and Reager ash bed (both new).

Ada Swineford, J. C. Frye, and A. B. Leonard, 1955, Jour. Sed. Petrology, v. 25, no. 4, p. 244 (fig. 1), 253–255. In northwestern Kansas, includes (ascending) Rawlins (new), Fort Wallace (new), Dellvale (new), Reager, and Reamsville (new) volcanic ash beds.

R. E. Stevenson, 1959, Geology of the Dallas quadrangle (1:62,500) : South Dakota Geol. Survey. Geographically extended into Dallas quadrangle, South Dakota. Bulk of formation consists of interbedded buff to greenish-tan fine-grained arkosic sand and ledge-forming vuggy calcareous arkosic sandstone; beds of greenish-tan fine-grained clayey and silty arkosic sand locally present; some of strata are ashy, and some contain white dense limestone concretions. Maximum thickness 110 feet. Includes Bijou facies. Underlies Herrick formation.

Type section: Exposures in Ash Hollow Canyon southeast of Lewellen, Garden County, Nebr.

Ashishik Basalt

Tertiary and Quaternary: Southwestern Alaska.

F. M. Byers, Jr., and others, 1947, U.S. Geol. Survey Alaska Volcano Inv. Rept. 2, pt. 3, p. 25, 27, 38, pl. 3. Consists of a sequence of massive basalt flows with minor interbedded tuff-breccia and tuff; individual flows range in thickness from 20 to 60 feet. Thickness 500 feet measured on cliff west of New Jersey Creek, but base not exposed. Underlies Crater Creek basalt (new).

F. M. Byers, 1959, U.S. Geol. Survey Bull. 1028–L, p. 309–311, pl. 41. As redefined in this report, includes most of bulk of Okmok Volcano and comprises Ashishik basalt, tuff breccia, and tuff, that part of Crater Creek basalt on outer flanks of Okmok Volcano, Idak basalt, excepting the mass of Mount Idak, and basalt flows of Hill 1200 (Byers and others, 1947). Ashishik basalt is subdivided into three lithologic units: mafic phenocryst basalt, palagonitized pyroclastic rocks, and aphyric (nonporphyritic) feldspathic basalt. Separated from younger Crater Creek basalt by erosional surface. Separated from Crater Creek by fault on north wall of Okmok Caldera. Latest Tertiary and Quaternary.

Named for exposures in east-facing cliff, 2 to 3 miles south of Ashishik Point at northernmost part of Umnak Island.

Ashland Formation

Silurian: Northeastern Maine.

W. H. Twenhofel, 1940, (abs.) Geol. Soc. America Bull., v. 51, no. 12, pt. 2, p. 1978–1979; 1941, Jour. Paleontology, v. 15, no. 2, p. 170–172, 173–174. Defined to include Ashland limestone, Ashland shale, and Graptolite shale of Williams (1900). Field relations and fossils suggest that Graptolite shale and Ashland shale are parts of one stratigraphic unit, that strata designated Ashland limestone are lenses of limestone in this shale, and that Sheridan sandstone succeeds Ashland shale. Thus interpreted, section becomes (descending) Sheridan formation, Ashland formation, Aroostook formation.

W. S. White, P. E. Cloud, Jr., and Josiah Bridge, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1939–1940. Stratigraphic sequence given (descending): Ashland formation, Aroostook formation, Sheridan sandstones.

Named for exposures in Ashland village, Aroostook County.

Ashland Limestone[1]

Silurian: Northeastern Maine.

Original reference: H. S. Williams, 1900, U.S. Geol. Survey Bull. 165, p. 21, 51, 52, 54.

W. H. Twenhofel, 1940, (abs.) Geol. Soc. America Bull., v. 51, no. 12, pt. 2, p. 1978–1979; 1941, Jour. Paleontology, v. 15, no. 2, p. 170–172, 173–174. Included in Ashland formation (new).

Named for exposures in Ashland village (in a ledge opposite Ashland Hotel), Aroostook County.

Ashland Limestone

Ashland limestone facies (of Callaway Formation)

Middle Devonian: Northeastern Missouri.

E. B. Branson, 1941, Kansas Geol. Soc. Guidebook 15th Ann. Field Conf., p. 81, 83, 85. Compact, fossiliferous limestone. Maximum thickness about 15 feet. In type area, uncomformably underlies Callaway limestone; unconformably overlies Jefferson City dolomite. Crops out in sec. 1, T. 47 N, R. 12 W.

A. G. Unklesbay, 1952, Missouri Geol. Survey and Water Resources, 2d ser., v. 33, p. 37–39. Term Ashland is preoccuped. Unit is herein referred to as Ashland limestone facies to denote *Rensselandia*-bearing beds of Callaway formation. Type locality redesignated due to typographical error in original description.

Type locality: NE¼SW¼ sec. 1, T. 46 N., R. 12 W., Boone County, about 0.3 mile north of Sycamore School, along an old abandoned roadway, 9 miles north-northwest of Jefferson City. Type locality covers only about 10 acres. Name derived from village of Ashland.

Ashland 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, 24.

Named for town of Ashland.

Ashland Mica Schist[1]

Ashland Series

Precambrian: Eastern Alabama.

Original reference: E. A. Smith and H. McCalley, 1904, Alabama Geol. Survey Bull. 9, p. 8.

G. W. Crickmay, 1936, Geol. Soc. America Bull., v. 47, no. 9, p. 1379. Considered as part of the Carolina gneiss or series.

F. R. Hunter, 1944, Alabama Geol. Survey Bull. 54, p. 13, 14. Referred to as Ashland series. Described as containing a variety of metasedimentary rocks that have been severely folded and faulted. Bordered on west by Hillabee chlorite schist and on the east by Pinckneyville granite (known to be younger than Ashland). Area of report covers Coosa County.

Named for exposure around Ashland, Clay County.

Ashland Shale[1]

Silurian: Northeastern Maine.

Original reference: H. S. Williams, 1900, U.S. Geol. Survey Bull. 165, p. 21, 45, 49–51.

W. H. Twenhofel, 1940, (abs.) Geol. Soc. America Bull., v. 51, no. 12, pt. 2, p. 1978-1979; 1941, Jour. Paleontology, v. 15, no. 2, p. 170–172, 173–174. Included in Ashland formation (new).

In Ashland village, along road opposite the hotel, and southward toward Masardis, Aroostock County.

†Ashley Marl[1]

†Ashley River Beds or Marl[1]

†Ashley-Cooper Beds or Marl[1]

Eocene, upper: Southern South Carolina.

Original reference: M. Tuomey, 1848, Agric. Survey South Carolina 1st Rept., p. 162–169, 190, 211.

Named for exposures along Ashley River, Dorchester County.

Ashley Hill Limestone[1]

Cambrian: Eastern New York.

Original reference: T. N. Dale, 1893, U.S. Geol. Survey 13th Ann. Rept., pt. 2, p. 312.

J. C. Craddock, 1957, Geol. Soc. America Bull., v. 68, no. 6, p. 694–695. Ashley Hill conglomerate mentioned under section headed Schodack shale and limestone. Rock sequence crops out on west ridge of Ashley Hill. Sequence begins with dark-gray quartzite and is succeeded by sequence of limestone, shale, and limestone conglomerate which is not known elsewhere in Kinderhook quadrangle. A crystalline limestone pebble in Ashley Hill conglomerate contains *Botsfordia caelata.* On basis of lithologic, stratigraphic, and fossil evidence, conglomerate and underlying limestone and shale are correlated with Schodack shale and limestone. Underlying quartzite is probably equivalent to Diamond Rock quartzite (Ruedemann, 1930, New York Mus. Bull. 285).

Occurs at Ashley Hill, in northeast corner of Chatham Township, Columbia County, about 1 mile north of Rayville or Rider's Mills Station on Lebanon Springs Railroad, and 2 miles south of Brainard, in Nassau.

Ash Mountain Complex

Paleozoic(?)-Mesozoic(?): Central California.

D. C. Ross, 1958, California Div. Mines Spec. Rept. 53, p. 6–7, pl. 1. Four rock types are mapped together as Ash Mountain complex. Major type is dark-gray fine-grained rock of quartz diorite composition which is intruded by a fine-grained lighter gray rock also of quartz diorite composition. The two fine-grained types are dissimilar to the plutonic types in mapped area and are possibly altered metamorphic rocks. Smaller amounts of quartz diorite, resembling material of Giant Forest pluton, and Cactus Point pluton, are present within the complex.

Named for exposures in vicinity of Ash Mountain Park headquarters, Sequoia National Park.

Ashnola Gabbro[1]

Carboniferous(?): Southwestern British Columbia, Canada, and central northern Washington.

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

Lies 2 miles east of Ashnola River, British Columbia and Washington.

Ashokan Formation (in Hamilton Group)

Ashokan Beds[1]

Ashokan Shales and Flags

Middle Devonian: Eastern New York.

Original reference: A. W. Grabau, 1917, Geol. Soc. America Bull., v. 28, p. 954.

Winifred Goldring, 1943, New York State Mus. Bull. 332, p. 267–273. Referred to as Ashokan shale and flags.

Theodore Arnow, 1949, New York State Water Power and Control Comm. Bull. GW–20, p. 15, pl. 2. Described as a formation consisting of tough laminated arkosic flagstones containing interbedded shales which weather red or brown. Sandstones are generally coarse grained and range from thin beds to flags thick enough to be quarried. Maximum thickness in Albany County nearly 350 feet. Outcrop area small. Overlies Mount Marion formation; underlies Kiskatom formation.

Named for exposures in Ashokan district, west of Kingston.

Ashtabula Till

Pleistocene (Wisconsin): Northern Ohio and northwestern Pennsylvania.

V. C. Shepps and others, 1959, Pennsylvania Geol. Survey Bull., 4th ser., G–32, p. 10 (fig. 3), 13 (fig. 4), 45, pl. 1. Gray to bluish-gray, moderately pebbly silt till deposited during Ashtabula advance near close of Cary time. Younger than Hiram till (new). Name credited to G. W. White (in press).

G. W. White, 1960, U.S. Geol. Survey Bull. 1121–A, p. 2 (table 1), 3 (fig. 1), 10–11. Thickness generally more than 25 feet and probably exceeds 50 feet in many places; at type section 19½ feet. Surface material in many areas. Overlies bedrock, Hiram till, or, in places where Hiram is absent, an earlier, coarser till. Youngest glacial deposit in Ohio. Type section designated.

Type section: Roadcut at top of bluff on east side of valley of Ashtabula River at Plymouth-Sheffield Township line, 1 mile south of northwest corner of Sheffield Township and 3 miles east of southeast corner of Ashtabula corporation line, Ashtabula County, Ohio.

†Ashton Schists[1]

Precambrian: Northeastern Rhode Island.

Original reference: J. B. Woodworth, 1899, U.S. Geol. Survey Mon. 33, p. 106, 107.

Occurs at Ashton, Providence County.

†Aspalaga Clay or Marl[1]

†Aspalaga phase (of Chattahoochee Formation or Waldo Formation)[1]

Miocene, lower: Florida and southern Georgia.

Original reference: L. C. Johnson, 1892, Geol. Soc. America Bull., v. 3. p. 128–132.

Probably named for exposures at Aspalaga, Liberty County, Fla.

Aspen Shale[1]

Aspen Shale Member (of Mancos Shale)

Lower Cretaceous: Southwestern Wyoming, eastern Idaho, northwestern Montana, and northeastern Utah.

Original reference: A. C. Veatch, 1907, U.S. Geol. Survey Prof. Paper 56.

P. T. Walton, 1944, Geol. Soc. America Bull., v. 55, no. 1, p. 97 (table 1), 100 (table 2), 101–102. Member of Mancos shale in Uinta Basin, Utah. Overlies a lower unnamed shale member; underlies a middle unnamed shale member. Thickness 15 to 95 feet.

A. J. Eardley, 1944, Geol. Soc. America Bull., v. 55, no. 7, p. 824 (table 1), 839–840. Mapped in north-central Wasatch Mountains where it is about 250 feet thick. Underlies Frontier formation; overlies Kelvin(?) formation.

L. S. Gardner, 1944, U.S. Geol. Survey Bull. 944–A, p. 6, pl. 1. Mapped in Irvine quadrangle, Idaho. Thickness 2,015 feet. Underlies Frontier formation; overlies Bear River formation.

W. A. Cobban and J. B. Reeside, Jr., 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 8, p. 1893. Age designated as Lower Cretaceous on basis of ammonite fauna.

Teng-Chien Yen, 1952, Geol. Soc. America Bull., v. 63, no. 8, p. 760–761. Bear River formation in type area underlies Aspen shale. On basis of fauna, Bear River strata are assigned to Upper Cretaceous (Cenomanian).

A. La Rocque and C. D. Edwards, 1954, Geol. Soc. America Bull., v. 65, no. 4, p. 315–326. Cretaceous Bear River and Aspen section in Willow Creek, 6 miles southeast of junction of Hoback and Snake Rivers, Teton County, Wyo., described in detail including position and nature of its faunas. Bear River is 539 feet thick, and Aspen 1,307 feet. On lithologic and paleontologic grounds, Bear River-Aspen contact is placed lower than in earlier reports. Aspen section contains 63 feet of porcellanite, which suggests prolonged volcanic activity in region. Conflicting age assignments for Bear River and Aspen discussed. Suggested that this conflict may be due to complex intertonguing between the two formations.

Robert Scholten, K. A. Keenmon, and W. O. Kupsch, 1955, Geol. Soc. America Bull., v. 66, no. 4, p. 356 (table 1), 367, 368, pl. 1. Mapped in Lima region, Montana. Overlies Kootenai formation. Upper(?) Cretaceous.

D. M. Kinney, 1955, U.S. Geol. Survey Bull. 1007, p. 98. In this report [Uinta River-Brush Creek area, Duchesne and Uintah Counties, Utah], term Mowry is used in preference to Aspen for lower dark-gray fissile shale member of Mancos.

J. B. Reeside, Jr., and W. A. Cobban, 1960, U.S. Geol. Survey Prof. Paper 355, p. 7–11. Short summary of Aspen shale included in report on Mowry shale and contemporary formations in United States and Canada. Note on type area.

Named for former station at Aspen, on now abandoned alinement of Union Pacific Railroad. Old Aspen was at center of sec. 29, T. 14 S., R. 118 W., Uinta County, Wyo., about 20 miles northeast of southwest corner of the State.

As Perdido Beds

See Asuberudido Beds.

Aspermont Dolomite[1]

Aspermont Member (of Dog Creek Formation)

Permian: North-central Texas and southwestern Oklahoma.

Original reference: W. E. Wrather, 1917, Southwestern Assoc. Petroleum Geologists Bull., v. 1, sec. opposite p. 96.

R. L. Clifton, 1942, Jour. Paleontology, v. 16, no. 6, p. 686, 687. Middle member of Dog Creek formation. Shown on chart as underlying unnamed shales and gypsums below Childress member and overlying shales above Guthrie member. Noted as occurring in Harmon County, Okla.

Probably named for Aspermont, Stonewall County, Tex.

Asphalto Lake Bed[1]

Pliocene: Southern California.

Original reference: J. G. Cooper, 1894, California Acad. Sci. Proc., 2d ser., v. 4, p. 168.

Probably named for exposures at or near Asphalto, a village near McKittrick, Kern County.

Asphalt Ridge Sandstone (in Mesaverde Group)

Upper Cretaceous: Northeastern Utah.

P. T. Walton, 1944, Geol. Soc. America Bull., v. 55, no. 1, p. 99 (table 2). 110–111, pl. 1. Defined as lower of two basal marine sandstones of Mesaverde group in Vernal (Utah) region. Usually a single massive yellow to white soft sandstone bed bounded on top by a thin tongue of Mancos shale and on bottom by main body of Mancos shale. Upper boundary transitional; in some places it is impossible to draw a sharp line between Asphalt Ridge and overlying Rim Rock sandstone (new). Thickness about 100 feet.

Typically exposed in Asphalt Ridge. Traced, with interruptions, from north end of Asphalt Ridge to the Rim Rock at Green River, where it feathers out into main body of Mancos shale.

Asphaltum Sandstone[1]

Pennsylvanian: Central southern Oklahoma.

Original reference: J. R. Bunn, 1930, Oklahoma Geol. Survey Bull. 40PP, p. 10.

G. W. Chase, 1954, Oklahoma Geol. Survey Mineral Rept. 26, p. 1–2, 4–5. Discussion of occurrence of radioactive material in sandstone lenses of southwestern Oklahoma. These sandstone lenses are associated with a crossbedded bituminous gray sandstone shown on Geologic Map of Oklahoma (Miser, 1954). Age of sandstone is given by Miser as probably equal to that of base of Garber sandstone of northern Oklahoma. Crossbedded bituminous sandstone was mapped in Cotton County and part of Tillman County as upper part of Auger conglomerate in upper part of Wichita formation by Munn (1914). Auger conglomerate extends from Cotton County into Jefferson County where it was mapped by Bunn (1930) as Ryan-Asphaltum sandstone. Crossbedded bituminous gray sandstone occurs in upper part of Asphaltum sandstone. Ryan sandstone is almost entirely crossbedded dark-gray sandstone.

Exposed in vicinity of Asphaltum, Jefferson County.

Aspinwall Limestone Member (of Onaga Shale)

Aspinwall Limestone Member (of Chicago Mound Formation)

Aspinwall Limestone or Shale (in Admire Shale)[1]

Permian: Southeastern Nebraska, eastern Kansas, and northern Oklahoma.

Original reference: G. E. Condra and N. A. Bengston, 1915, Nebraska Acad. Sci. Pub., v. 9, no. 2, p. 9, 17, 29.

G. E. Condra, 1935, Nebraska Geol. Survey Paper 9, p. 9. Permian. Underlies Hawxby shale formation; overlies Towle shale formation.

R. C. Moore, 1937, Kansas Geol. Soc. Guidebook 11th Ann. Field Conf., p. 99. Noted as persisting into northern Oklahoma. Lowermost limestone of Admire group.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 37. Basal member of Chicago Mound formation (new); underlies Hawxby shale member. Thickness 1 to 3 feet.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2273, 2274 (fig. 1). Reallocated to member status in Onaga shale (new). Underlies Hawxby shale member; overlies Towle shale member.

Type locality: Aspinwall [now abandoned], Nemaha County, Nebr.

Assabet Quartz-Diorite

Upper Paleozoic(?): Eastern Massachusetts.

W. R. Hansen, 1956, U.S. Geol. Survey Bull. 1038, p. 46, pl. 1. Medium grained, medium to dark gray, and slightly to moderately foliated. Composed chiefly, and in order of abundance, of andesine, hornblende, quartz, and biotite.

Type locality: Exposures on Hill 272 in northeast corner of Maynard. The main tongue-shaped mass of rock extends from Maynard northeastward into Concord quadrangle. Named for exposures near Assabet River in town of Maynard.

Assumption Coal Member (of Spoon Formation)

Pennsylvanian: Southwestern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 33, 45 (table 1), pl. 1. Assigned member status in Spoon formation (new). Present in lower part of formation. Coal named by Cady (1935, Illinois Geol. Survey Bull. 62). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: Mine, NE¼NW¼ sec. 2, T. 12 N., R. 1 E., Christian County.

Astoria Formation

Astoria Shale[1]

Miocene, middle: Northwestern Oregon and southwestern Washington.

Original reference: E. D. Cope, 1880, Am. Nat., v. 14, p. 457–458; 1880, Am. Phil. Soc. Proc., v. 19, p. 62.

H. V. Howe, 1926, Pan-Am. Geologist, v. 45, no. 4, p. 295–306. In city of Astoria [type locality], formation consists of a lower sandstone member, probably more than 150 feet thick, overlain by a succession of sandy shales, about 1,000 feet thick, and these in turn by a second sandstone member.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 173, 175–187; C. E. Weaver and others, 1944, Geol. Soc. America Bull., v. 55, no. 5, p. 184, chart. Formation consists of sandy clay shales with brown sandstone in upper part, in Grays Harbor area; becomes progressively more sandy toward the lower Columbia River and prevailingly massive brown medium-grained sandstone in northwest Oregon. Basaltic flows are intercalated in southwest Washington and increase in importance until, east of Portland, the formation is composed almost entirely of basalt. Thickness varies from 1,500 to as much as 12,000 feet. In some areas underlies Montesano formation; unconformably overlies Twin Rivers formation.

W. C. Warren, Hans Norbisrath, and R. M. Grivetti, 1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 42. In Clatsop and Tillamook Counties, Oreg., the Astoria reported as overlying beds of Blakeley age.

W. R. Rau, 1948, Jour. Paleontology, v. 22, no. 6, p. 774–782. Foraminiferal fauna indicates an age of lower to middle Miocene; some evidence indicates upper lower Miocene (upper Saucesian).

Well exposed in the city of Astoria, Oreg., on south side of Columbia River near its mouth. Formation has been folded into a syncline whose axis trends northwest through city of Astoria.

†Astoria Group[1]

Miocene: Northwestern Oregon and southwestern Washington.

Original reference: W. H. Dall and G. D. Harris, 1892, U.S. Geol. Survey Bull. 84, p. 223–227.

Named from Astoria, Clatsop County, Oreg.

†Astoria Sandstone[1]

Miocene: Northwestern Oregon and southwestern Washington.

Original reference: W. H. Dall and G. D. Harris, 1892, U.S. Geol. Survey Bull. 84, p. 223–227.

Named from Astoria, Clatsop County, Oreg.

Asuberudido (As Perdido) Beds

Eocene(?): Mariana Islands (Saipan).

Risaburo Tayama, 1952. Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 47–48, table 4 [English translation in library of U.S. Geol. Survey, p. 57]; S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 19. Oldest fossiliferous beds on island. Upper member consists of (ascending) tuff, conglomerate, agglomerate, shale, limy tuff; lower member is thick, false-bedded sandy tuff cut by small faults. Underlie andesite.

Typical outcrop at Asuberudido (also spelled Asuberudedo).

Asuncion Group or Formation

Upper Cretaceous: West-central California.

N. L. Taliaferro, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 11, p. 2095. Upper Cretaceous sediments (Asuncion group) rest on lower Upper Cretaceous (Jack Creek formation) with angular unconformity up to 70°, and overlap all older rocks. Asuncion group is thickest and most widespread of all divisions in Santa Lucia Range.

N. L. Taliaferro, 1943, California Div. Mines Bull. 118, pt. 2, p. 132–134, pt. 2 [preprint 1941]. Name Asuncion group is used to include all of Upper Cretaceous beds in central Coast Ranges above Pacheco group (new). Asuncion group consists of over 10,000 feet of coarse conglomerates, sandstones, and shales, which, in Santa Lucia Range, unconforably overlie Pacheco sediments and overlap onto all older rocks, Shasta, Knoxville, and Franciscan, and basement complex. In Santa Lucia Range, group is subdivided into Cantinas sandstones, Godfrey shales, and Piedras Altas formation (all new). On west side of San Joaquin Valley, group is divided into Panoche (restricted), Moreno, and Garzas formations. Majority of beds previously mapped in this region [central Coast Ranges] as "Chico" belong to Asuncion group. The two groups are separated by Santa Lucian orogeny.

N. L. Taliaferro, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 4, p. 484–512. In this report, which discusses Cretaceous of Santa Lucia Range, both terms, Asuncion group and formation, are used. Asuncion group is separated from older Pacheco group by Santa Lucian orogeny. Asuncion formation unconformably overlies Jack Creek formation of Pacheco group. Ordinarily in fault contact with Lower Cretaceous Marmolejo formation (new), though in some areas there is angular discordance. Type section stated. Anderson's Upper Cretaceous Paskenta and Horsetown groups are considered faunal stages.

F. M. Anderson, 1958, Geol. Soc. America Mem. 71, p. 30–71. Discussion of subdivisions of Pacific Coast Upper Cretaceous. Taliaferro's terms Asuncion and Pacheco groups are used. All strata definitely referable to Senonian are included in Lower Asuncion group, and strata of probable Maestrichtian age are included in Upper Asuncion group.

Type section: In Asuncion Grant, in southeast part of Adelaida quadrangle where there are good exposures of all phases along Santa Rita Creek, Templeton-Cayuocos Road, and road past Asuncion School.

Asuncion Limestone

Pleistocene: Mariana Islands (Tinian).

Risaburo Tayama, 1939, Correlation of the strata of the South Sea Islands: Geol. Soc. Japan Jour., v. 46, no. 549, p. 346 (correlation chart) [English translation in library of U.S. Geol. Survey]. Named on correlation chart. Correlated with Chatcha [Chacha] limestone of Saipan, Peleliu limestone of Palau, and Fais limestone of West Caroline. [Appears to be same as Sonson limestone (Tayama, 1952).]

Asylum 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), 1707, 1717 (fig. 16). Quaternary section of Texas Coastal Plain between Brazos River and Rio Grande is divided into 11 terraces and terrace deposits. Name Asylum is applied to a terrace deposit younger than Uvalde and older than Capitol (new). Thickness near Austin about 15 feet. Name Asylum was applied to a terrace by Hill and Vaughan (1898, U.S. Geol. Survey 18th Ann. Rept).

Named for occurrence at Austin State Hospital, Austin, Travis County. Present along Colorado River.

Atalaya Limestone

Upper Cretaceous: Puerto Rico.

R. C. Mitchell, 1954, Puerto Rico Univ. Agr. Expt. Sta. Tech. Paper 13, p. 47, 48 (table 4). Incidental mention. [May be synonymous with Las Marias limestone.]

Occurs in Atalaya Mountains, Lares district.

Atarque Member (of Mesaverde Formation)

Upper Cretaceous: Northwestern New Mexico.

W. S. Pike, Jr., 1947, Geol. Soc. America Mem. 24, p. 11, 35, 60, pl. 12. Nonmarine deposit composed of sandstones, shales, carbonaceous shales, and thin seams of coal. Thickness about 127 feet. Lowest Mesaverde in area. Underlies Horsehead tongue (new) of Mancos shale.

Occurs near village of Atarque, Valencia County, and also in Zuni Indian Reservation, McKinley County.

†Atascadero Formation[1]

Upper Cretaceous: Southern California.

Original reference: H. W. Fairbanks, 1904, U.S. Geol. Survey Geol. Atlas, Folio. 101.

Named for exposures along Atascadero Creek, San Luis Obispo County.

Atascosa Formation

Cenozoic(?): Southern Arizona.

B. P. Webb and K. C. Coryell, 1954, U.S. Atomic Energy Comm. RME-2009, p. 7, pl. 1. Consists of coarse conglomerates and some thin interbedded lava in upper section. Becomes increasingly tuffaceous toward base. Tuffs well bedded; one unit up to 500 feet thick. Thickness about 800 feet. Conformably overlies Montana Peak formation (new).

Named because of its prominent outcrops in Atascosa Range, Ruby quadrangle.

Atchinson Formation

Tertiary: Southwestern Utah.

E. F. Cook, 1957, Utah Geol. and Mineralog. Survey Bull. 58, p. 16 (fig. 2a) 18–20, 61, 63. In most places, basal unit of this formation is black breccia composed of angular blocks of augite andesite lava; about 500 feet thick and grades irregularly into unbroken flow-rock in Atchinson Mountain; locally at base are found a little white limestone and red sandstone gravel. Upper unit is a red to red-brown monolithic breccia. Thickness ranges from a fraction of a foot to about 500 feet. Overlies Rencher and Grass Valley formations (both new).

Mapped in northern half of Pine Valley Mountains, Washington and Iron Counties. Named for exposures on Atchinson Mountain.

Atchison Formation

Pleistocene: Northeastern Kansas and southern Nebraska.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 12 (fig. 5), 15. Sand and silt, well sorted; sand and gravel at base; commonly thinly laminated in upper part. Comprises pro-Kansas outwash of early Kansas age. Not recognized beyond limits of Kansas glaciation. Maximum thickness in Atchison County, 80 feet; commonly 40 feet. Underlies Kansas glacial till; overlies Nebraska till.

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 51, 62 (fig. 2), 70–74, pl. 1. Extended into Nebraska where it overlies Red Cloud formation. Type locality designated.

C. W. Hibbard, 1958, Am. Jour. Sci., v. 256, p. 55 (fig. 1). In revised classification, Atchison is basal member of unnamed formation in upper part of Meade group.

Type locality: Exposures in creek bank in SE¼SW¼ sec. 2, T. 6 S., R. 20 E., Atchison County, Kans.

†Atchison shale[1]

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

Original reference: C. R. Keyes, 1899, Am. Geologist, v. 23, p. 309.

Named for Atchison County, Mo.

Athelstane Granite[1]

Precambrian: Wisconsin.

Original reference: C. C. Wang, 1932, Geol. Soc. China Bull., v. 11, no. 4, p. 426–428.

Athens Group[1]

Pennsylvanian: Appalachian Basin.

Original reference: J. J. Stevenson, 1907, Geol. Soc. America Bull., v. 18, p. 178.

Named for Athens County, Ohio.

Athens Marble[1]

Silurian: Central western Illinois.

Original reference: A. H. Worthen, 1866, geology: Illinois Geol. Survey, v. 1, p. 1933; 1882, Econ. Geology, v. 1, p. 102–103. Menard County.

Athens Shale or **Limestone**

Athens Shale (in Blount Group)[1]

Middle Ordovician: Eastern Tennessee, northern Alabama, western North Carolina, and western Virginia.

Original reference: C. W. Hayes, 1894, U.S. Geol. Survey Geol. Atlas, Folio 4, p. 2.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 159–170. Formation has three distinct facies in Virginia; gray to black shale, sandstone, and limestone. Thickness varies from a few feet on western margins to perhaps 5,000 to 10,000 feet in large area in southern Washington County, Va., and northern Sullivan County, Tenn. In all areas in Virginia where Holston limestone and Athens are both present, Athens is underlain by Whitesburg limestone; locally overlies Lenoir limestone; in Rich Valley underlies Ottosee limestone; in Shenandoah, Rockingham, Montgomery, and Pulaski Counties, underlies Chambersburg limestone; in some areas, underlies Lowville-Moccasin formation. In Blount group. Chazyan series.

Charles Butts, 1940, U.S. Geol. Survey Geol. Atlas, Folio 226. Described in Montevallo and Columbiana quadrangles, Alabama, where it is 12 to 350 feet thick. Unconformable above Lenoir limestone and below Little Oak limestone.

C. E. Decker, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 1, p. 1–145. Discussion of graptolites of Athens shale. Shale occurs in narrow long strip for about 700 miles in Appalachian Valley from central Alabama, across northwestern Georgia, eastern Tennessee, and western part of Virginia. Athens graptolite fauna is repeated in Normanskill shale of New York. Normanskill-Athens fauna extends northeastward across New England, eastern Quebec, New Brunswick, and Newfoundland, a total distance of 2,300 miles. If westward extent is considered, including Womble shale of Arkansas and Stringtown shale and lower Viola limestone of Oklahoma, there is total extent of Athens fauna for 2,800 miles in North America.

John Rodgers, 1952, Geology of the Athens quadrangle, Tennessee (1:24,000): U.S. Geol. Survey Geol. Quad. Map. Commonly yellow-weathering blue calcareous shale or shaly limestone. Thickness 400 feet. Underlies Holston limestone; overlies Lenoir limestone. Hayes (1895, Folio 20) and Keith (1896, Folio 25) recognized that Athens they mapped is lateral equivalent of what they mapped as Chickamauga limestone, which corresponds to Lenoir limestone of Athens area. Keith mapped typical Athens as grading laterally along strike into less argillaceous limestone in Oostanaula Valley less than 10 miles northeast of Athens. Unfortunately, evidence of this lateral gradation of Athens shale into Lenoir limestone has since been overlooked by most geologists, and Athens has been mistakenly placed above the Holston instead of below. Only lowest beds of Lenoir in Sweetwater Valley are equivalent to Lenoir at Athens and farther southeast, the rest being equivalent to Athens shale. Middle Ordovician.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, p. 72–80, pls. Name Athens shale was proposed by Hayes and first used by him in Kingston folio for Upper Ordovician shale, here assigned to Reedsville shale, in belt next northwest of Whiteoak Mountain fault. In Cleveland folio (1895), which includes type locality, Hayes used name Athens for the shale here in question, between a thin "Chickamauga" limestone (Lenoir of Rodgers, 1953 [1952]) and the "Tellico sandstone" (Holston marble of Rodgers, 1953 [1952]). For present map, the thin underlying limestone is included at base of Athens. Athens in belt between Knoxville and Rocky Valley faults and Chestuee and Dumplin Valley faults consists partly of shaly nodular limestone like that in contiguous Lenoir limestone and partly of blue yellow-weathering very calcareous shale similar to that in Ottosee shale. The two grade into each other, and the formation is perhaps more generally shaly limestone than true shale. No black or noncalcareous shale and no sandstone are present. Thickness 800 to 1,100 feet. At Athens, the "shale" is exposed along southwest side of Oostanaula Creek southwest of Etowah road, but better section is exposed along Athens branch of Louisville and Nashville Railroad and along stream just north. Decker (1952) called railroad locality the type locality of Athens. Lenoir limestone and Athens shale grade into each other in vague belt near Monroe-McMinn County line. This gradation was observed and mapped by Keith (1896, Loudon folio), and it is difficult to understand how Keith's field observations could have been so long overlooked while attempt was made to fit Athens shale into the column above Holston formation instead of below. In western Sevier County, some sandstone layers in Sevier shale contain hematite and grade into red-weathering calcareous sandstone like that in Holston formation. In Blount County, detailed work by Neuman has shown that such sandstone layers occur at intervals through several thousand feet of shale. In this area, Keith (1895, Knox folio; 1896, Loudon folio) mapped some of these sandstone layers; a lower group he mapped as Tellico sandstone separating Athens shale below from Sevier shale above, and a thick persistent layer above the middle he mapped as a sandstone lentil in Sevier shale. Correlation of these layers is in dispute. Lower group of layers constitutes type Tellico sandstone as mapped by Keith on Tellico River, Monroe County (1896, Loudon folio). To the compiler [Rodgers], thick middle layer is representative in this belt [southeast of Chestuee and Dumplin Valley faults and of Saltville fault northeast of Morristown] of sheet of red sandstone and lime-sandstone forming Holston formation, and it is mapped as such from western edge of Sevier County through Blount and Monroe Counties. Shale below it is called Athens, and shale above it Ottosee. By this correlation, the lower group of layers, typical Tellico of Keith, occurs within Athens and becomes Tellico sandstone member of Athens; the higher and more lenticular layers correspond to limestone and sandstone lenses and layers in the typical Ottosee shale. Neuman disagrees with this correlation; he believes the whole shale sequence here called Sevier is younger than Holston formation in what is herein termed the standard belt. [See Holston limestone.]

R. B. Neuman, 1955, U.S. Geol. Survey Prof. Paper 274–F, p. 145, 148, 149, 154. Discussion of Middle Ordovician of Tellico-Sevier belt, eastern Tennessee. Classification used does not agree with that used by Rodgers (1953). Blockhouse shale (new) was included in lower part of Athens by Rodgers. Tellico formation, as defined in present report, includes upper part of Athens. Believed that Rodgers' introduction of terms Ottosee shale and Holston formation and continued use of Athens shale give these terms time-stratigraphic rather than rock-unit status.

Josiah Bridge, 1956, U.S. Geol. Survey Prof. Paper 277, p. 57. Term Blount group discarded.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 43–45. Proposed that name Athens be restricted to type region where formation proves to be a facies of Arline formation (new). At type section, Athens rests on thin tongue of "Chickamauga" limestone, identified in this belt as Lenoir, overlain by thin bed of impure limestone, Fetzer tongue (new) of Arline formation. Athens shale of Georgia is thinned representative of Paperville formation (new). Athens shale of Alabama is papery black shale herein named Columbiana formation. Athens shale of Virginia has been renamed, in Bristol area and Catawba Valley, Paperville formation. Graptolite shales in Saltville thrust block are herein named Rich Valley formation. Ash-weathering black limestones of Virginia, called Athens by Butts, were regarded as facies of Edinburg formation for which Campbell's (1905) name "Liberty Hall" was revived by Cooper and Cooper (1946).

Named for exposures at Athens, McMinn County, Tenn.

Athensville 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 introduced for coal formerly called Upper Scottville. Stratigraphically above Rock Branch coal member (new) and below Scottville limestone 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: SE¼NW¼SW¼ sec. 16, T. 12 N., R. 9 W., Macoupin County. Name derived from village of Athensville, Greene County, about 4½ miles to southwest of type locality.

Atherton Clay[1]

Mississippian: Southern Indiana and northwestern Kentucky.

Original reference: A. F. Foerste, 1910, Kentucky Geol. Survey Rept. Prog. 1908 and 1909, p. 76, 83, 84.

Derivation of name not stated.

Atherton Formation

Pleistocene: South-central Indiana.

H. H. Gray, R. D. Jenkins, and R. M. Weidman, 1960, Indiana Geol. Survey Bull. 20, p. 19–20, 21, pl. 1. Formation, as defined by W. J. Wayne (in preparation), includes a number of interrelated unnamed facies, all of which are a part of, or are closely associated with, sands and gravels that were deposited along melt-water streams during glacial ages. Only two of the major facies of formation are present in Huron area, and only one of these is exposed at surface. Windblown sand facies is exposed on valley slopes along East Fork of White River; thickness probably does not exceed 20 feet. Outwash sand and gravel facies present in valley of White River to a depth of 60 feet or more below present river level; exact distribution unknown as deposits are covered by alluvial sands of Martinsville formation (new). Sand and gravel facies probably intertongues with lower part of Prospect formation (new). Part is Wisconsin but part may be Illinoian or older.

Type locality and derivation of name not stated.

Athertonville facies (of Brodhead Formation)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 76, 148–154. Consists of limestone in upper half; lower strata generally siltstone and silty, gritty shales. Thickness 175 to 200 feet. Includes near base, Rolling Fork limestone (above) and Ginseng siltstone members (both new) of Brodhead formation. Merges with Pilot Knob facies (new) on west and with Liberty facies (new) on east. Underlies Floyds Knob formation; overlies New Providence formation, Keith Knob and Junction City facies (both new).

Named for village of Athertonville, on U.S. Highway 68, northwestern La Rue County. Entire Brodhead formation is exposed along secondary road which ascends valley side of Rolling Fork of Salt River, one-fourth mile north of village.

Athol Shale[1]

Middle Devonian: Western New York.

Original reference: A. W. Grabau, 1930, Science Quart. Nat. Univ. Peking, China, v. 1, no. 4, p. 322–326.

Exposed on the Lake shore (Eighteen-mile Creek region) at Athol Springs and Bay View, Erie County.

Atkinson Formation

Upper Cretaceous: Subsurface in Georgia, Alabama, and Florida.

P. L. Applin and E. R. Applin, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 26. Comprises subsurface deposits of early Upper Cretaceous sequence occurring between base of beds of Austin age and top of Lower Cretaceous. On basis of differences in lithology, formation is divided into three unnamed members.

Name derived from Atkinson County, Ga., where Sun Oil Co. drilled Doster-Ladson Well 1 (lot 71, Land District 7).

Atlantic Amygdaloid (in Ashbed Group)[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Named for occurrence in Atlantic mine, Houghton County.

Atlantic Flow[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Named for occurrence in Atlantic mine, Houghton County.

†Atlantic Group[1]

Tertiary: Atlantic Coastal Plain.

Original reference: O. Meyer, 1888, Am. Geologist, v. 2, p. 88–89, 93–94.

Comprises the Atlantic States proper from New Jersey to Florida.

Atlantic Muck

Pleistocene and Recent: Panamá.

[T. F. Thompson], 1943, Panama Canal, Spec. Eng. Div., 3d Locks Proj., pt. 2, chap. 3, p. 23. Heterogeneous mixture of alluvially deposited silts, clays, and carbonaceous material within which are beds of marine origin containing Pleistocene and early Recent forms of mollusks and corals.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 324. Informal name. Marine deposits contain numerous species of mollusks, nearly all of which are Recent.

Present on Atlantic side of Panama Canal.

Atlas Formation[1]

Quaternary: Southern California.

Original reference: A. C. Lawson, 1906, California Univ. Pub., Dept. Geology Bull., v. 4, p. 431–462.

O. P. Jenkins, 1943, California Div. Mines Bull. 118, p. 673. Quaternary. Older than Tank volcanics.

Derivation of name not stated.

Atoka Formation[1]

Atoka Series

Atoka(n) Stage

Middle Pennsylvanian: Eastern Oklahoma, western and southwestern Arkansas, eastern New Mexico, and central and western Texas.

Original reference: J. A. Taff and G. I. Adams, 1900, U.S. Geol. Survey 21st Ann. Rept., pt. 2, p. 273.

C. W. Wilson, Jr., 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 4, p. 504–507; C. W. Wilson, Jr., and N. D. Newell, 1937, Oklahoma Geol. Survey Bull. 57, p. 24–35, pl. 1. Formation, in Muskogee-Porum district, subdivided into 12 units, 6 sandstone members each overlain by an unnamed shale unit. Sandstone members (ascending): Coody (Coata), Pope Chapel, Georges Fork, Dirty Creek, Webbers Falls, and Blackjack School. Thickness about 600 feet. Overlies Bloyd formation of Morrow group; underlies Hartshorne sandstone. Basal formation of Des Moines group. Atoka, Hartshorne, McAlester, and Savanna formations and a part of Boggy shale are directly traceable into Winslow formation as heretofore mapped in Muskogee quadrangle.

B. H. Harlton, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 7, p. 854 (fig. 1), 858, 859. Overlies Barnett Hill formation (new). Unit here termed Barnett Hill was locally assigned by Taff to Atoka formation but in other areas was included in Wapanucka.

M. G. Cheney and others, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 2, p. 156. Discussion of main divisions of Pennsylvanian system. Pronounced unconformities are reported within thick type Atoka section; hence it is thought to represent considerable length of time and complex geologic history. If Atoka division is not given rank of series, it might be given rank of group; if time-rock term stage is to be used for Paleozoic rock divisions as it is in Europe and as it has been introduced for Mesozoic and Cenozoic rocks of United States, this division could appropriately be called Atoka stage.

R. C. Spivey and T. G. Roberts, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 2, p. 185–186. Raised to series rank and defined to include all beds from top of Wapanucka limestone, Morrow series, to base of Hartshorne sandstone, Des Moines series. As thus defined, includes

Marble Falls, Smithwick, and overlying *Fusulinella* (restricted)-bearing beds of central and north Texas, Derry series of New Mexico and west Texas, and equivalent beds in other areas as equivalence is established.

C. A. Moore, 1947, Oklahoma Geol. Survey Bull. 66, p. 17 (table 1), 50–52, measured section. Detailed discussion of Morrow series in northeastern Oklahoma. All sections measured in Morrow series were carried at least to base of Atoka sandstone and, where possible, to top of hills, so as to include a portion of Atoka formation. Locally thin-bedded, generally medium- to coarse-grained crossbedded sandstone rests on upper part of Bloyd shale in all areas except northward from Yonkers, where Bloyd was removed by pre-Atoka erosion, and Atoka is in contact with Hale formation. Top of Atoka not present in area. These post-Morrow beds in Adair and most of Cherokee Counties were called Winslow (Taff, 1905, U.S. Geol. Survey Geol. Atlas, Folio 122; 1906, U.S. Geol. Survey Geol. Atlas, Folio 132) and, in Wagoner and Mayes Counties, have been referred to Cherokee. Croneis (1930, Arkansas Geol. Survey Bull. 3) first used term Atoka for beds called Winslow in Arkansas, and Wilson (1937) recognized Atoka, Hartshorne, McAlester, and Savanna formations in Muskogee area, replacing general term Winslow. Des Moines series.

R. C. Moore and M. L. Thompson, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 3, p. 292. Rocks of Oklan series (new) are divisible into two stages, Atokan (or Derryan) and Desmoinesian.

T. A. Hendricks and Bryan Parks, 1950, U.S. Geol. Survey Prof. Paper 221–E, p. 69 (table), 70–73, pl. 11. Discussion of Fort Smith district, Arkansas. Atoka formation, oldest bedded rock exposed in area, crops out in five parts of district; largest area of outcrop is in southern part of district. Consists chiefly of alternating beds of sandstone and shale, the shale being more abundant, and locally contains discontinuous streaks of coal and coaly shale. Thickness about 6,900 feet south of Backbone Mountain; about 3,300 feet near Mansfield. Underlies Hartshorne sandstone, minor unconformity. Atoka formation of Fort Smith district is identical with Atoka formation in Oklahoma.

L. G. Henbest, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 8, p. 1935–1953. Formation, in Arkansas, subdivided to include Greenland sandstone member (new) at base. Overlies Bloyd shale of Morrow group. Exact position of boundary between Morrow group and Atoka locally difficult to determine on purely physical stratigraphic basis in Washington County.

J. A. Reinemund and Walter Danilchik, 1957, U.S. Geol. Survey Oil and Gas Inv. Map OM–192. Formation described in Waldron quadrangle, Scott County, Ark. Composite section of measured outcrops of Atoka across Waldron syncline shows that about 11,800 feet of strata assigned to formation crop out between top of formation, 4 miles north of Waldron and Ross Creek fault, 3½ miles south of Waldron. Rocks underlying those exposed in Waldron syncline crop out in Brushy Mountain anticline where they have combined stratigraphic thickness of about 7,200 feet. Total thickness in northern part of Waldron quadrangle, north of Ross Creek fault, appears to be at least 19,000 feet. In southern part of quadrangle, stratigraphic thickness in Black Fork syncline is estimated at about 18,500 feet, but highest and lowest strata are not present.

Overlies Johns Valley shale; underlies Hartshorne sandstone. (Stratigraphic equivalence of Hartshorne in Waldron quadrangle with Hartshorne in Fort Smith district and eastern Oklahoma is in doubt). Atoka formation is included in Atoka series.

G. G. Huffman and others, 1958, Oklahoma Geol. Survey Bull. 77, p. 14 (fig. 2), 82–86, pls. Discussion of south and west flanks of Ozark uplift, northeastern Oklahoma. Atoka formation is widespread from Arkansas line westward to Arkansas River southeast of Muskogee. Thins northward from maximum of 600 feet southeast of Muskogee to 0 near Adair where it is truncated and overlapped by younger units. Northward thinning is by convergence, loss of lower member by progressive northward overlap and unconformity above. Webbers Falls member believed to be most extensive. Lies with unconformity upon Bloyd, Hale, and Fayetteville formations. Truncated by erosion and overlapped northward by shales, clays, and sandstones of Hartshorne-McAlester sequence. Assigned to Atoka series of Middle Pennsylvanian age.

J. G. Blythe, 1959, Oklahoma Geol. Survey Circ. 47, p. 5–74. Discussion of Atoka formation on north side of McAlester basin. Formation passes northward into a platform facies, thins, and is overlapped by Desmoinesian rocks. Facies changes and thinning of section north of Arkansas River made it unwise to attempt perfect identification of the rapidly thinning shelf-facies section with member as described in Muskogee-Porum area. Webbers Falls sandstone provided persistent marker unit and made it possible to identify Blackjack School member. Georges Fork and Dirty Creek members could not be identified north of Arkansas River and were mapped as one unit. Likewise Coody and Pope Chapel were mapped as one unit. Thickness 37 to 508 feet.

O. B. Shelburne, 1960, Oklahoma Geol. Survey Bull. 88, p. 17 (fig. 2), 41–44, 63, 64, pl. 1. Formation is 6,800 feet thick in Boktukola syncline; an unknown thickness has been removed by erosion. Basal part of formation is Morrowan. Contains sandstone mold faunas similar to Honess' (1924, [Oklahoma] Bur. Geology Circ. 3) "Morrow fauna" and spiculite cherts which may be partially equivalent to Chickachoc chert. Middle and upper parts of formation of Boktukola syncline are equivalent to Atoka formation of frontal Ouachitas. Harris Creek syncline is fan fold which exposes Atoka formation rather than anticline of Stanley shale as shown on Geologic map of Oklahoma. Overlies Johns Valley formation in Boktukola and Harris synclines. Morrowan-Atokan.

Named for Atoka, Atoka County, Okla., which is situated on outcrop of formation.

Atolia Quartz Monzonite[1]

Cretaceous(?): Southern California.

Original reference: C. D. Hulin, 1925, California State Mining Bur. Bull. 95, p. 33–42, map.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 509–510, table 4. Mentioned in discussion of crystalline rocks of southern California. Listed on table as Late Mesozoic.

U.S. Geological Survey currently designates the age of the Atolia as Cretaceous(?) on the basis of a study now in progress.

Named for exposures at and around Atolia, San Bernardino County.

Atrasado 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. Thin- to thick-bedded gray to dark-gray limestone, gray and red shale, and red to light-reddish-brown and gray conglomeratic sandstone. Thickness 550 to 800 feet. Underlies Red Tanks member (new); conformably overlies Gray Mesa member (new).

Occupies tops of Gray Mesa and Monte de Belen; exposed in other parts of Lucero Uplift, Valencia and Socorro Counties.

Atrypa limestone[1]

Upper Devonian: Nevada.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 52, 78.

Name derived from Atrypa Peak, in Eureka district.

Attalla Chert Conglomerate Member (of Chickamauga Limestone)[1]

Attalla Formation

Middle Ordovician: North-central Alabama.

Original reference: C. Butts, 1910, U.S. Geol. Survey Geol. Atlas, Folio 175.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 45, 53, 55. Referred to as Attalla formation. Butts applied name Attalla to a coarse conglomerate, 20 to 40 feet thick, at base of Chickamauga limestone in Birmingham Valley. Conglomerate is patchy in occurrence. This conglomerate, together with red and green shales at base of the Chickamauga which the writer [Cooper] includes in name Attalla, is suggestive of Blackford lithology of Tennessee and Virginia but obviously deposited at a different time than Blackford. Except for Butts' use of name Chickamauga in Alabama, term has passed into disuse.

Named for exposures at Attalla, Etowah County.

Attica Shale[1] (in Naples Group)

Upper Devonian: Western New York.

Original references: G. H. Chadwick, 1919, Geol. Soc. America Bull., v. 30, p. 157; 1923, Geol. Soc. America Bull., v. 34, p. 69.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 63, no. 12, pt. 1, chart 4. Shown on correlation chart as overlying Cashaqua shale and underlying Grimes sandstone or Angola shale. Included in Naples group.

R. G. Sutton, 1960, New York State Mus. Bull. 380, p. 10–11, 19. Name Attica shale, formerly applied to Naples strata above Cashaqua formation in Lake Erie region, is herein abandoned, and term Rhinestreet black shale is applied westward to Lake Erie.

Probably named for exposure at Attica, Wyoming County.

Attleboro Sandstone[1]

Carboniferous: Southeastern Massachusetts and Rhode Island.

Original reference: J. B. Woodworth, 1899, U.S. Geol. Survey Mon. 33, p. 134, 144, 151–152.

Named for exposures in town of North Attleboro, Bristol County, Mass.; also exposed in vicinity of Deantown, in Attleboro Township.

Attwood Series[1]

Carboniferous(?): Southern British Columbia, Canada, and northeastern Washington.

Original reference: R. A. Daly, 1912, Canada Geol. Survey Dept. Mines Mem. 38, map 10.

Mapped at and around Attwood Mountain, British Columbia.

Atwater Member (of Crooked Creek Formation)

Pleistocene (Kansan and Yarmouthian): Southwestern Kansas.

C. W. Hibbard, 1958, Am. Jour. Sci., v. 256, no. 1, p. 55 (fig. 1), 58. Named and described as consisting of sandy silt, silt, silty clay, and clay which contains Pearlette ash lentil, when present; massive caliche generally present at top of member. Thickness about 50 feet. Overlies Stump Arroyo sand and gravel member; underlies Kingsdown formation.

Type section: In N½ sec. 21, T. 33 S., R. 28 W., on east side of Crooked Creek, Meade County. Name derived from old Atwater post office.

Atwater Creek Shale[1]

Middle Ordovician: Eastern New York.

Original reference: Rudolf Ruedemann, 1921, New York State Mus. Bull. 227, 228, p. 124–126, 130.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 286, pl. 4. Arenaceous transitional facies between black Deer River shale and sandy Lorraine shale of northwestern New York. Thickness at type locality about 70 feet.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, p. 286, chart 2 (column 19). Placed in Utica shale (restricted).

Type area: Atwater Creek, west of Martinsburg, Lewis County.

Aubrey Group[1]

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

Original reference: G. K. Gilbert, 1875, U.S. Geog. and Geol. Survey W. 100th Meridian, v. 3, p. 176–185, 197.

T. F. Stipp and H. M. Beikman, 1959, U.S. Geol. Survey Oil and Gas Inv. Map OM–201. Group includes (ascending) Supai formation, Hermit shale, Coconino sandstone, Toroweap formation, and Kaibab limestone. Overlies Redwall limestone; underlies Moenkopi formation.

Named for exposures at Aubrey Cliff, which faces Aubrey Valley, in northern Arizona and stretches southeast nearly to Camp Apache.

†Aubrey Limestone[1]

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

Original reference: G. K. Gilbert, 1875, U.S. Geog. and Geol. Survey W. 100th Meridian, v. 3, p. 171–187, figs. 81, 82.

Named for exposures at Aubrey Cliff, which faces Aubrey Valley, in northern Arizona and stretches southeast nearly to Camp Apache.

†Aubrey Sandstones[1]

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

Original reference: G. K. Gilbert, 1875, U.S. Geog. and Geol. Survey W. 100th Meridian, v. 3, p. 171–187, figs. 81, 82.

Named for exposures at Aubrey Cliff, which faces Aubrey Valley, in northern Arizona and stretches southeast nearly to Camp Apache.

Aubreyan series[1]

Carbonic: Northern Arizona.

[Original reference: C. R. Keyes, 1922, Pan-Am. Geologist, v. 38, p. 251, 336.]

Charles Keyes, 1936, Pan-Am. Geologist, v. 66, no. 3, p. 215 (chart), 223. Includes (ascending) Chiquito sandstones, Huethawali limestone, Havasupai sandstones, Wompats limestone, and Kanab limestones (new). Unconformably overlies Tusayan series (new). Of Carbonic age.

In Grand Canyon region.

Auburn Chert[1]

Middle Ordovician (Trentonian): East-central Missouri.

Original reference: R. R. Rowley, 1908, Missouri Bur. Geology and Mines, 2d ser., v. 8, p. 14, 16.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, p. 262–263, chart 2 (column 51). Placed in lowest Trentonian to conform to placement of Spechts Ferry shale with which it is correlated.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 27, pt. 1, p. 117. Has been suggested that Auburn chert be included in Plattin group; brachiopods are not in accord with this suggestion. Here suggested that formation may be chertified Decorah of Missouri-Barnhart formation (new) rather than Plattin and correlation should be with Guttenberg member of Decorah.

Forms surface stone of Auburn, Lincoln County.

Auburn Shale (in Wabaunsee Group)[1]

Pennsylvanian (Virgil Series): Eastern Kansas, southwestern Iowa, northeastern Missouri, southeastern Nebraska, and northern Oklahoma.

Original reference: J. W. Beede, 1898, Kansas Acad. Sci. Trans., v. 15, p. 30.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 18. Geographically extended into Iowa and Missouri.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 56 (fig. 21), 60, 70 (fig. 25). Somewhat complex and variable unit composed chiefly of shale containing minor amounts of sandstone and limestone, part of which is chalky. Contains two or more local coal beds. Near Kansas River, contains lenses of crossbedded limestone and conglomerate and coquinoid masses of molluscan and algal remains as much as several feet thick; locally contains dark shale-bearing ostracodes and pelecypods. Thickness in Kansas ranges from about 20 to 70 feet. Underlies Reading limestone; overlies Wakarusa limestone.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2274 (fig. 1). Wabaunsee group redefined. Auburn shale overlies Wakarusa limestone member of Bern limestone (new); underlies Reading limestone member of Emporia limestone.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 54–55. Term is applied to sandstone-shale sequence between Wakarusa and Reading limestones. Auburn is continuous from southeastern Nebraska across

Kansas into northern Oklahoma, where it has been traced into southern Lincoln County. South of Lincoln County, limiting limestones pinch out, and Auburn cannot be distinguished from adjacent shales. Thickness 65 to 70 feet in Pawnee County. Overlies Wakarusa limestone; underlies Reading limestone member of Emporia limestone.

H. G. Hershey and others, 1960, Iowa Highway Research Bull. 15, p. 13, fig. 5. Upper part of greenish-gray clayey shale; in center shale is deep red to maroon, silty, and micaceous; this middle part commonly contains leaf prints and carbonaceous films; lower part is silty, dark gray to black, and locally carbonaceous. Thickness about 35 feet. Underlies Reading limestone; overlies Wakarusa limestone. Wabaunsee group.

Type locality: Not designated but undoubtedly in vicinity of Auburn, Shawnee County, Kans. Good exposures along Wakarusa Creek near NE cor. sec. 26, T. 13 S., R. 14 E., southwest of Auburn.

Auger Conglomerate Lentil (in Wichita Formation)[1]

Permian: Southwestern Oklahoma.

Original reference: M. J. Munn, 1914, U.S. Geol. Survey Bull. 547, p. 23–26.

G. W. Chase, 1954, Oklahoma Geol. Survey Mineral Rept. 26, p. 1, 2, 3–4. Discussion of radioactive material in sandstone lenses of southwestern Oklahoma. These sandstones are associated with a crossbedded bituminous gray sandstone shown on Geologic Map of Oklahoma (Miser, 1954). Age of sandstone is given by Miser as probably equal to that of base of Garber sandstone of northern Oklahoma. The crossbedded bituminous sandstone was mapped in Cotton County and parts of Tillman County as upper part of Auger conglomerate in upper part of Wichita formation by Munn (1914). Auger conglomerate extends from Cotton County into Jefferson County where it was mapped by Bunn (1930, Oklahoma Geol. Survey Bull. 40PP) as Ryan-Asphaltum sandstone.

Named for old Fort Auger and Auger Creek, Tillman County.

Au Gres Limestone

See Point aux Gres Limestone.

†Augusta limestone,[1] group,[1] or stage[1]

Mississippian: Iowa, Illinois, and Missouri.

Original reference: C. R. Keyes, 1893, Iowa Geol. Survey, v. 1, p. 59–71.

Named for Augusta, Des Moines County, Iowa.

Augusta Mountain Formation

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]. Limestone and dolomite with some intercalated shale. At type locality subdivided into three unnamed members. Total thickness about 2,500 feet. Conformably underlies Cane Spring formation (new); conformably overlies Favret formation (new).

H. G. Ferguson, S. W. Muller, and R. J. Roberts, 1951, Geology of Winnemucca quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–11]. Overlies Panther Canyon formation (new).

Type locality: Augusta Mountain.

Augustinillo Formation (in Jacaguas Group)

Eocene, middle: Puerto Rico.

E. A. Pessagno, Jr., 1960, Geology of the Ponce-Coamo area, Puerto Rico: Puerto Rico Econ. Devel. Adm. and Princeton Univ. Dept. Geology, p. 94–103, geol. map. Consists of 17,000 feet of marine sediments. Includes Collores member (new) to east and Monserrate member (new) to west. Interfingers with Naranjo formation (new). May interfinger with Río Culebrinas formation to west.

E. A. Pessagno, Jr., 1960, Caribbean Geol. Cong., 2d, Mayagüez, Puerto Rico, 1959, Trans., p. 83, 84–85. Text states that Augustinillo is in Guayabal group. Footnote states that the Guayabal is currently called Jacaguas group.

Typically exposed in area to east and west of Cerro Augustinillo. Crops out in Ponce, Jayuya, and Adjuntas quadrangles.

Aunuu Tuff

Aunuu Island Tuff

Recent: Samoa Islands (Aunuu).

R. A. Daly, 1924, Carnegie Inst. Washington Pub. 340, p. 113, pl. B (geol. map). Mapped as Aunuu Island tuff. Referred to in text as Aunuu cone and crater.

H. T. Stearns, 1944, Geol. Soc. America Bull., v. 55, no. 11, p. 1285 (table 1), pl. 1 (geol. map). Aunuu tuff about 200 feet thick.

G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 153. Referred to Aunuu Island formations. A tuff cone, consisting of palagonitic tuff containing fragments of reef limestone. Recent.

Occurs on Aunuu Island.

Aurela Ridge Group or Granulites

Age unknown: Southern California.

K. J. Hsu, 1955, California Univ. Dept. Geol. Sci. Bull., v. 30, no. 4, p. 231–274, geol. map. Essentially granulites; associated with minor amphibolites, mylonitic plutonic rocks, and plutonic intrusives. Separated from Cucamonga Canyon group (new) by Cucamonga Canyon thrust. Alf (1948, Geol. Soc. America Bull., v. 59, no. 11) referred to these rocks as "pyroxene dioritic gneiss," but term is misleading and is therefore discarded.

Named for exposures on Aurela Ridge in Cucamonga quadrangle, San Bernardino County. Occurs in an east-northeast-trending belt with a maximum width of about three-fourths of a mile.

Aurora Siltstone Member (of Orangeville Shale)

Aurora Sandstone Member (of Orangeville Shale)[1]

Mississippian: Northeastern Ohio.

Original reference: C. S. Prosser, 1912, Ohio Geol. Survey, 4th ser., Bull. 15, p. 123, 209, 211.

F. T. Holden, 1941, Illinois Acad. Sci. Trans., v. 34, no. 2, p. 172; 1942, Jour. Geology, v. 50, no. 1, p. 41 (table 2), 44–45. Listed as a submember of Orangeville shale member of Tinkers Creek facies of Cuyahoga formation.

J. F. Pepper, Wallace de Witt, Jr., and D. F. Demarest, 1954, U.S. Geol. Survey Prof. Paper 259, p. 42. Composed predominantly of siltstone. At type locality, lies upon about 12 feet of grayish-black and very dark gray shale of the Orangeville which includes Sunbury member. Maximum thickness about 6 feet.

Named for exposures on Aurora Creek in northwest part of Portage County.

†Ausable Granite[1]

Precambrian: Northeastern New York.

Original reference: J. F. Kemp, 1894, New York State Mus. 47th Ann. Rept.

Quarried near Keeseville, Essex County.

Ausable Sandstone[1]

Upper Cambrian: Eastern New York.

Original reference: H. I. Alling, 1919, New York State Mus. Bull. 207, 208, p. 113–145.

D. W. Fisher, 1956, Internat. Geol. Cong., 20th, Mexico, Cambrian Symposium, pt. 2, p. 329. Name was briefly mentioned by Alling (1919), and never since used, for basal Potsdam underlying the white Potsdam or "Keeseville" sandstone. Probably not valid unit.

Austell Granite

Precambrian(?): Northwestern Georgia.

G. W. Crickmay, 1952, Georgia Geol. Survey Bull. 58, p. 41–42. Described as an augen gneiss.

Exposed in an elongate area extending from Austell, Cobb County, southwestward across Douglas County, into eastern Carroll County.

Austin Chalk[1]

Austin Group

Upper Cretaceous (Gulf Series): Eastern Texas.

Original reference: B. F. Shumard, 1860, St. Louis Acad. Sci. Trans., v. 1, p. 583, 585.

L. W. Stephenson, 1937, U.S. Geol. Survey Prof. Paper 186–G, p. 133–146. Consists of interbedded layers of hard chalk, softer chalk, and chalky marl; some of marly layers are strongly argillaceous as in upper part that Adkins (1932 [1933]) called Burditt marl. Estimated thickness at type locality 420 feet. Relation of faunal zones in upper part of Austin chalk to top of chalk indicates presence of unconformity of regional extent separating the Austin and beds of Austin age from overlying Taylor marl and beds of Taylor age. Time value of this unconformity varies from place to place along strike.

D. L. Frizzell, 1954, Texas Univ. Bur. Econ. Geology Rept. Inv. 22, p. 34–39. Austin group comprises Ector tongue, Bonham clay, Blossom sand, Brownstown marl, Gober tongue, Austin chalk, and Burditt marl. Below Taylor group and above Eagle Ford group. Foraminifera described.

Type area: Travis County. Named for Austin.

†Austin Marble[1]

Lower Cretaceous (Comanche Series): Southeastern Texas.

Original reference: R. T. Hill, 1889, Texas Geol. Survey Bull. 4, p. xxii.

Named for occurrence at Austin.

Austin Glen Member (of Normanskill Formation)

Middle Ordovician: Eastern New York.

Rudolf Ruedemann, 1942, New York State Mus. Bull. 327, p. 28. Incidental mention in discussion of Cambrian and Ordovician fossils.

Rudolf Ruedemann, 1942, New York State Mus. Bull. 331, p. 93 (fig. 35), 102, 107–108, 115–116, geol. map [1946]. Grit and shale with lenses of mud pebbles and arkosic conglomerate. Thickness varies; more than 500 feet. Overlies Mount Merino member; underlies Rysedorph conglomerate. Derivation of name given.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2 (column 14). Shown on correlation chart as Mohawkian (Trentonian).

Named for Austin Glen in Catskill Valley near village of Catskill [Catskill quadrangle]. Exposed in creek bed where it forms a north-south striking anticline, giving an outcrop of 355 feet length across the strike.

Austinville Dolomite Member (of Shady Dolomite)

Lower Cambrian: Southwestern Virginia.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 41, 42, 51–52. Defined as middle member of Shady dolomite. Thick-bedded coarsely crystalline nearly white light-gray to cream-colored dolomite. Thickness about 1,000 feet. Underlies Ivanhoe limestone member; overlies Patterson limestone member.

A. J. Stose and G. W. Stose, 1957, Virginia Div. Mineral Resources Bull. 72, p. 115. Name Austinville not used because dolomite exposed at Austinville is regarded as Ledger dolomite and not part of Shady dolomite.

Named for town of Austinville, Wythe County.

Au Train Formation

Lower and Middle Ordovician: Northern Michigan.

W. K. Hamblin, 1958, Michigan Dept. Conserv., Geol. Survey Div. Pub. 51, p. 6 (fig. 1), 115–120, pls. 2, 4. Dominantly medium- to fine-grained dolomitic sandstone. Comprises two unnamed members. Lower member, approximately 100 feet thick, characterized by abundant glauconite which occurs as disseminated grains in dolomitic sand and concentrated in thin dark-green beds. Thin beds of glauconite more abundant near base of section at 3- to 12-foot intervals. Bedding in glauconitic member thin and undulatory; color buff to brownish gray, except for more glauconitic areas where color is speckled green or solid dark green. Some of more dolomitic beds blue to bluish gray. Much of weathered surface a definite brown. In upper member, glauconite completely absent and thin sandstone lenses numerous. Sandstone beds, more than 10 feet thick, also present. Sandstone characteristically medium to fine grained and contains few thin lenses of blue to greenish shale. Maximum thickness of formation, indicated in core samples, slightly more than 300 feet but only lower 125 feet exposed at type locality. Overlies Miners Castle member (new), Munising formation with unconformity. Hamblin, following Grabau (1906), proposes that Au Train formation be used for these rocks, which had been included under Hermansville limestone.

U.S. Geological Survey currently designates the age of the Au Train as Lower and Middle Ordovician on the basis of a study now in progress.

Type locality: Au Train Falls, in Alger County, where rocks are best exposed and sections are thickest.

Auts Canyon Formation (in Sheeprock Group)

Precambrian: West-central Utah.

DeVerle Harris, 1958, Brigham Young Univ. Research Studies, Geology Ser., v. 5, no. 1, p. 6, 8–15, pl. 1. Succession of phyllites, phyllitic quartzites, quartzites, feldspathic quartzites, and graywacke conglomerate semischists that comprises allochthon of Sheeprock thrust. Total measured thickness 5,559 feet. Underlies Ekker formation (new).

Measured in Aut's Canyon, Dutch Peak area, Sheeprock Range, Tooele County.

Aux Sable Limestone[1]

Upper Ordovician: Northeastern Illinois

Original reference: J. R. C. Evans, 1926, Chicago Univ., Abs. Theses, Sci. serv., v. 2, p. 199–200.

Type locality not stated.

Aux Vases Sandstone[1]

Aux Vases Formation

Aux Vases Sandstone (in New Design Group)

Upper Mississippian (Chester Series): Eastern Missouri, southwestern Illinois, and southern Indiana.

Original reference: C. R. Keyes, 1892, Geol. Soc. America Bull., v. 3, p. 295.

J. M. Weller, 1939, Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 131, 134; J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 766 (fig. 1), 823–824. Basal formation of newly defined New Design group. Commonly a brownish massive fine-grained crossbedded sandstone. In Missouri more or less variegated shaly beds occur in both upper and lower parts of formation and middle massive sandstone is more yellowish; in Perry County, is coarser grained and locally resembles St. Peter formation. Basal conglomerate present in many places in both Illinois and Missouri. Thickness varies because of deposition upon uneven surfaces of Ste. Genevieve and St. Louis limestone and because it suffered erosion before deposition of Renault limestone. In Monroe County, Ill., overlapped by Renault; elsewhere attains thickness of 80 to 100 feet.

C. A. Malott, 1946, Jour. Geology, v. 54, p. 322–326. Geographically extended into southern Indiana where it underlies Paoli limestone and overlies Ste. Genevieve limestone.

C. A. Malott, 1952, Stratigraphy of the Ste. Genevieve and Chester formations in southern Indiana: Ann Arbor, Mich., The Edwards Letter Shop, p. 11–12. Aux Vases typically rests on Bryantsville breccia. Varies from thin shaly beds only a few inches thick to a hard cross-laminated calcareous sandstone 1 to 8 feet thick. At many places, welded directly with base of Paoli limestone without sign of break between the two. Extends throughout outcrop area of base of Chester, except locally; about 6 miles northwest of Greencastle, Putnam County, Pennsylvanian Mansfield sandstone cuts below it at Mississippian-Pennsylvanian contact.

T. G. Perry and N. M. Smith, 1958, Indiana Geol. Survey Bull. 12, p. 23, pl. 1. Because Indiana exposures contain variety of rock types and mixtures of rock types, Indiana Geological Survey uses term Aux Vases formation. Term New Design group not used in Indiana.

H. H. Gray, R. D. Jenkins, and R. M. Weidman, 1960, Indiana Geol. Survey Bull. 20, p. 49–50. Term Aux Vases rejected in Indiana. Unit formerly called Aux Vases is included in Paoli limestone as herein redefined.

Named for exposures on Aux Vases River, Ste. Genevieve County, Mo.

Auxvasse Creek Sandstone Member (of Callaway Limestone)[1]

Devonian: East-central Missouri.

Original reference: F. B. Conselman, [1935], Missouri Acad. Sci. Proc., v. 1, p. 105, 108–113, 119.

M. A. Stainbrook, 1945, Am. Jour. Sci., v. 243, no. 3, p. 144. Discussion of stratigraphy of Independence shale of Iowa. Stratigraphically, Independence corresponds to 15-foot bed of sandstone which crops out about 10 miles south of Hannibal, Mo. At this locality, Callaway limestone has typical Cedar Valley fossils and limestone below the Cooper is in every way similar to Davenport member of Wapsipinicon. This sandstone appears to be the same one previously designated as Auxvasse Creek sandstone member of Callaway. It seems to be a continuation of the sandstone below Cedar Valley to north in southeast Iowa and of Independence shale farther north.

Occurs in Auxvasse Creek quadrangle, Callaway County.

Ava Shale (in Pottsville Formation)[1]

Ava Shale (in Tradewater Group)

Pennsylvanian: Southwestern Illinois.

Original reference: T. B. Root, 1928, Illinois Geol. Survey Rept. Inv. 16, p. 9, 10, pls. 1, 2.

H. R. Wanless and Raymond Sevier, 1956, Illinois Geol. Survey Circ. 217, pl. 1 (column 5). Shown in Tradewater group. Lies below Makanda formation and above Boskydell sandstone.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 28, 54, 55, 56. Presentation of new rock-stratigraphic classification of Pennsylvanian strata of Illinois. Term Tradewater group discontinued; hence terms Ava, Makanda, and Boskydell are discontinued.

Avant Limestone Member (of Iola Limestone)

Avant Limestone Member (of Ochelata Formation)[1]

Pennsylvanian (Missouri Series): Northwestern Oklahoma.

Original reference: D. W. Ohern, 1910, Oklahoma State Univ. Research Bull. 4, p. 31, 37.

R. C. Moore and others, 1937, Kansas Geol. Soc. Guidebook 11th Ann. Field Conf., p. 40, 43. Reallocated. Comprises upper member of Iola formation. Underlies Lane-Vilas shale; overlies Muncie Creek shale member, Iola formation. Equivalent to Raytown in Kansas.

M. C. Oakes, 1952, Oklahoma Geol. Survey Bull. 69, p. 82–83, pl. 11. Described as limestone, sandy limestone, calcareous shale, and clay shale. Locally interfingers with underlying Muncie Creek shale member. Underlies Wann formation. Type locality designated.

M. C. Oakes, 1959, Oklahoma Geol. Survey Bull. 81, p. 32–33. Member of Iola. Avant is 55 feet thick at type locality. Only upper part of this thick phase extends across Tulsa County. There are sandy limestone beds in sec. 4, T. 20 N., R. 10 E., that occupy same stratigraphic position as basal bed of Avant at Avant and they extend across Tulsa County. The two sets of calcareous beds are called colloquially upper and lower Avant and are thought to mark limits of Avant member, which contains more shale than limestone at south side of western Tulsa County. In Creek County, a prominent escarpment that extends from north line to south side of sec. 20, T. 14 N., R. 9 E., is capped by sandy limestone that represents Avant limestone member, but upper limit of member cannot be determined. This limestone grades into basal part of massive sandstone, Tiger Creek sandstone of Fath (1925), that caps the escarpment southward.

Type locality: In T. 23 N. [Rs. 12 and 13 E.]. Named for Avant, Osage County.

Avawatz Formation

Pliocene, lower: Southern California.

P. C. Henshaw, 1939, Carnegie Inst. Washington Pub. 514, p. 5–7, 8, 16 [preprint]. Proposed to include Tertiary series of sedimentary rocks which lie immediately to south and west of eastern end of Avawatz Mountains. Roughly divided into four members: a coarse conglomerate (fanglomerate); green and brown clays (lake beds); resistant breccia (atmoclastic breccia); and arkosic sands and tuffs (fluviatile deposits). Overlies basement complex of metamorphic and plutonic rocks; unconformably underlies a coarse conglomerate believed to be Quaternary in age. Thickness over 1,000 feet, possibly several thousands of feet.

Area is in Avawatz Mountains quadrangle. A fossil locality lies on southeasternmost flank of Avawatz Mountains, 10 miles by road northwesterly from town of Silver Lake on Tonopah and Tidewater Railroad.

Avenal Sandstone[1]

Eocene: Southern California.

Original reference: F. W. Anderson, 1905, California Acad. Sci. Proc., 3d ser., v. 2, p. 164–168.

J. A. Cushman and S. S. Siegfus, 1942, San Diego Soc. Nat. History Trans., v. 9, no. 34, p. 390. Listed as underlying Canos siltstone member of Kreyenhagen shale at Garza Creek, Kings County.

V. S. Mallory, 1959, Lower Tertiary biostratigraphy of the California Coast Ranges: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 46, 50–51. In Tent Hills area, overlies Acebedo formation (new).

Exposed at Tar Springs and at Sulphur Springs on Zapato Chino Creek, Diablo Range.

Averill Granite[1]

Age(?): Northeastern Vermont.

Original reference: R. A. Schroeder, 1921, Vermont State Geol. Rept. 1919–1920, p. 39–42.

B. K. Goodwin, 1959, Dissert. Abs., v. 20, no. 5, p. 1740. Granitic rocks occupy about two-thirds of Island Pond area. Three major granitic bodies are present: Averill granite, Nulhegan quartz monzonite (new), and Echo Pond granitic complex (new).

Underlies and surrounds Big Averill Lake and all but a small part of Little Averill Lake, Essex County.

Avery Shale[1]

Middle Devonian: Western New York.

Original reference: A. W. Grabau, 1930, Sci. Quart. Nat. Univ. Peking, China, v. 1, no. 4, p. 323–326.

On Eighteen-Mile Creek. Derivation of name not stated.

Avila Member (of Serpiente Sandstone)

Upper Cretaceous: Southern California.

O. T. Marsh, 1960, California Div. Mines Spec. Rept. 62, p. 7 (fig. 3), 21–24, pls. 1, 2. Large tongue of concretionary sandstone, 2,710 feet thick; lies between upper and lower portions of Torcido member. To north, member extends outside mapped area for an undetermined distance; at its southern end, it tapers and pinches out about one-half mile south of Avila Canyon.

Named for occurrence in vicinity of Avila Canyon, Orchard Peak area, Kern County.

Avilton Conglomerate[1]

Upper Devonian: Western Maryland.

Original reference: C. K. Swartz and others, 1913, Maryland Geol. Survey Middle and Upper Devonian volume, p. 352, 383–385.

Named Avilton because of its occurrence in immediate vicinity of post office of that name on Pea Ridge.

Avis Limestone (in Hinton Formation[1] or Group)

Avis Limestone Member (of Pennington Formation)

Mississippian (Mauch Chunk Series): Southeastern West Virginia and southwestern Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 296, 347.

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 174, 175, pl. 15. Avis limestone member near top of Pennington formation in Burkes Garden quadrangle. Consists of 15 to 40 feet of bluish-gray shaly limestone. Underlies Falls Mills sandstone member.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (columns 97, 98, 99). In Virginia, limestone in Pennington formation. Elsewhere considered in Hinton group. Locally, in West Virginia, overlies Payne Branch sandstone.

Type locality: Vicinity of Avis and Hinton, Summers County, W. Va.

Avis 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. 296, 345.

Type locality: High up sides of mountains in vicinity of Hinton and Avis, Summers County. Also observed in Mercer County.

Avis Sandstone Member (of Graham Formation)

Avis Sandstone Formation (in Thrifty Group)

Avis Sandstone Member (of Thrifty Formation)[1]

Upper Pennsylvanian: North-central Texas.

Original reference: P. B. Plummer and R. C. Moore, 1922, Jour. Geology, v. 30, p. 24, 31.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Rank raised to formation in Thrifty group (redefined).

D. A. Myers, 1960, Soc. Econ. Paleontologists and Mineralogists, Permian Basin Sec., [Guidebook] Ann. Field Trip, p. 49 (fig. 2), 50, 56. Reallocated to member status in Graham formation. A channel-fill deposit. Overlies Wayland shale member; underlies Ivan limestone member.

Named for town of Avis, Jack County. Typically developed in Jack, Young, and Stephens Counties.

Avis 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, 346–352.

Type locality: Region around Avis, Hinton, and Bellepoint, Summers County. Also in Mercer County.

Avoca Limestone Member (of Lecompton Limestone)[1]

Pennsylvanian (Virgil Series): Southeastern Nebraska, southwestern Iowa, northeastern Kansas, northwestern Missouri, and northern Oklahoma.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 44, 45, 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), 155; F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 17. Avoca limestone member of Lecompton formation; overlies King Hill shale member; underlies Tecumseh formation. This is classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma, May 1947.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16 p. 23. In Nebraska, underlies Kenosha shale member of Tecumseh formation. Thickness 1 to 4 feet or more in Iowa, Nebraska, and northwestern Missouri; becomes cryptozoon-bearing limestone and thicker in southern Kansas and Oklahoma. Type locality stated.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 19, fig. 5. Consists of two thin fossiliferous dark- to bluish-gray limestones separated by dark-gray fossiliferous shale. Thickness about 2 feet in western Mills County; not differentiated in northeastern Adair County.

Overlies King Hill shale member; underlies Kenosha shale member of Tecumseh shale.

Type locality: On south branch Weeping Water Creek, 3 miles east of Avoca, Otoe County, Nebr.

Avon Shale and Limestone (in Pottsville Formation)[1]

Pennsylvanian: Central western Illinois.

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

Derivation of name not stated, but probably named for Avon, Fulton County.

†Avondale Limestone[1]

Precambrian: Southeastern Pennsylvania.

Original reference: P. Frazer, 1883, Pennsylvania 2d Geol. Survey Rept. C_4, p. 307, 321, 322.

Avondale, Kennett Square, and other places in Chester County.

†Avondale Series[1]

[Precambrian]: Pennsylvania.

Original reference: A. C. Hawkins, 1924, Am. Jour. Sci., 5th, v. 7, p. 355–364.

Vicinity of Avondale, Chester County, Pa.

Avon Park Limestone

Avon Park Limestone (in Claiborne Group)

Eocene, middle: Florida (subsurface and surface).

P. L. Applin and E. R. Applin, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 12, p. 1678 (table 1), 1680, 1686–1688. Name used for upper part of late middle Eocene which, in well samples, shows distinct faunal and lithologic characteristics. Mainly cream-colored highly microfossiliferous chalky limestone throughout its known extent. Thickness varies; 50 feet or less in northeast Florida where only basal part is present; 450 to 650 feet in southern part of peninsula. Underlies Ocala limestone; in region of Tallahassee overlies Tallahassee limestone (new), elsewhere overlies Lake City limestone (new). Tentatively correlated with Yegua formation (Claiborne). Avon Park limestone, Tallahassee limestone (with its equivalent nonfossiliferous facies), and Lake City limestone represent Claiborne group in peninsular Florida, and where all three units are present they appear to make, in most places, a conformable sequence.

D. B. Ericson, 1945, Science, new ser., v. 102, no. 2644, p. 234. Suggests abandoning name in favor of Gulf Hammock formation because outcrops have been discovered in Levy and Citrus Counties.

F. S. MacNeil, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 29. Used on correlation chart as name of surface formation.

R. O. Vernon, 1951, Florida Geol. Survey Bull. 33, p. 95–111, pl. 1. Surface exposures described. As used in this report, Avon Park is a series of pasty to fragmental marine carbonate beds containing a distinct fauna and considerable amounts of peat, lignite, and plant remains. Unconformably underlies Inglis member (new) of Moodys Branch formation; unconformably overlies Lake City limestone. Name Gulf Hammock abandoned. Claiborne group.

Type well: At Avon Park Bombing Range, Polk County, Fla., sec. 31, T. 32 S., R. 30 E. Samples from well are indexed at No. W–668 in files of Florida Geological Survey. Surface outcrops in Citrus and Levy Counties.

Axemann Limestone (in Beekmantown Group)[1]

Lower Ordovician: Central Pennsylvania.

Original reference: E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, p. 552, 653, 660, 674, pl. 27.

E. O. Ulrich and G. A. Cooper, 1938, Geol. Soc. America Spec. Paper 13, p. 23. Fossiliferous pure Upper Canadian limestone, 158 feet thick, at Bellefonte, Pa. Here it rests on about 500 feet of dolomite [Nittany] containing unquestionable Cotter fossils; succeeded by Bellefonte dolomite which extends upward, with thickness of 2,140 feet, to boundary between Canadian and Ordovician systems. Suggests term Nittany be abandoned.

F. M. Swartz, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1555, 1556 (fig. 19). Medium-bedded bluish limestone. Thickness 500 feet. Underlies Bellefonte dolomite; overlies Nittany dolomite, Beekmantown group.

Crops out 1 mile east of Axemann, Centre County.

Axes Creek phase (of Cherry Creek Series)

Precambrian: Southwestern Montana.

E. S. Perry, 1948, Montana Bur. Mines and Geology Mem. 27, p. 2, pl. 2B. Name suggested for zones of marble in Cherry Creek series. On Axes Creek at least six marble members are present, and some are 400 to 800 feet or more thick. Amount of marble in series decreases eastward, and members cannot be correlated readily between Dillon and Ennis.

Well exposed on Axes Creek in Beaverhead County.

Axtell Formation

Pliocene or Pleistocene: Central Utah.

E. M. Spieker, 1949, Utah Geol. Soc. Guidebook 4, p. 38, geol. map. Youngest bedrock in area. Conglomerate containing pebbles, cobbles, and boulders of all other bedrock formations including lava. At type locality, conglomerate is 50 to 75 feet thick and dips northward about 21° in an angular unconformity over west-dipping Green River limestone. Probably late Tertiary.

W. N. Gilliland, 1949, Ohio State Univ. Abs. Doctors' Dissert. 57, p. 71, 72. Overlies Bald Knoll formation (new) with angular discordance.

W. N. Gilliland, 1951, Nebraska Univ. Studies, new ser., no. 7, p. 11 (table 1), 50–52, pl. 2. In some areas in Gunnison quadrangle, overlies Bald Knoll formation with angular unconformity, and in some areas overlies unnamed pyroclastics and associated sediments with angular discordance. Spieker tentatively assigned Axtell to late Pliocene or early Pleistocene because it is obviously younger than all bedrock in region. Mapped as Pliocene.

Type locality: Stretch about 2 miles east of Axtell on eastern margin of Sevier Valley between abandoned plant of Great Western Salt Company and Willow Creek.

Aycross Formation

Eocene, middle: Northwestern Wyoming.

J. D. Love, 1939, Geol. Soc. America Spec. Paper 20, p. 10, 11 (fig. 2), 66–73, pl. 17. Proposed for middle Eocene sequence lying unconformably upon all older rocks from Precambrian to lower Eocene and which is unconformably overlain by strata of upper Eocene age. Consists of variegated clays, acidic andesite tuffs, conglomerates, and bentonite beds.

Changes in physical appearance rapidly in short distances. Thickness at type locality about 1,000 feet; in some areas less than 100 feet. In type area, formation was deposited on a surface of high relief cut in folded and faulted rocks. In places there is angular discordance of 90° with underlying strata, whereas in adjacent localities only a few miles distant there is only slight erosional unconformity. Shown on columnar section as unconformably underlying Tepee Trail formation (new) and unconformably overlying Wind River formation.

R. L. Hay, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 8, p. 1880, 1892–1896. West and south of Anchor post office, Masursky (1952, Wyoming Geol. Assoc. Guidebook 7th Ann. Field Conf., map) mapped beds equivalent to Pitchfork formation (new) as Aycross. 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, as 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.

Type area: North side of North Mesa in secs. 7, 8, 17, and 18, T. 7 N., R. 5 W., Fremont County, about 1 mile southeast of A Cross Ranch. Named derived from A Cross Ranch on East Fork River at Duncan.

Ayer Granite[1] **or Granodiorite**

Late Paleozoic(?): Eastern Massachusetts, northeastern Connecticut, and southeastern New Hampshire.

Original reference: B. K. Emerson, 1917, U.S. Geol. Survey Bull. 597, p. 86, 223–228.

R. H. Jahns, 1942, Am. Geophys. Union Trans., v. 23, pt. 2, p. 341–342. Referred to as Ayer granodiorite in Lowell area, Massachusetts.

M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000): U.S. Geol. Survey. Mapped as Ayer granodiorite. Upper Devonian(?).

M. P. Billings, J. B. Thompson, Jr., and John Rodgers, 1952, Geol. Soc. America Guidebook for field trips in New England, p. 45. Listed with units included in New Hampshire magma series.

W. R. Hansen, 1956, U.S. Geol. Survey Bull. 1038, p. 47–48, pl. 1. Described in Hudson and Maynard quadrangles, Massachusetts, as Ayer granite. Light to medium gray, moderately coarse grained. Consists of two mappable facies, a porphyritic and nonporphyritic. Late Paleozoic(?).

M. P. Billings, 1956, Geology of New Hampshire, pt. 2, Bedrock geology: Concord, New Hampshire State Plan. Devel. Comm., p. 68. Discussed with units included in Hillsboro plutonic series (new) which may belong to New Hampshire magma series.

Type area extends from Hampstead, N.H., to point between Harvard and Bolton, Mass., and is 6 miles across at its widest part, between Harvard and East Groton, Mass.

Ayers Cliff Formation

Ayers Cliff Member (of Waits River Formation)

Middle Ordovician (Trentonian or younger): Northern Vermont, and Quebec, Canada.

C. G. Doll, 1951, Vermont Geol. Survey Bull. 3, p. 15, 22–24, pl. 1. Belt of impure limestones, calcareous sandstones, and minor slates. Thickness about 4,500 feet. Unconformably underlies Barton River formation; overlies Northfield slates. Newly defined terms Ayers Cliff, Barton River, and Westmore formations make terms Waits River formation (Currier and Jahns, 1941), and Tomifobia formation (Clark, 1934) inadequate.

J. G. Dennis, 1956, Vermont Geol. Survey Bull. 8, p. 16. Name Ayers Cliff retained as member of Waits River formation although Ayers Cliff does not crop out in area of this report [Lyndonville quadrangle].

Type section: In series of roadcuts beginning one-half mile west of village of Ayers Cliff at south end of Lake Massawippi in Canada. Good exposures occur at Coventry Falls in the Black River, on Stony Hill, 2 miles northwest of Irasburg, and on shore of Lake Memphremagog. Formation is traceable from vicinity of Round Hill [Irasburg quadrangle] northward into Canada.

Ayers Landing Member (of Caloosahatchee Marl)

Pleistocene: Southern Florida.

J. R. DuBar. 1957, Illinois Acad. Sci. Trans., v. 50, p. 192 (table 1). Table shows Ayers Landing as uppermost member of Caloosahatchee. Overlies Bee Branch limestone member (new); underlies Okaldakoochee marl member (new) of Fort Thompson formation.

J. R. DuBar, 1958, Gulf Coast Assoc. Geol. Soc. Trans., v. 8, p. 136 (fig. 4), 144. Shell bed that conformably overlies Bee Branch member in many localities between La Belle and Fort Denaud. At many localities, unit is very arenaceous, and calcium carbonate content is mainly in form of mollusk shells. Thick beds are generally only slightly consolidated. Sands are usually tan to yellow brown, and fossils nearly white. At some localities, unit is better consolidated, much more calcareous, concretionary, and fine grained. Both facies are massive and generally without stratification. Thickness 2½ to 8½ feet; unit is discontinuous, being absent or greatly thinned over the arches.

H. S. Puri and R. O. Vernon, 1959. Florida Geol. Survey Spec. Pub. 5, p. 192, 193, 194. Thickness 3.1 feet at type locality, herein stated. Here, overlies Bee Branch member and underlies Fort Thompson formation(?). Includes shell bed, marine limestone, and *Panope* faunizone. Entire upper section of Caloosahatchee, which is called Ayers Landing marl by DuBar (1958), was included in Fort Thompson formation by Parker and Cooke (1944, Florida Geol. Survey Bull. 27) and Parker and others (1955, U.S. Geol. Survey Water-Supply Paper 1255) and considered to be Pleistocene in age.

Type locality: DuBar's section A35, (SW¼NW¼ sec. 1) T. 43 S., R. 28 E., Hendry County. Section measured on right bank of Caloosahatchee River about 90 yards upstream from Turtle Creek, in vicinity of Ayers Landing.

Ayiyak Member (of Seabee Formation)

Upper Cretaceous: Northern Alaska.

C. L. Whittington *in* George Gryc and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 253–254, figs. 4, 5. Greenish-gray somewhat tuffaceous siltstone and silt shale. Sandstone, although a subordinate lithologic constituent, forms important part. Sandstones are light tan to light chocolate brown, slightly tuffaceous, hard, and clean and weather to light buff. Member becomes progressively more shaly toward base, and limestone lenses and beds occurr in this shaly part.

Locally, "salt-and-pepper" sandstone near base. Thickness at type locality 360 feet. Underlies nonmarine beds of Tuluvak tongue of Prince Creek formation; overlies dark clay shale typical of Seabee formation and is mappable unit in southernmost exposures of the marine formation. Cannot be differentiated from rest of formation north of Umiat-Maybe Creek area.

Type locality: Along east fork of Tuluga River, lat 68°50′ N., and between long 151°28′ W. and 151°35′ W. Named from Ayiyak River along which it is exposed.

Aylesworth Limestone Member (of Pottsville Formation)[1]

Pennsylvanian: Northwestern Illinois.

Original reference: T. E. Savage, 1930, Illinois Acad. Sci. Trans., v. 22, p. 498.

McDonough County. Derivation of name not stated.

Aylor Member (of Big Saline Formation)

Lower Pennsylvanian: Central Texas.

F. B. Plummer, 1947, Jour. Paleontology, v. 21, no. 2, p. 142, 143, 144; 1947, Jour. Geology, v. 55, no. 3, pt. 2, p. 196, 197; 1950, Texas Univ. Bur. Econ. Geology Pub. 4329, p. 64–66. Consists of light-gray crystalline limestone and oolite. In vicinity of Colorado River, oolite increases in thickness to form a lentil 5 miles long and 10 to 100 feet thick. Underlies Lemons Bluff member; overlies Gibbons member.

Type section: On Aylor Bluff in McAnnelly's Bend of Colorado River [San Saba County].

Aylor Bluff member

See Aylor Member.

Aymamón Limestone

Miocene, lower: Puerto Rico.

A. D. Zapp, H. R. Bergquist, and C. R. Thomas, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 85, sheets 1, 2. Includes uppermost Tertiary of northern coastal belt. Consists almost entirely of very dense conchoidally fracturing limestone of white, light-gray, buff, and rose colors; unit is quite uniform in lithology over its entire outcrop and throughout its entire thickness. In Aymamón Mountains, shows sharply defined uniform bedding, the beds averaging between 1 and 2 meters in thickness. Top of limestone is erosion surface developed since end of Tertiary deposition; hence thickness varies with irregularities of that surface. Greatest thickness is in area west of Isabela, where beds capping outer sea cliffs are estimated to be 325 to 350 meters above base of limestone. Overlies Aguada limestone (new). Includes units formerly termed Quebradillas limestone and Los Puertos limestone.

C. A. Kaye, 1959, U.S. Geol. Survey Prof. Paper 317–A, p. 7 (table), 34–35, pl. 2. Described in San Juan metropolitan area where it conformably overlies Aguada formation. Thickness may be over 2,000 feet at latitude of coast.

W. H. Monroe, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B356, B358 (fig. 1642). Oligocene and Miocene sequence in north-central Puerto Rico is (ascending) San Sebastián formation. Lares limestone, Cibao formation, Aguada limestone, and Aymamón limestone. Aymamón consists of more than 200 meters of very pure limestone, generally stratified to massive but locally consisting of breccia.

Named from Aymamón Mountains, an area of rugged limestone hills, west of Río Guajataca and about midway between towns of San Sebastián and Quebradillas.

Azotea Tongue (of Seven Rivers Formation)

Azotea Tongue (of Carlsbad Limestone)[1]

Permian: Southeastern New Mexico.

Original reference: W. B. Lang, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 7, p. 847 (fig. 5), 868.

A. M. Morgan, 1938, New Mexico State Engineer 12th-13th Bienn. Repts., p. 172. Underlies Three Twins member of Chalk Bluff formation; overlies Seven Rivers gypsiferous member of Chalk Bluff formation.

U.S. Geological Survey has abandoned term Carlsbad and currently classifies the Azotea as a tongue of Seven Rivers Formation.

Caps western Azotea Mesa, Pecos Valley.

Aztec Sandstone[1]

Jurassic(?): Southeastern Nevada.

Original reference: D. F. Hewett, 1931, U.S. Geol. Survey Prof. Paper 162, p. 9, 35.

C. R. Longwell, 1949, Geol. Soc. America Bull., v. 60, no. 5, p. 929 (table 1), 931. Shown on table of formations of Muddy Mountain area, Nevada, as underlying Upper Cretaceous Willow Tank formation (new) with angular unconformity and overlying Chinle formation. Thickness about 2,500 feet.

C. R. Longwell, 1952, Utah Geol. Soc. Guidebook 7, p. 34 (fig. 4), 35. In Frenchman Mountain area, Nevada, underlies Thumb formation (new) with angular unconformity. In Muddy Mountains, underlies Willow Tank formation and overlies Chinle formation.

D. F. Hewett, 1956, U.S. Geol. Survey Prof. Paper 275, p. 48, pl. 1. Described as a red sandstone made up of lenses of sand mostly 10 to 25 feet thick; these lenses are made up of laminae, ½ to 2 inches thick, that have parallel strike and dip within the lenses. Thickness 2,100 feet at northern edge of Goodsprings quadrangle; 800 feet thick in Ivanpah quadrangle where it overlies Chinle formation. In Ivanpah quadrangle, overlain by 50 feet of limestone and dolomite beds mapped with Aztec.

Name derived from Aztec Tank [Goodsprings quadrangle], a natural depression in the sandstone several hundred feet east of Contact mine.

Aztecan series[1]

Cretaceous: Colorado, New Mexico, and Arizona.

Original reference: C. R. Keyes, 1915, Conspectus of geologic formations of New Mexico, p. 2, 5.

San Juan region.

Azuero Formation[1]

Cretaceous(?): Azuero Peninsula, Panamá.

Original reference: O. H. Hershey, 1901, California Univ. Dept. Geol. Bull., v. 2, p. 237.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 324. Poorly defined name for basement altered volcanic rocks. Late Jurassic or Early Cretaceous age suggested.

On west side of Azuero Peninsula.

Babcock Hill Member (of Onondaga Formation)

Middle Devonian: East-central New York.

R. E. Stevenson, 1949, New York State Sci. Service Rept. Inv. 3, p. 7, 8. Named and described as thin- to medium-bedded gray fine-grained fossiliferous limestone with abundant nodular and irregularly bedded cream-colored to black chert. Thickness 36 to 50 feet. Underlies unnamed member; overlies Springfield Center member (new).

Occurs in area of Herkimer-Otsego County line.

Babeldoab Agglomerate

See Babelthuap Agglomerate.

Babelthuap (Babeldoab) Agglomerate

Eocene: Caroline Islands (Babelthuap).

Risaburo Tayama, 1935, Tohoku Univ. Inst. Geology and Paleontology Contr. in Japanese Language, no. 18, p. 13, 18–20, 40–41 [English translation in library of U. S. Geol. Survey, p. 21–24, 46–48]. Massive unstratified agglomerate. Lower part is dark-green or blackish augite andesite; upper part black pyroxene andesite with light-colored hornblende andesite agglomerate at top. Conformably, and locally disconformably, underlies Ngardok (Galdog) formation.

U.S. Army Corp of Engineers, 1956, Military geology of Palau Islands, Caroline Islands: U.S. Army Corp of Engineers Far East, p. 38–40, pls. 4, 8, 9. Thickness probably 2,000 feet but may exceed 5,000 feet; data uncertain because of lack of continuous section and recognizable beds for correlation; numerous fractures and faults and dips varied. Base not exposed; grades upward into Aimeliik formation. Believed to be Eocene; diagnostic fossils not found.

Exposed on Babelthuap, Korror, Ngarebobasang (Arakabesan), and Makarakar.

Baby Capulin Basalt

Late Cenozoic: Northeastern New Mexico.

Brewster Baldwin and W. R. Muehlberger, 1959, New Mexico Bur. Mines Mineral Resources Bull. 63, pt. 2. p. 132, 144, pls. 1b, 13. Medium dark-gray porphyritic vesicular basalt. Usually has scattered, large olivine phenocrysts. This flow was last volcanic event of northwestern Union County. Baby Capulin basalt lies within levees of Twin Mountain (new) or Purvine Hills basalt (new).

Derived from vent of Baby Capulin, a small cinder cone that lies about midway between Capulin Mountain and Folsom village, in sec. 36, T. 30 N., R. 28 E.

Babylon cyclothem (in Abbott Formation)

Babylon cyclothem (in Tradewater Group)[1]

Pennsylvanian: West-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), 65, 201, 202, 203. Cyclothem occurs near base of Tradewater group and in sequence underlies Tartar cyclothem.

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

Named from exposures along Spoon River one-half mile north of Babylon, in NE¼NE¼ sec. 14, T. 7 N., R. 1 E., Fulton County.

Babylon Sandstone Member (of Abbott Formation)

Babylon Sandstone (in Tradewater Group)

Pennsylvanian: West-central Illinois.

Original reference (cyclothem): H. R. Wanless, 1931, Illinois Geol. Survey Bull. 60, p. 189, 192.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 37, 78. Babylon sandstone is normally basal Pennsylvanian member in western Illinois. Sandstone is medium grained, well sorted, and free from feldspar, mica, and argillaceous matter. Occurs below Babylon coal.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 65, 201, 202, 203. Babylon sandstone, present in practically all parts of area where cyclothem occurs, has maximum exposed thickness of 25 feet. Cyclothem occurs near base of Tradewater group and in sequence underlies Tartar cyclothem.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 31, 44 (table 1). Included in Abbott Formation (new). Occurs at base of formation below Manley coal member (new). Provisionally correlated with Grindstaff sandstone member in southern Illinois; pending further study both names are retained. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: Along Spoon River one-half mile north of Babylon, in NE¼NE¼ sec. 14, T. 7 N., R. 1 E., Fulton County.

Baca Formation

Eocene(?): Central New Mexico.

R. H. Wilpolt and others, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map. 61. Coarse conglomerate, red and white sandstone, and red clay. Thickness of conglomerate ranges from 80 to 140 feet. Total thickness of formation in Baca Canyon 694 feet. Unconformably overlies all Cretaceous formations in area; underlies Datil formation. Eocene(?).

W. H. Tonking, 1957, New Mexico Bur. Mines Mineral Resources Bull. 41, p. 23–26, pl. 1. Age designated as Upper Cretaceous(?) to Eocene(?) on plate 1. Baca Canyon section measured by Wilpolt and others here cited as type section. Thickness in Puertecito quadrangle ranges from a fraction of a foot to as much as 700 feet.

Type section: In Baca Canyon from which unit is named, in secs. 4, 5, 8, 9, T. 1 N., R. 4 W., north Bear Mountain, Socorro County.

Bachelor Formation

Lower Mississippian: East-central and southwestern Missouri.

M. G. Mehl, 1960, Denison Univ. Jour. Sci. Lab., v. 45, art. 5, p. 94–98. Proposed for a basal Mississippian sandstone that cuts across time zones ranging in age from oldest Mississippian to as late as early Osagean.

With exception of Siphonodella zone at base, lithology is varied although it consists dominantly of pale buff quartz sandstone of medium grain size, moderately well to poorly sorted. Over most of extent, including Siphonodella zone, thickness of unit is to be measured in inches rather than feet. In Callaway County, average thickness is perhaps less than 2 feet; in east-central Callaway and western Montgomery Counties, thicknesses of as much as 8 to 10 feet may be found. Unconformable above underlying strata; subjacent beds range from Jefferson City Ordovician to late Massie Creek (new); conformable with overlying strata—Burlington or Chouteau.

Type locality: Exposure in SE¼NW¼SW¼ sec. 9, T. 48 N., R. 8 W., Callaway County. Named for exposures to east, west, and south of Bachelor.

Bachelor Creek Limestone[1] Member (of Howard Limestone)

Pennsylvanian (Virgil Series): Southern Kansas.

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. Guidebook 6th Ann. Field Conf., p. 21, 94, 96.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 57 (fig. 22), 63. Basal member of Howard limestone. Underlies Aarde shale member; overlies Severy shale. Locally two beds separated by shale. Thickness as much as 8 feet.

Type locality: Bachelor Creek, sec. 33, T. 25 S., R. 11 E., about 5 miles east of Eureka, Greenwood County, Kans.

Backbone Limestone[1]

Devonian: Southwestern Illinois.

Original reference: T. E. Savage, 1920, Am. Jour. Sci., 4th, v. 49, p. 169–178.

J. M. Weller, 1939, Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 127, 128; 1940, Illinois Geol. Survey Rept. Inv. 71, p. 23–24. Known only in Union and Jackson Counties. Estimated thickness 230 feet. Thins and disappears southward or, in that direction, has been so completely weathered that it cannot be identified. Believed to overlie Grassy Knob chert. May have been included in Clear Creek in many places.

Well exposed near southern end of Devil's Backbone Ridge, a short distance north of Grand Tower, Jackson County.

Backwater Creek Shale Member (of Fort Scott Formation)

See Blackwater Creek Shale Member (of Fort Scott Formation).

Bacon Limestone Member (of Ferry Lake Formation)

Lower Cretaceous (Glen Rose): Eastern Texas (subsurface).

W. V. Jones, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 6, p. 839–845. Name given to a lenticular limestone developed at the base of the Ferry Lake. Thickness varies from 18 to 28 feet; extends from 7,287 to 7,312 feet in discovery wells.

Type well; Tide Water Associated Oil Co. and Seaboard Oil Co. A. J. Bacon No. 1, New Hope field, Franklin County. Alternate type locality (designated because of poor core from type well): Suite of cores from Tide Water Associated Oil Co. and Seaboard Oil Co. F. M. Anderson No. 1, in the C. F. McKenzie (Abstract 307) Survey, Franklin County.

Bacon Bend Member (of Sevier Formation)

Middle Ordovician: Eastern Tennessee.

R. B. Neuman, 1955, U.S. Geol. Survey Prof. Paper 274–F, p. 145 (table), 160, 162–164, pl. 27. Unit at top of formation in which gray calcareous shale and sandstone have submarine slump structures; also contains even-bedded beds of gray and red calcareous mudrock. Thickness 40 to 165 feet. Underlies Bays formation; overlies main body of Sevier formation.

Name taken from meander neck of same name on Little Tennessee River (Vonore quadrangle), Monroe County. Type section about 1 mile northeast of southeast end of prominent bluffs that overlook river.

Bacon Ridge Sandstone

Upper Cretaceous: Northwestern Wyoming.

J. D. Love and others, 1948, Wyoming Geol. Survey Bull. 40, p. 2–3, 4–5, 21–24, 32–34. Name applied to thick sequence of marine sandstone; overlies about 2,000 feet of shale that in turn overlies Frontier formation as defined in central Wyoming. Measured sections show thicknesses of 318, 714, and 925 feet.

Well exposed along both sides of Bacon Ridge, in T. 41 N., R. 111 W., Teton County.

Bad Axe Member (of Franconia Sandstone)[1]

Upper Cambrian: Southeastern Minnesota and western Wisconsin.

Original reference: A. C. Trowbridge and others, 1935, Kansas Geol. Soc. Guidebook 9th Ann. Field Conf., p. 81, 92, 134, 140, 159, 431, 446, figs. 1, 2.

C. R. Stauffer, G. M. Schwartz, and G. A. Thiel, 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1238 (table 2), 1239; C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 30, 40–41, measured section. In Minnesota, underlies Nicollet Creek member (new) of St. Lawrence formation.

G. O. Raasch, 1951, Illinois Acad. Sci. Trans., v. 44, p. 141, 147. Underlies Arcadia member (new) of Trempealeau formation.

R. R. Berg, 1953, Jour. Paleontology, v. 27, no. 4, p. 553, 554, 555; 1954, Geol. Soc. America Bull., v. 65, no. 9, p. 858 (fig. 1), 864–865. Franconia member names used by Twenhofel, Raasch, and Thwaites (1935, Geol. Soc. America Bull., v. 46, no. 11) are geographic names applied to faunal zones. New member names are proposed to designate rock types because distribution of faunal zones in formation is largely independent of natural rock units. Bad Axe member is *Dikelocephalus postrectus* zone. This fauna is present in Reno member.

Named for Bad Axe River, near Franconia, Chisago County, Minn.

Baden Sandstone[1]

Pennsylvanian: Central eastern Missouri.

Original reference: H. A. Wheeler, 1895, St. Louis Acad. Sci. Trans., v. 7, p. 125.

Named for exposures at Baden, St. Louis County.

Bader Limestone (in Council Grove Group)

Bader Formation (in Council Grove Group)[1]

Permian: Northeastern Kansas and southeastern Nebraska.

Original references: R. C. Moore, M. K. Elias, and N. D. Newell, 1934, Stratigraphic sections of Pennsylvanian and "Permian" rocks of Kansas River valley: Kansas Geol. Survey, issued Dec.; R. C. Moore, 1935, Rock formations of Kansas *in* Kansas Geol. Soc.: Wichita, Kans. [Am. Assoc. Petroleum Geologists 20th Ann. Mtg., Mar. 21–23]; G. E. Condra, 1935, Nebraska Geol. Survey Paper 8, p. 4, 7.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 39, p. 61–62. Contains (ascending) Eiss limestone, Hooser shale, and Middleburg limestone, units that were named by Condra as members of the Garrison formation. Type exposure noted.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 46. Underlies Easly Creek shale; overlies Stearns shales. Wolfcamp series.

Type exposure is near Bader, Chase County, Kans.

Badger Shale

Lower 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), 9–12, pls. 1, 2. Dark-green silty clay shale with gray buff-weathering calcareous nodules: some very fine-grained arkosic graywackes with abundant fragments of carbonized wood on bedding planes; contains two tuffaceous graywackes. Thickness 3,620 feet at type locality; 3,710 feet in Annette quadrangle southwest of Orchard Peak. Underlies Risco formation (new); at type locality, contact is conformable; in Annette quadrangle, thrust contact. Lower contact is everywhere a fault, generally, a thrust surface along which serpentine has been squeezed. This unit has been designated as Shasta by previous workers.

Type locality: Badger Ridge, 1½ miles west of Cottonwood Pass, Orchard Peak area, Tent Hills quadrangle, northwestern Kern County.

Badger Butte Quartz-Biotite Norite

Lower Cretaceous(?): Northeastern Oregon.

W. H. Taubeneck, 1957, Geol. Soc. America Bull., v. 68, no. 2, p. 193–195, 235. A medium-grained dark-gray rock with a crude parallelism of plagioclase. Intruded by, and nearly surrounded by, Bald Mountain tonalite (new).

Exposed in area near Badger Butte, in Elkhorn Mountains [Grant County]. Forms part of Bald Mountain batholith.

Badito Formation[1]

Pennsylvanian and Permian(?): Central southern Colorado.

Original reference: R. C. Hills, 1900, U.S. Geol. Survey Geol. Atlas, Folio 68.

R. B. Johnson, 1958, U.S. Geol. Survey Bull. 1042–0, p. 559–560. On flanks of Greenhorn anticline, consists of from 200 to 382 feet of rocks lithologically similar to Sangre de Cristo formation and rests on Precambrian rocks. Locally underlies Ocate sandstone. Pennsylvanian and Permian(?).

Probably named for Badito Peak or town of Badito, just west of Walsenburg quadrangle and in Huerfano quadrangle.

Badito Quartzite Member (of Hopewell Series)

Precambrian (Proterozoic): North-central New Mexico.

Evan Just, 1937, New Mexico School Mines Bull. 13, p. 13, (table 1), 21, pl. 2. Consists of bluish-gray quartzite, unquestionably of sedimentary origin. At mouth of Picuris Canyon, it has been converted to quartz-muscovite schist.

Occurs in Picuris area along north side of Rio Pueblo gorge and in a long strip extending from mouth of Picuris Canyon across south and east spurs of Picuris Peak, Taos and Rio Arriba Counties.

Bad River Dolomite[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, 1959, no. 1, p. 85 (table 1). Included in Animikie series. Overlies Sunday quartzite; underlies Palms quartzite with uncomformity.

Named for occurence at Bad River, in Penokee Gap section, Wisconsin.

†Bad River Gabbro[1]

Precambrian (Keweenawan): Northwestern Wisconsin and northern Michigan.

Original references: R. D. Irving, 1883, U.S. Geol. Survey 3d Ann. Rept., p. 115, 134, 135; 1883, U.S. Geol. Survey Mon. 5, p. 40–41, 144, 155, 377, 435.

Largely developed in Bad River region, Ashland County, Wis., and exposed on Bad River, Iron County, Wis.

†Bad River Sandstone[1]

Precambrian (Keweenawan): Northwestern Wisconsin.

Original reference: E. T. Sweet, 1876, Wisconsin Acad. Sci., Arts., and Letters Trans., v. 3, p. 40–55.

Largely represented on Bad River, Ashland County.

Badwater Greenstone (in Baraga Group)

Precambrian (Animikie Series): Northern Michigan and northeastern Wisconsin.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 30 (table 1), 37. Uppermost formation in group. Lies stratigraphically above Michigamme slate; relationship is based on top directions established by graded bedding in Michigamme and ellipsoidal structures in the greenstone; this relationship is important in that it establishes not only the position of the greenstone but of sequence of rocks [Paint River group] that overlies it in Florence district of Wisconsin and Iron River-Crystal Falls district of Michigan. Maximum thickness attained is several miles; beds now exposed are about vertical. Map patterns reveal mound-like piles in which thicknesses of several miles diminish to the vanishing point within as little as 15 miles along the strike.

Named for extensive exposures in secs. 1, 2, and 11, T. 40 N., R. 31 W., in vicinity of Badwater Lake, Dickinson County, Mich.

Baga Shale and Limestone (in Joserita Member of Lowell Formation)

Lower Cretaceous: Southeastern Arizona.

A. A. Stoyanow, 1949, Geol. Soc. America Mem. 38, p. 12. Dark-gray and greenish impure limestone in places lens shaped and grading laterally into white shale. Thickness 7 feet.

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.

Bagley Andesite[1]

Lower(?) Jurassic: Northern California.

Original reference: J. S. Diller, 1960, U.S. Geol. Survey Geol. Atlas, Folio 138.

A. F. Sanborn, 1960, California Div. Mines Spec. Rept. 63, p. 6, 14, pl. 1. As traced from its type area into Big Bend region, overlies and is interfingered with basal beds of Potem formation. Term Arvison formation is proposed for series of dominantly phyroclastic beds, which are intermediate between Modin and Potem formations and which do not appear to be continuous with Bagley. Estimated thickness of Bagley in Big Bend area, 700 feet. Since Bagley andesite appears to be volcanic facies of Potem formation, its age and correlation in this area are considered to be same as that of the Potem—Lower and Middle Jurassic.

Named for Bagley Mountain in northeast corner of Redding quadrangle.

Bagnell glaciation

Bagnell till[1]

Pleistocene (pre-Nebraskan): Missouri.

Original reference: C. R. Keyes, 1932, Pan-Am. Geologist, v. 58, p. 203, 208, 217.

C. R. Keyes, 1938, Pan-Am. Geologist, v. 68, no. 2, p. 129. Referred to as glaciation.

Bailey Limestone[1]

Bailey Limestone (in Helderbergian Group)

Lower Devonian: Eastern Missouri and southwestern Illinois.

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

J. M. Weller *in* J. M. Weller and G. E. Ekblaw, 1940, Illinois Geol. Survey Rept. Inv. 70, p. 7, 11; J. M. Weller, 1940, Illinois Geol. Survey Rept. Inv. 71, p. 21–22; 1944, Illinois Geol. Survey Bull. 68, p. 89, 94. Described in Illinois where it is included in Helderbergian group. Thin-bedded very earthy and siliceous formation that contains much chert; limestone is medium gray, dense or slightly shaly and commonly occurs in beds less than 4 inches thick. Thickness more than 200 feet and may be as much as 350 feet. Contact with underlying Bainbridge not observed; may be transitional. Underlies Grassy Knob chert; contact transitional.

Carey Croneis, 1944, Illinois Geol. Survey Bull. 68, p. 103 (chart), 105–111. Described in southeastern Missouri where neotype area is designated.

Continuous exposures of entire formation not available. In Perry County, three more or less characteristic divisions showing gradational contacts are recognized: lower, thin- to medium-bedded gray and buff limestones, with interbedded shales and cherts—125 feet, middle, medium- to thick-bedded blue and buff limestones, with large flint concretions—75 feet; upper, very thin-bedded limestones and interbedded cherts—100 feet. Greatest thickness probably occurs in Perry County, either in region between Wittenberg and Neelys Landing, or in neotype area near Red Rock Landing. If partially covered exposure at Red Rock Landing is actually a continuous section, beds have thickness of more than 300 feet, and possibly nearly 400 feet. Thins both north and south from Red Rock Landing and at westernmost exposure in Ste. Genevieve County is at least 200 feet. No undoubted contacts with subjacent or superjacent formations have been clearly observed, although contact with underlying Bainbridge can be located near village of Lithium Springs. Youngest part of underlying Bainbridge apparently considerably older than youngest America Silurian beds, and oldest Bailey is presumably younger than oldest known Devonian. Presumably unconformable with overlying Little Saline formation in Ste. Genevieve County; contact with overlying Clear Creek should also be disconformable because variations in thickness of Bailey suggest post-Bailey pre-Clear Creek erosion.

J. M. Weller and others, 1952, Illinois Geol. Survey Bull. 76, p. 56. Bailey limestone is very cherty and siliceous, light to dark brownish gray, and very fine grained. A more cherty upper part has been described from outcrops in Union County and called Grassy Knob chert, but subsurface studies in Illinois fail to separate this from rest of formation, and it is believed that the greater part of chert in the outcrops is due only to local leaching of limestone and concentration of silica in post-Devonian times. Helderbergian group.

J. E. Lamar, 1959, Illinois Geol. Survey Rept. Inv. 211, p. 18. Exact thickness not known. Maximum observed thickness 130 feet, but total thickness may be between 300 and 400 feet. Basal beds of formation are greenish or gray shale that grades down into shale of upper part of underlying Bainbridge group.

Neotype area: Outcrops in river bluffs at and north of Red Rock Landing, Perry County, Mo. Here beds crop out in fault block tilted toward river and are exposed southeastward along fault zone in a narrow discontinuous band almost to Brazeau Creek in NW¼ sec. 11, T. 34 N., R. 13 E. Ulrich (1904) gave name Bailey to strata considered to be identical with or equivalent to rocks comprising Meek and Worthen's (1866, Illinois Geol. Survey, v. 2) "Lower Helderberg group" exposed in bluffs of Mississippi River at and above Red Rock Landing, Mo. Name was derived from settlement of Bailey's Landing, which was apparently at or near present site of Grand Eddy. Boat landing has been abandoned owing to changes in river channel, and outcrops mentioned by Meek and Worthen have been buried under alluvium. Inasmuch as no Devonian rocks are exposed at Grand Eddy neotype area is herein designated.

Bailey Spring Limestone[1]

Upper Mississippian and Lower Pennsylvanian: Eastern Nevada.

Original reference: L. G. Westgate and A. Knopf, 1932, U.S. Geol. Survey Prof. Paper 171, p. 7, 21.

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 pertaining to Great Basin, Bailey Spring limestone is shown equivalent to Ely limestone; Ely is recommended term. Pennsylvanian. Pioche district, as used in this report, extends north to Dutch John Mountain, approximately 40 miles north of Pioche.

Present in large areas southeast of Bailey Spring, on western side of Bristol Range, Pioche district, Lincoln County.

Baileyville Member (of Stonehenge Limestone)

Lower Ordovician (Canadian): Central Pennsylvania.

A. C. Donaldson, 1960, Dissert, Abs., v. 20, no. 9, p. 3693. Characterized by algal and aphanitic limestones. Overlies Graysville member (new); underlies Logan Branch member (new).

Type locality and derivation of name not stated.

Bainbridge Limestone[1]

Bainbridge Formation

Bainbridge Group

Middle Silurian: Eastern Missouri and southwestern Illinois.

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

J. R. Ball, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 4, p. 595–601. Described at designated type section as Bainbridge formation. Includes some red, strongly mottled, argillaceous limestones; some poorly bedded, greenish-gray earthy limestones; and a unit of finely laminated dark brown shale in which *Cyrtograptus ulrichi* Ruedemann is conspicuous fossil. Thickness more than 100 feet, but base is below water level and a railroad bridge is against foot of bluff.

J. M. Weller, 1940, *in* J. M. Weller and G. E. Ekblaw, Illinois Geol. Survey Rept. Inv. 70, p. 10–11; J. M. Weller, 1940, Illinois Geol. Survey Rept. Inv. 71, p. 21. In Illinois, Bainbridge limestone overlies Sexton Creek limestone; contact with underlying Bailey limestone not observed. Thickness about 40 feet south of Thebes.

J. R. Ball, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 1, p. 7–11. Includes Osgood member below and Laurel member above.

Carey Croneis, 1944, Illinois Geol. Survey Bull. 68, p. 110. In Missouri, underlies Bailey limestone though no undoubted contacts have been observed. Youngest part of Bainbridge is apparently considerably older than youngest American Silurian.

H. A. Lowenstam, 1949, Illinois Geol. Survey Rept. Inv. 145, p. 12–18. Redefined as group. Consists of Niagaran strata of belt east and south of Ozarks. Characterized by two lithologically well-differentiated formations, St. Clair below, and Moccasin Springs (new) above. Formations extend considerably beyond area under consideration; at their geographic limits both formations interfinger with other Niagaran formations. Group is distinguished by its red, pink, and purplish colors, predominance of limestone, absence of chert, and comparative persistence of lithologic types over wide areas. Underlies tapering wedge of Thorn group (new). [Report deals with Niagaran reefs in Illinois and their relation to oil accumulation; much data relative to thickness and distribution of units are based on subsurface studies.]

A. J. Boucot, 1958, Jour. Paleontology, v. 32, no. 5, p. 1029–1030. Bainbridge limestone considered to be of lower Ludlow or highest Wenlock, that is, early Late or latest Middle Silurian, because of occurrence of Ludlovian and highest Wenlock eospiriferids of the *Eospirifer nobilis* type.

Type section: In head of small box canyon in SE¼SE¼NW¼ sec. 24, T. 32 N., R. 14 E., along Bainbridge Creek, near Moccasin Springs, Cape Girardeau County, Mo.

†Bainbridge Marl[1]

Eocene, upper: Southwestern Georgia.

Original reference: A. F. Foerste, 1894, Am. Jour. Sci., 3d, v. 48, p. 41–54.

Named for exposures at Bainbridge, Decatur County.

Bainbridge residual beds[1]

Oligocene and Miocene: Southwestern Georgia.

Original reference: W. H. Dall and J. Stanley Brown, 1894, Geol. Soc. America Bull., v. 5, p. 170.

Named, apparently, for exposures at or in vicinity of Bainbridge, Decatur County.

Baird Shale[1] or **Formation**

Mississippian: Northern California.

Original reference: H. W. Fairbanks, 1894, Am. Geologist, v. 14, p. 28.

C. A. Lamey, 1948, California Div. Mines Bull. 129, pt. K, p. 141 [1946]. Listed in Shasta County as Baird formation consisting of tuff, sandstone, and shale. Underlies Permian(?) McCloud limestone.

I. E. Klein, W. P. Irwin, and B. A. Ogle, 1960, Sacramento Geol. Soc. Ann. Field Trip, June 3–5, geol. map. Map explanation shows Baird formation as Pennsylvanian.

A. H. Coogan, 1960, California Univ. Pubs. Geol. Sci., v. 36, no. 5, p. 243–255. Baird formation, according to Diller (1906, U.S. Geol. Survey Geol. Atlas, Folio 138), consists of lower 500 feet of white and purple tuff and tuffaceous slaty sedimentary rocks, and an upper 200 feet of tuffaceous and siliceous slate. Near McCloud River bridge, the Baird is present on both sides of river and is said to be disconformably beneath McCloud limestone. Although well-documented fossiliferous beds of the Baird have a Mississippian fauna, presence of *Staffella?* in beds a few feet below Baird-McCloud contact at this locality indicates that here topmost beds of the Baird formation are at least Pennsylvanian and may be Permian in age.

Prominantly exposed on west side of [McCloud] River just above Baird Post Office [Shasta County].

†Baker Limestone[1]

Lower Silurian: Western Tennessee.

Original reference: A. F. Foerste, 1901, Geol. Soc. America Bull., v. 12, p. 397, 402.

Named for Baker, Davidson County.

Baker Member (of Ladd Formation)

See **Baker Canyon Conglomerate Member** (of Ladd Formation).

Baker Canyon Conglomerate Member (of Ladd Formation)

Baker Member (of Ladd Formation)

Upper Cretaceous: Southern California.

W. P. Popenoe, 1937, Jour. Paleontology, v. 11, no. 5, p. 380. Named Baker member of Ladd formation. Gray to brownish massive- to thick-bedded boulder conglomerate below, grading up into thick bedded to shaly arkosic soft brown sandstone above; sandstones at top highly fossiliferous. Thickness about 200 feet. Underlies Holz member of Ladd formation (both new); overlies Trabuco formation.

W. P. Popenoe, 1941, Jour. Geology, v. 49, no. 7, p. 740. Referred to as Baker conglomerate member of Ladd formation.

W. P. Popenoe, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 2, p. 166, 168 (fig. 2), 170–171. Renamed Baker Canyon member of Ladd formation. Name Baker preoccupied. Derivation of name given.

J. E. Schoellhamer and others, 1954, U.S. Geol. Survey Oil and Gas Inv. Map 154. Shown on map legend as Baker Canyon conglomerate member of Ladd formation.

Named for its development in Baker Canyon, north of Silverado Canyon, Santa Ana Mountains.

Baker Lake Porphyry

Tertiary: Central Colorado.

J. T. Stark and others, 1949, Geol. Soc. America Mem. 33, p. 83, pl. 1. Quartz monzonite porphyry, coarser and darker gray than typical Eshe porphyry. Block jointing has broken rock units into slabs from a few inches to a few feet in diameter. Talus obscures contacts with surrounding sediments.

Exposed in northwestern part of South Park in secs. 17, 19, 20, 28, 29, and 30, T. 7 S., R. 75 W., and secs. 24 and 25, T. 7 S., R. 76 W., Park County. Outcrop is 4 miles long and averages one-half mile wide. Central part of outcrop has been eroded to a depression which now holds Baker Lake.

Baker Pond Gneiss (in Oliverian Magma Series)

Upper Devonian(?): West-central New Hampshire.

J. B. Hadley and others, 1938, Geologic map and structure sections of the New Hampshire portion of the Mount Cube quadrangle (1:62,500): New Hampshire Highway Dept. Fine-grained gray gneiss, locally containing microcline phenocrysts. Largely quartz monzonite with some granodiorite. Border phase is dark-greenish-gray quartz diorite gneiss. Included in Oliverian magma series whose age is younger than Lower Devonian and is probably Upper Devonian.

Mapped in the area around Upper Baker Pond, which is located on the border of the Mount Cube and Rumney quadrangles.

Bakerstown Clay[1]

Pennsylvanian (Conemaugh Series): Western West Virginia.

[Original reference]: C. E. Krebs and D. D. Teets, Jr., 1914, West Virginia Geol. Survey Kanawha County, p. 177.

J. B. McCue and others, 1948, West Virginia Geol. Survey [Repts.], v. 18, p. 14. Bakerstown underclay, 3 to 10 feet thick, commonly occurs below Bakerstown coal which is generally 160 to 190 feet above base of Conemaugh series.

Occurrences noted in Barbour, Braxton, Kanawha, Lewis, Roane, and Upshur Counties.

Bakerstown Sandstone (in Conemaugh Formation)[1]

Bakerstown shale and sandstone member

Pennsylvanian: Southwestern Pennsylvania and eastern Ohio.

Original reference: J. P. Lesley, 1878, Pennsylvania 2d Geol. Survey Rept. Q, p. xlx (preface), 305–308.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 95 (table 11), 120. Geographically extended into Athens County, Ohio, where it is called Bakerstown shale and (or) sandstone member of Anderson cyclothem in Conemaugh series. Lesley applied name in Pennsylvania to sandstone underlying Bakerstown (Anthony) coal and overlying Lower Barren Measure (Conemaugh) red shales, which rest on Pine Creek (Wilgus?) coal. Heretofore member has been unnamed in Ohio or called Anderson as by Flint (1951, Ohio Geol. Survey, 4th ser., Bull. 48). In Athens County, Bakerstown member has maximum and minimum thickness of 32 and 3 feet, respectively, with average thickness of 13 feet. Where underlying Cambridge and Wilgus members [of Wilgus cyclothem] are absent or indistinct and replaced by sandy and shaly beds, it is difficult to separate Bakerstown member from Buffalo member and undifferentiated Buffalo-Bakerstown shale and sandstone members attain considerable combined thickness. Stratigraphically below Bloomfield limestone member [of Anderson cyclothem]. Bloomfield member is well developed only in Muskingum County.

Name first used in Allegheny County, Pa.

Bakersville Gabbro[1]

Precambrian(?): Western North Carolina.

Original reference: A. Keith, 1903, U.S. Geol. Survey Geol. Atlas, Folio 90, p. 5.

J. L. Stuckey and S. G. Conrad, 1958, North Carolina Div. Mineral Resources Bull. 71, p. 25; J. L. Stuckey, 1958, Geologic map of North Carolina (1:500,000): North Carolina Div. Mineral Resources. Dense, hard unmetamorphosed rock, nearly black when fresh but becoming reddish brown on weathering. Composed chiefly of plagioclase, hornblende, and pyroxene in crystals of medium size with small amounts of magnetite, epidote, and garnet as accessory minerals. Texture usually massive and granular, but locally becomes aplite. Exact age still in doubt. Some recent workers believe Bakersville may have been emplaced between late Ordovician or early Silurian and the Triassic.

U.S. Geological Survey currently designates the age of the Bakersville as Precambrian(?) on the basis of a study now in progress.

Named for Bakersville, Mitchell County.

Bakken Formation

Upper Devonian(?) and Lower Mississippian: Subsurface in North Dakota and Montana, and Manitoba and Saskatchewan, Canada.

J. W. Nordquist, 1953, Billings Geol. Soc. Guidebook 4th Ann. Field Conf., p. 72–74, figs. 4, 5. Consists of two black fissile shales separated by light-gray to gray-brown fine-grained calcareous sandstone interbedded with minor amounts of gray-brown cryptocrystalline limestone. Thickness 105 feet in type well. Occurs between depths of 9,615 and 9,720 feet. Overlies Three Forks formation; underlies Lodgepole formation.

C. A. Sandberg and C. R. Hammond, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 10, p. 2328. Overlies Three Forks formation in standard subsurface section of Three Forks. Devonian(?) and Lower Mississippian.

U.S. Geological Survey currently designates age of the Bakken as Upper Devonian(?) and Lower Mississippian on basis of study now in progress.

Type well: Amerada Petroleum Corporation-H. O. Bakken No. 1 deep test, center SW¼NW¼ sec. 12, T. 157 N., R. 95 W., Williams County, N. Dak.

Bakoven Shale[1] (in Hamilton Group)

Middle Devonian: Eastern New York.

Original reference: G. H. Chadwick, 1933, Am. Jour. Sci., 5th, v. 16, p. 480, 483.

G. A. Cooper, 1941, Washington Acad. Sci. Jour., v. 31, no. 5, p. 180. Beds hitherto classified as "Marcellus" shale (Bakoven of Chadwick) immediately underlie Stony Hollow member (new) of Marcellus and are now proved to be equivalent of Union Springs member of Marcellus.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1733, chart 4. Represents easternmost known facies of Union Springs shale.

Winifred Goldring and G. A. Cooper, 1943, New York State Mus. Bull. 332, p. 240–249. In Coxsackie quadrangle, forms narrow belt for full length of area. In upper part, it is entirely included in Hamilton escarpment which rises abruptly above Onondaga Flats. Further south, in part, it forms east face of Hamilton Hills and, in part, underlies a hilly valley occupied in extreme south by Hollister Lake and a branch of the Catskill. Thickness for this area between 180 and 200 feet. Not in contact with Onondaga in this quadrangle. Stony Hollow member (new) of Marcellus overlies Bakoven shale. Bakoven shale of Chadwick now represents gray shale facies of Union Springs member of Marcellus.

Theodore Arnow, 1949, New York State Water Power and Control Comm. Bull. GW–20, p. 8 (table 1), 11 (fig. 3), 15. Bakoven, formerly termed "Marcellus shale," is basal formation of Hamilton group in Albany County. Typically black pyritiferous fissile shale. Thickness about 200 feet. Underlies Mount Marion formation; overlies Onondaga limestone. Middle Devonian.

Type section (partial): Where Catskill-Palenville Road crosses Kaaters Kill. Bakoven is local Dutch name of valley produced by the shale.

Balaklala Rhyolite[1]

Middle Devonian: Northern California.

Original reference: J. S. Diller, 1906, U.S. Geol. Survey Geol. Atlas, Folio 138.

A. R. Kinkel, Jr., and J. P. Albers, 1951, California Div. Mines Spec. Rept. 14, p. 4. Name restored as formal stratigraphic unit because new evidence indicates formation is composed principally of extrusive rhyolite and pyroclastics and not intrusive alaskite porphyry as considered by Graton (1910) who abandoned the name.

A. R. Kinkel, Jr., W. E. Hall, and J. P. Albers, 1956, U.S. Geol. Survey Prof. Paper 285, p. 1, 17–32, pl. 1. Composed of soda-rich rhyolitic flows and pyroclastic material. Subdivided into three units: lower nonporphyritic rhyolite, middle medium-phenocryst rhyolite, and upper coarse-phenocryst rhyolite. Probably 3,500 feet thick in central part of district, but forms volcanic pile that thins on edges. Conformably overlies, and in some areas interfingers with, Copley greenstone; underlies Kennett formation.

I. E. Klein, 1960, Sacramento Geol. Soc. [Guidebook] Field Trip June 3, 4, and 5, p. 11. Intruded by Mule Mountain granite (new).

Named for fact it forms hills about Balaklala mine, Redding quadrangle. Rhyolite crops out in a belt 16 miles long and 5 miles wide that strikes N. 15° E. from south half of Whiskeytown quadrangle to southwest quarter of Behemotosh quadrangle.

Balanos Beds

See **Bolanos Pyroclastic Member** (of Umatac Formation).

Bald Crater Basalt Flow

Pleistocene to Recent: Southwestern Oregon.

J. S. Diller and H. B. Patton, 1902, U.S. Geol. Survey Prof. Paper 3, p. 33. Name applied to basalt flow on Bald Crater. [See Timber Crater Basalt Flow.]

Bald Crater is north and west of Crater Lake.

†Bald Eagle Conglomerate,[1] Formation, or Sandstone

Bald Eagle Member (of Juniata Formation)

Upper Ordovician: Central Pennsylvania.

Original reference: A. W. Grabau, 1909, Jour. Geology, v. 17, p. 235.

Bradford Willard and A. B. Cleaves, 1939, Geol. Soc. America Bull., v. 50, no. 7, p. 1165–1198. Term Oswego apparently misapplied in Pennsylvania. For beds commonly referred to by that name, term Bald Eagle (Grabau, 1909) is revived and treated as basal member of Juniata. This new application of term restricts Martinsburg at top. Grades upward into red Juniata. Where Juniata is absent, underlies Tuscarora sandstone; overlies Martinsburg formation, in some areas the Fairview member. Thickness varies from 10 feet to as much as 124 feet.

F. M. Swartz, 1948, Pennsylvania Geologists Guidebook 14th Ann. Field Conf., p. 4–5, diagram. At its type section, Bald Eagle formation is about 650 feet thick and consists of poorly winnowed unfossiliferous graywacke-type sandstones, virtually without pebbles except for shale-chips of intraformational type. Formation includes a middle strong ridge-making sandstone member, underlain by weaker shale and sandstone member. Eastward toward Lewistown, ridge-making member of Bald Eagle sandstone becomes conglomeratic, with pebbles of vein quartz, quartz-veined quartzites, cherts and jaspers, and rarely of quartz-veined metaargillites. This conglomerate is here named Lost Run conglomerate. Overlies Reedsville shale and at eastern limit Martinsburg shale; underlies unnamed sandstone member of Juniata.

F. M. Swartz, 1955, Pennsylvania State Univ., Dept. Geology Contr. 3, 58 p. Bald Eagle sandstone, in type area, subdivided into Centennial School sandstone and shale member below and Spring Mount sandstone member (both new). Underlies East Waterford red sandstone member (new) of Juniata; overlies Reedsville shale.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook for Field Trips, Pittsburgh Mtg., p. 7, pl. 1. Formation comprises typically dark-gray, greenish, well-cemented, poorly sorted graywacke and orthoquartzite. Basal part commonly conglomeratic. Thickness 30 feet at Susquehanna Gap; nearly 1,000 feet in central Pennsylvania. Underlies Juniata formation. Contact with underlying Reedsville transitional: contact arbitrarily placed at youngest occurrence of *Orthorhynchula*.

Named for Bald Eagle Mountain at Tyrone, Blair County.

Bald Hill Agglomerate Member (of Tuscan Formation)

[Pliocene]: Northern California.

R. C. Treasher, 1947, (abs.) Geol. Soc. America Bull., v. 58, no. 12, pt. 2, p. 1257. Tuscan formation is subdivided into five members. Bald Hill agglomerate is second in sequence (ascending). Underlies Seven-Mile tuff and sand member; overlies Supan tuff and sand member.

Occurs at Iron Canyon dam site near Red Bluff, Tehama County.

Bald Hill Granite Gneiss[1]

Precambrian: Southeastern New York.

Original reference: C. E. Gordon, 1911, New York State Mus. Bull. 148, p. 11, 14–16, 20–21, 32, 34, 40.

Composes Bald Hill, Poughkeepsie region.

Bald Hill Limestone (in Tradewater Formation)[1]

Pennsylvanian: Southeastern Illinois.

Original reference: G. H. Cady, 1926, Illinois State Acad. Sci. Trans., v. 19, p. 263.

Exposed in railroad cut east of Stonefort as a discontinuous layer a few inches thick but is more typically developed at Bald Hill, about 2 miles southeast of Stonefort, Saline County, on north side of Big Four Railroad.

Bald Hill Sandstone (in Tradewater Formation)[1]

Pennsylvanian: Southeastern Illinois.

Original reference: G. H. Cady, 1926, Illinois State Acad. Sci. Trans., v. 19, p. 258, 263.

Occurs along crest of hill north of Stonefort, that is, Stonefort Hill, and is exposed on low knoll upon which Mitchellville, Saline County, is located.

Bald Hill Shale (in Henshaw Formation)[1]

Pennsylvanian: Western Kentucky.

Original reference: L. C. Glenn, 1922, Kentucky Geol. Survey, ser. 6, v. 5, p. 118.

Named for Bald Hill, just east of Dixon.

Bald Hills Formation

Upper Cretaceous: Northern California.

M. A. Murphy and P. U. Rodda, 1960, Jour. Paleontology, v. 34, no. 5, p. 835–858. Conglomerate, sandstone, and mudstone. Thickness 1,870 feet at type locality. Conformably overlies Ono formation; conformably underlies unnamed Upper Cretaceous mudstone unit. Molluscan fauna described.

Type section: In Bald Hills along Crow Creek in secs. 25, 26, and 31, T. 30 N., R. 7 W., Mount Diablo base and meridian, Shasta County.

Baldhills Member (of Isom Formation)

Eocene(?) or Oligocene, lower(?): Southwestern Utah.

J. H. Mackin, 1960, Am. Jour. Sci., v. 258, no. 2, p. 90 (table 1), 99. Porphyry of latitic composition, glassy to lithoidal in texture, black to dark red brown in color, with strong platy parting and blocky fracture. Exhibits some features of ignimbrites of very highly welded type, but has some internal structural features indicative of viscous flow. Lower member of formation; underlies Hole-in-the-Wall member (new). Discussion of ignimbrites of area.

Named for occurrence in Baldhills ridge (Three Peaks quadrangle) which trends northward from type locality of Isom formation, Iron Springs district.

Bald Knob Shale (in Kanawha Formation)[1]

Pennsylvanian: Southern West Virginia.

Original reference: C. E. Krebs and D. D. Teets, Jr., 1915, West Virginia Geol. Survey Rept. Boone County, p. 497.

Named for Bald Knob post office, Boone County.

Bald Knoll Formation

Eocene, upper, or Oligocene, lower: Central Utah.

W. N. Gilliland, 1949, Ohio State Univ. Abs. Doctors' Dissert. 57, p. 71; 1951, Nebraska Univ. Studies, new ser., no. 9, p. 11 (table 1), 43–47, pl. 2. Succession of light-green, light-tan, gray, and white clays with interbedded siltstone, sandstone, and minor amounts of soft limestone of the same colors. Thickness at type locality about 600 feet; elsewhere may be as much as 800 to 1,000 feet. Underlies Axtell formation with angular discordance; overlies Crazy Hollow formation.

D. P. McGookey, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 5, p. 605, 606–608. Gray Gulch formation as designated by Spieker (1949) includes strata equivalent to Bald Knoll formation of Gilliland (1951), part of Bullion Canyon volcanics of Callaghan (1939), and a previously unnamed interval that was mapped as Gray Gulch(?) formation by Lautenschlager (1952, unpub. thesis). Proposed herein that term "Gray Gulch" be abandoned and term "Bald Knoll formation" be used for lower part of interval formerly assigned to Gray Gulch. Thickness about 1,049 feet on Lost Creek. Underlies Dipping Vat formation (new); overlies Crazy Hollow formation. Eocene.

Type locality: At mouth of Bald Knoll Canyon in southwest corner of Gunnison quadrangle.

Bald Mountain Dacite[1]

Tertiary: Central southern Colorado.

Original reference: W. Cross, 1896, U.S. Geol. Survey 17th Ann. Rept., pt. 2, p. 295.

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 dikes cutting earlier andesite. Bald Mountain dacite flows, rhyolite in dikes, eruptive channels and flows, Pringle andesite, trachyte flows, and Bassick agglomerate.

Named for Bald Mountain, Custer County.

Bald Mountain Formation

Precambrian: Northeastern Utah.

D. J. Jones, 1955, Utah Geol. Mineralog. Survey Bull. 51, p. 13, 14, fig. 2. Series of buff-colored thin-bedded quartzites and metamorphosed conglomerate. Many thin layers of brown and green shale in between layers of quartzite. Thickness about 1,250 feet.

Named from Bald Mountain, Uinta Mountains, where formation is well exposed.

Bald Mountain Gneiss[1]

Precambrian: Northeastern Oregon.

Original references: W. D. Smith and E. L. Packard, 1919, Oregon Univ. Bull., v. 16, no. 7, p. 105; 1919, Jour. Geology, v. 27, p. 105.

Bald Mountain Lake Beds Member (of Esmeralda Formation)[1]

Miocene, upper, and Pliocene, lower: Central Nevada.

Original reference: H. G. Ferguson, 1924, U.S. Geol. Survey Bull. 723.

Composes upper part of Bald Mountain within 400 feet of its top. Manhattan district.

Bald Mountain Limestone[1]

Lower Ordovician: Eastern New York and western Vermont.

Original reference: W. W. Mather, 1843, Geology New York, v. 1, p. 367.

P. H. Osberg, 1952, Vermont Geol. Survey Bull. 5, p. 116 (fig. 16). Shown on correlation chart for Vermont. In Taconic sequence, Bald Mountain limestone occurs above Deepkill shale and below Normanskill formation. Taconic sequence occupies a range that extends southward from Brandon, Vt., into Massachusetts and Connecticut.

D. W. Fisher, 1954, Geol. Soc. America Bull., v. 65, no. 1, p. 76. Only lower part of Bald Mountain is Canadian; upper part is of Black River and Trenton ages.

Named for occurrence on Bald Mountain, Washington County, N.Y.

Bald Mountain Tonalite

Lower Cretaceous(?): Northeastern Oregon.

W. H. Taubeneck, 1957, Geol. Soc. America Bull., v. 68, no. 2, p. 197–204, 235. Medium-grained fairly uniform pale-blue-gray tonalite with some dark minerals. Intrudes Permian sedimentary and volcanic sequence and Triassic ultramafic-gabbroic series. Intruded by Mount Ruth leucogranodiorite and Red Mountain leucogranodiorite (both new). Surrounds Badger Butte quartz-biotite norite (new). Grades into Anthony Lake granodiorite (new) near center of batholith; this transition zone is intruded by Elk Peak quartz monzonite (new).

Characteristically exposed on Mount Ireland (Bald Mountain), in Elkhorn Mountains [Grant County]. Major rock component of Bald Mountain batholith.

Bald Peak Basalt[1] (in Berkeley Group)

Bald Peak Formation (in Contra Costa Group)

Pliocene: Western California.

Original reference: A. C. Lawson and C. Palache, 1902, California Univ. Pubs., Dept. Geol. Sci. Bull., v. 2, map.

D. E. Savage, B. A. Ogle, and R. S. Creely, 1951, (abs.) Geol. Soc. America Bull., v. 62, no. 12, pt. 2, p. 1511. Bald Peak formation included in sequence of formations (in west-central Contra Costa County) for which a new group name is proposed [name not given]. Sequence (ascending): Orinda, Moraga, Siesta, Bald Peak, and unnamed formation.

N. L. Taliaferro, 1951, California Div. Mines Bull. 154, p. 143. Noted as Bald Peak lavas, which are chiefly flows of basalt and andesite. Interbedded with and overlies Siesta formation.

C. R. Ham, 1952, California Div. Mines Spec. Rept. 22, p. 15. Included in Contra Costa group (new).

Forms large part of Bald Knob, east of Berkeley, Contra Costa County.

Bald Rock Conglomerate Member (of Lee Formation)[1]

Pennsylvanian: Southwestern Virginia.

Original reference: J. B. Eby, 1923, Virginia Geol. Survey Bull. 24, p. 65.

H. R. Wanless, 1946, Geol. Soc. America Mem. 13, p. 14. Middle of three conglomerates in the type Lee—the Bee Rock at top and an unnamed zone at base.

Named for Bald Rock, about 4 miles west of Dungannon, Wise County.

Bald Rock Granite

Late Jurassic(?): Northern California.

Anna Hietanen, 1951, Geol. Soc. America Bull., v. 62, no. 6, p. 583, 584. Named in a petrographic discussion of rocks of the area.

Report on the Merrimac area, Plumas National Forest, Butte and Plumas Counties.

Baldwin Formation

Mississippian (Chester Series): Southwestern Illinois.

J. M. Weller, 1939, *in* Stuart Weller and J. M. Weller, Illinois Geol. Survey Rept. Inv. 59, p. 10 (fig. 2), 12, 13; J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 837. Proposed for strata formerly known as upper Okaw or Plum Creek beds. Consists of more or less sandy beds at bottom and top separated by shale and dark-gray somewhat cherty limestone; these three parts are equivalent to Tar Springs, Vienna, and Waltersburg formations of southern Illinois, but the sandstones are erratically developed and it is impractical to map them separately. Thickness 60 to 75 feet. Conformably underlies Menard limestone; locally overlies Okaw limestone unconformably and rests on different members of it in different places.

Name derived from town on east side of Kaskaskia River in Randolph County. Outcrops extended from near Baldwin to Fort George and thence along Mississippi bluff to mouth of Marys River.

Baldwin Gneiss

Precambrian(?): Southern California.

R. B. Guillou, 1953, California Div. Mines Spec. Rept. 31, p. 5, 6–7, pl. 1. Chiefly fine-grained gneiss and schist and augen gneiss. Includes two ages of pre-Mississippian granitic intrusives. Thickness about 2,000 feet. Gneiss is in reverse fault contact with Chicopee formation (new) east of Baldwin Lake and with Furnace limestone to south. West of Doble mine, gneiss is in fault contact with Chicopee formation and overthrust by Saragossa quartzite. Intruded by Cactus quartzite. Gneisses and associated granitic intrusions were included in Saragossa quartzite by Vaughan (1922).

Type locality: East of Baldwin Lake, San Bernardino Mountains, San Bernardino County.

Baldwin Sandstone Member (of Mesaverde Formation)

Upper Cretaceous: Central Colorado.

E. C. Dapples, 1939, Econ. Geology, v. 34, no. 4, p. 371. Name proposed for strata, near village of Baldwin, identified earlier (W. T. Lee, 1912) as Bowie member. Contains several coal beds locally. Underlies Rollins sandstone member.

Village of Baldwin located in Anthracite-Crested Butte coal district, Gunnison County.

Baldwin Corner Formation

Lower Ordovician: East-central New York.

John Rodgers *in* M. P. Billings, John Rodgers, and J. B. Thompson, Jr., 1952, Geol. Soc. America Guidebook for Field Trips in New England, p. 35 (table 2), 53 (road log). Gray or yellow earthy fine-grained dolomite with persistent limestone layers near middle and at base. Thickness 120 feet. Underlies Great Meadows formation (new); overlies Whitehall formation. Formerly included in Whitehall formation. Refers to R. H. Flower (unpub. ms.).

Occurs in Fort Ann quadrangle.

Baldwinsville 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.

Derivation unknown.

Baldy Hill Formation (in Dockum Group)

Triassic: Northeastern New Mexico.

Brewster Baldwin and W. R. Muehlberger, 1959, New Mexico Bur. Mines Mineral Resources Bull. 63, pt. 2, p. 31, 35–38, pls. 1a, 1b, 2. Consists of silty mudstone, with beds of ledge-forming sandy mudstone and very fine-grained sandstone in type section where it is 115 feet thick. A 13-foot interval of claystone present near bottom of section. Formation characterized by purple color, which mottles orange, gray red, light to medium gray, and light olive. Nodules of red and yellow chalcedony and some silicified wood present below top of unit. Several sandstone beds present at base of formation where it underlies Travesser formation (new) 1 or 2 miles east and northeast of type section.

Type section: Measured 2,000 feet north of Baldy Hill at sec. 36, T. 32 N., R. 32 E., Union County. Exposed in an area of about 8 square miles on the former Baker Ranch, just north of junction of New Mexico Highways 325 and 370. Named from Baldy Hill.

Baldy Mountain Member (of Davis Creek Formation)

Upper Jurassic[?] or Cretaceous[?]: Northern California.

J. E. Lawton, 1956, Dissert. Abs., v. 16, no. 10, p. 1885. Named as lower member of formation. Underlies Buck Island member (new); overlies Round Mountain member of Little Valley formation (both new). Upper Jurassic and Cretaceous section, about 40,000 feet thick, consists of sequences of shale and silty shale which alternate with sequences of sandstone.

Occurs in Morgan-Wilbur area in Lake, Yolo, and Colusa Counties.

Balfour Formation

Oligocene, lower: Central Colorado.

J. H. Johnson, 1937, (abs.) Colorado Univ. Studies, v. 25, no. 1, p. 77. Consists of brown clays and sandy shales with interbedded flows and trachyte and fragmental volcanic material. Underlies Antero formation (new); overlies Denver formation.

J. T. Stark and others, 1949, Geol. Soc. America Mem. 33, p. 34 (table 7), 61–63, pl. 1. Sequence of stream-channel, flood-plain, alluvial-fan, deltaic, and true lake sediments. Thickness 0 to 200 feet. Relation to Denver formation nowhere exposed; may prove to be merely topmost part of the Denver.

Area: Best exposed north of Balfour in T. 13 S., R. 75 W. Scattered outcrops occur within area extending from R. 74 to R. 76 W., and from T. 14 to T. 12 S., Park County.

Ballard Formation (in Meade Group)

Pleistocene (Nebraskan and Aftonian): Southwestern Kansas.

C. W. Hibbard, 1958, Am. Jour. Sci., v. 256, no. 1, p. 55 (fig. 1), 56. Name proposed to include deposits between Rexroad formation below and Crooked Creek formation above in southwestern Kansas. Thickness about 20 feet. Includes Angell member (new) at base and Missler member. Separated by erosional unconformities from both underlying and overlying formations.

Type locality: On Big Springs Ranch in secs. 7 and 17, T. 32 S., R. 28 W., Meade County. Named from Louise Ballard Ranch which is shown on Meade County Platt book as saving included the present Big Springs Ranch.

Ballard Harmon Sandstone[1]

Mississippian: Southern West Virginia.

Original reference: R. V. Hennen and R. M. Gawthrop, 1915, West Virginia Geol. Survey Rept. Wyoming and McDowell Counties, p. 244.

Quarried on southwest side of Tug Fork, just below mouth of Ballard Harmon Branch, McDowell County.

†Ballast Point silex bed[1] (in Tampa Limestone)

Miocene, lower: Central Florida.

Original reference not stated.

Named for exposures at Ballast Point, Tampa, Hillsborough County.

Ballena Gravel[1]

Eocene: Southwestern California.

Original reference: W. J. Miller, 1935, Geol. Soc. America Bull., v. 46, no. 10, p. 1556–1561.

Type locality: Southwest of Ballena, San Diego County.

Ballou Clay (in Allegheny Formation)[1]

Pennsylvanian: Ohio.

Original reference not stated.

In Muskingum County.

Balmville Limestone Member (of Wappinger Limestone)[1]

Middle Ordovician: Southeastern New York.

Original reference: F. Holzwasser, 1926, New York State Mus. Bull. 270, p. 38–41, 43.

E-an Zen, 1960, (abs.) Geol. Soc. American Bull., v. 71, no. 12, pt. 2, p. 2009. Discussion of time and space relationships of Taconic rocks in western Vermont and eastern New York. Within southern Taconic area, Normanskill and higher rocks are autochthonous; they rest in normal succession on Whipple-correlative Balmville limestone member of Wappinger limestone.

Crops out north of Balmville, Orange County.

Balsora Limestone (in Palo Pinto Formation)[1]

Pennsylvanian: North-central Texas.

Original reference: G. Scott and J. M. Armstrong, 1932, Texas Univ. Bull. 3224, p. 24.

Occurs along Boone Creek. Named for outcrop in valley of a small stream 1 mile west of Balsora, Wise County.

Baltic Amygdaloid[1] (in Bohemian Range Group)

Precambrian (Keweenawan): Northern Michigan.

Original reference: L. L. Hubbard, 1898, Michigan Geol. Survey, v. 6, pt. 2, p. 135, 136.

T. M. Broderick, C. D. Hohl, and H. N. Eidemiller, 1946, Econ. Geology, v. 41, no. 7, p. 678 (fig. 1). Name used on geologic section of Michigan copper district.

Named for occurrence in Baltic mine, Houghton County.

Baltic Conglomerate[1] (in Bohemian Range Group)

Precambrian: Northern Michigan.

Original reference: A. C. Lane, 1906, Mines and Minerals, v. 27, p. 204–206.

Named for occurrence in Baltic mine, Houghton County.

Baltic Flow[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

H. R. Cornwall, 1951, Geol. Soc. America Bull., v. 62, no. 2, p. 194. Ophitic basalt of the Baltic flow overlies No. 3 conglomerate in Michigan copper district.

Michigan copper district on Keweenaw Peninsula in Houghton and Keweenaw Counties.

Baltic Sandstone[1] (in Bohemian Range Group)

Precambrian: Northern Michigan.

Original reference: A. C. Lane, 1911, Michigan Geol. and Biol. Survey Pub. 6, geol. ser. 4, p. 495, 499.

Probably named for its occurrence near Baltic mine or at or near town of Baltic, Houghton County.

Baltic West Amygdaloid[1] (in Bohemian Range Group)

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Named because it is usually the first amygdaloid west of Baltic lode.

Baltic 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).

Named for occurrence in Baltic mine, Houghton County.

Baltimore Gabbro or Gabbro Complex

Paleozoic (post-Lower Ordovician): Eastern Maryland.

Ernst Cloos and H. G. Hershey, 1936, Natl. Acad. Sci. Proc., v. 22, no. 1, p. 71, 78. Baltimore gabbro is intrusive into Glenarm series.

Ernst Cloos and others, 1936, Maryland Geol. Survey, v. 13, p. 33 (table 1), 217–236, pl. 1, 41. Post-Lower Ordovician. Gabbro occurs in peneplained area and occupies a structural basin in the Glenarm series and Baltimore gneiss.

Norman Herz, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 979–1015. Discussed as Baltimore gabbro complex. Intrudes Wissahickon and Peters Creek and is cut by quartzose intrusives including Relay diorite, Port Deposit granodiorite gneiss, and Ellicott City granite. The Relay occurs persistently along southeast margin of gabbro.

Complex comprises an area of about 50 square miles in Piedmont of Baltimore City and County and Howard County.

Baltimore Gneiss[1]

Precambrian: Northern Maryland, southeastern Pennsylvania, and central northern Virginia.

Original reference: G. H. Williams and N. H. Darton, 1892, U.S. Geol. Survey map of Baltimore to accompany "Guide to Baltimore" prepared for Baltimore meeting Am. Inst. Mining Engrs. Feb. 1892, p. 88, 139.

Ernst Cloos and others, 1936, Maryland Geol. Survey, v. 13, p. 33 (table 1), 217, pl. 1. Baltimore gabbro occurs in peneplained area and occupies a structural basin in Glenarm series and Baltimore gneiss.

Chi-shang Ch'ih, 1950, Geol. Soc. America Bull., v. 61, no. 9, p. 924. Northwest of Philadelphia, the Wissahickon is cut off by Cream Valley fault which brings it into contact with Baltimore gneiss.

Norman Herz, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 980. Unconformable below Glenarm series, lowest unit of which is Setters quartzite.

R. H. Jahns and W. R. Griffitts, 1953, U.S. Geol. Survey Prof. Paper 248–C, pt. 4, p. 172. Geographically extended into Anna River area, Virginia, where it forms a well-defined belt on east side of area; west of gneiss is Wissahickon schist.

Named for outcrops in city of Baltimore, Md., along banks of Jones Falls and Gwynns Falls.

†Baltimorean Formation[1]

Lower Cretaceous: Eastern Maryland.

Original reference: P. R. Uhler, 1888, Am. Philos. Soc. Proc., v. 25, p. 48.

Well developed in city of Baltimore.

Banbury Formation or **Basalt** (in Idaho Group)

Banbury Volcanics[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 (table), 50–51, pl. 5. Volcanics crop out fairly continuously as a series of even-bedded massive basalt flows more than 300 feet thick. Stratigraphic section shows Banbury volcanics above Raft lake beds and below Hagerman lake beds.

U.S. Geological Survey currently classifies the Banbury Basalt as a formation in Idaho Group on basis of study now in progress.

Named for exposures near Banbury Hot Springs, sec. 33, T. 8 S., R. 14 E., Twin Falls County.

Bandelier Tuff

Bandelier Rhyolite Tuff

Pleistocene: North-central New Mexico.

H. T. U. Smith, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 103. Named as sixth in a list of seven Quaternary formations in area. Older than Santa Clara basalt (new); locally overlies Puye gravel (new).

V. C. Kelley and Caswell Cooper, 1952, New Mexico Univ. Pubs. in Geology 4, p. 114 (fig. 14). Pleistocene.

Occurs in Abiquiu quadrangle, Rio Arriba County.

Bandera Shale[1] (in Marmaton Group)

Bandera Shale Member (of Oologah Limestone)

Bandera Shale (in Henrietta Group)

Pennsylvanian (Des Moines Series): Southeastern Kansas, southwestern Iowa, and northeastern Oklahoma.

Original reference: G. I. Adams, 1903, U.S. Geol. Survey Bull. 211, p. 32.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 38, pt. 11, p. 292, 321–325, pl. 1. Subdivided to include Bandera Quarry sandstone member (new). Overlies Laberdie limestone member (new) of Pawnee limestone; underlies Tina limestone member of Altamont limestone. Thickness commonly 50 feet. Included in Marmaton group. Note on type exposure.

L. M. Cline, 1941, Am. Assoc. Petroleum Geologists Bull., v .25, no. 1, p. 26–27 (fig. 2). Columnar section shows Bandera shale in Henrietta group.

L. M. Cline and F. C. Greene, 1950, Missouri Geol. Survey and Water Resources Rept. Inv. 12, p. 15–17. Geographically extended into Missouri. Underlies Altamont formation, in some areas Amoret limestone member. [Amoret replaces Tina.] Overlies Pawnee formation, Coal City member.

M. C. Oakes, 1952, Oklahoma Geol. Survey Bull. 69, p. 28. Term Oologah is extended to Kansas-Oklahoma line to include (ascending) Pawnee limestone, Bandera shale, and Altamont limestone as members.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 31, fig. 5. In southwestern Iowa, formation comprises rocks between Altamont formation above and Pawnee formation below. Not subdivided, and where Amoret member of Altamont is missing it is not possible to differentiate the formations. Bandera is well exposed below the Amoret and above Coal City limestones in ravine in NW¼ sec. 26, T. 75 N., R. 26 W., Madison County. Here it consists of 10 feet of red and green mottled clay and shale at top followed by 15 feet of green micaceous crossbedded sandstone and siltstone below. Marmaton group.

Named from Bandera Station in sec. 29, T. 25 S., R. 23 E., Bourbon County, Kans.

Bandera Quarry Sandstone Member (of Bandera Shale)

Pennsylvanian (Des Moines Series): Southeastern Kansas and northeastern Oklahoma.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 38, pt. 11, p. 292. Name applied to sandstone lenses in the Bandera shale.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 196. Gray and brown sandstone, generally thin bedded, locally "flagstones;" lenticular. Thickness as much as 30 feet; average 15 feet.

J. M. Jewett, 1945, Kansas Geol. Survey Bull. 58, p. 35, 37, 38, pl. 3. Sandstone is commonly well bedded and is fine and micaceous; locally the sandstone occupies entire Bandera section; where present, it is generally separated by shale ranging in thickness from a few feet to 20 or more feet.

C. M. Cade 3d, 1953, Tulsa Geol. Soc. Digest, p. 132 (fig. 2), 136–137. Geographically extended into Nowata and Craig Counties, Okla., where it occurs near top of Bandera shale, about 10 feet below base of the Altamont. A channel filling; most exposures show even bedding that is continuous for many miles. Locally contains thin shale members. Thickness of sandstone group is 11 feet.

Nearly all local occurrence is in flagstone quarries in vicinity of center of north line of SW¼ sec. 29, T. 25 S., R. 23 E., Bourbon County, Kans.

Bangor 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. M–9, p. 33, 104–107, maps.

Quarried at Bangor, Northampton County.

Bangor Limestone[1]

Upper Mississippian: Alabama, northwestern Georgia, and central and eastern Tennessee.

Original reference: E. A. Smith, 1890, Alabama Geol. Survey Rept. on Cahaba coal field, p. 155–157, map.

W. B. Jones, 1928, Alabama Geol. Survey Circ. 8, p. 13–15. Includes Burgess oolite and Rockwood oolite.

W. B. Jones, 1939, Econ. Geology, v. 34, no. 5, p. 575–578. Includes Spout Spring oolite (new) near base. Overlies Hartselle sandstone.

G. W. Stose, 1952, Washington Acad Sci. Jour., v. 42, no. 8, p. 214, 242 (fig. 1). In Murphree Valley anticline, Alabama, Bangor is fossiliferous cliff-making limestone about 600 feet thick. Underlies Pennington shale; overlies Tuscumbia limestone.

G. T. Malmberg and H. T. Downing, 1957, Alabama Geol. Survey County Rept. 3, p. 57–64. In Madison County, composed of about 350 to 420 feet of crystalline and oolitic limestone, dolomite, and shale. Overlies Hartselle sandstone; underlies Pennington formation; where Hartselle is missing, unconformably overlies Gasper formation.

Named for development at Bangor, Blount County, Ala.

Banjo Point Formation

Oligocene to Miocene: Alaska.

H. A. Powers, R. R. Coats, and W. H. Nelson, 1960, U.S. Geol. Survey Bull. 1028–P, p. 536–539, pl. 69. Bedded marine sandstone, conglomerate, tuffaceous shale, and some lapilli tuff of basaltic composition. Everywhere, top of formation is the present erosion surface. Could be as little as 400 feet thick; no marker beds could be traced through the many fault blocks to permit reconstruction of complete section, but partial section (considered type section) is about 138 feet thick, base not exposed. Unconformably overlies Amchitka formation (new). West of Banjo Point is in fault contact with Chitka Point formation (new). On basis of meager fauna, age range is considered Oligocene to Miocene.

Type section: Exposed on north coast at Banjo Point, Amchitka Island (Aleutian Islands). Occupies entire width of island westward from Makarius Bay to about 5 miles west of Banjo Point, and also several square miles of Saint Makarius Point; present on north coast west of Kirilof Point.

Bankston cyclothem

See Bankston Fork cyclothem.

Bankston Fork cyclothem (in Carbondale Formation)

Bankston Fork cyclothem (in McLeansboro Group)

Pennsylvanian: Southern Illinois.

J. M. Weller, 1942, Illinois Acad. Sci. Trans., v. 35, no. 2, p. 145 (table 1). In list of upper Pennsylvanian cyclothems, Bankston Fork occurs below Sparland cyclothem and above Jamestown cyclothem.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 11, pl. 1. On correlation chart, Bankston cyclothem is shown as including (ascending) Anvil Rock sandstone, Bankston Fork limestone, and Bankston coal. Underlies Cutler cyclothem (new); overlies Jamestown cyclothem.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 52 (table 2), 54 (table 3). In Carbondale formation.

Type locality not given; however, type locality of Bankston Fork limestone is in Saline County.

Bankston Fork Limestone Member (of Carbondale Formation)

Bankston Fork Limestone (in McLeansboro Formation)[1]

Bankston Fork Limestone (in McLeansboro Group)

Pennsylvanian: Southern Illinois and western Kentucky.

Original reference: G. H. Cady, 1926, Illinois State Acad. Sci. Trans., v. 19, p. 257, 261, 262.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, pl. 1. Included in Bankston cyclothem, McLeansboro group. On correlation chart, shown below Bankston coal and above Anvil Rock sandstone.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 34, 35, 48 (table 1), pl. 1. Reallocated to member status in Carbondale formation (redefined). Name Allenby coal member proposed for coal formerly called Bankston so that name may be restricted to Bankston Fork limestone. Stratigraphically above Anvil Rock sandstone member. Correlation chart shows Bankston Fork in western Kentucky. Type locality stated; location given by Cady (1926) incorrect. Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification is retained but is entirely independent of rock-stratigraphic classification.

Type locality: NE¼NW¼ sec. 19, T. 19 S., R. 5 E., Saline County, Ill.

Banner Limestone

Pennsylvanian(?) or Permian(?): Northeastern Nevada.

A. E. Granger and others, 1957, Nevada Bur. Mines Bull. 54, p. 116, pl. 14. Thick-bedded grayish-blue limestone, altered to silicates in wide zone adjoining quartz monzonite contact; conglomerate at base grading into quartzite. Estimated thickness 500 to 1,100 feet. Unconformably overlies Rio Tinto formation (new); underlies Nelson amphibolite (new). Fauna suggests age assignment of probably Pennsylvanian or Permian(?). Mapped in Carboniferous(?).

Map shows Banner Hill in Elko County.

Bannock Volcanic Formation[1]

Precambrian or Lower Cambrian: Southeastern Idaho.

Original reference: A. L. Anderson, 1928, Idaho Bur. Mines and Geology Pamph. 38, p. 3.

J. C. Ludlum, 1942, Jour. Geology, v. 50, no. 1, p. 88–89. Stratigraphically restricted to exclude upper sediments which are renamed Pocatello formation. Redefined as a series of lavas, tuffs, and volcanic breccias. Minimum thickness 400 feet. Precambrian.

Named for its occurrence in Bannock Range, Bannock County.

Baraboo Quartzite[1]

Precambrian: Central southern Wisconsin.

Original reference: R. D. Irving, 1877, Geology Wisconsin, v. 2, p. 504–519, 539, 542.

N. A. Riley, 1947, Jour. Geology, v. 55, no. 6, p. 453–475. Discussion of structural petrology of Baraboo quartzite. Thickness more than 4,000 feet. Underlies Seeley slate; overlies rhyolite, tuff, and granite. Algonkian.

Type locality and derivation of name not stated. Crops out in Baraboo area, Sauk and Columbia Counties.

Baraboo series[1]

Precambrian: Central southern Wisconsin.

Original reference: S. Weidman, 1904, Wisconsin Geol. and Nat. History Survey Bull. 13, Econ. ser. no. 8, p. 4, 22, 161, 162, 169–171.

In Baraboo region, Sauk County.

Baraga Group

Precambrian (Animikie Series) : Northern Michigan.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 27, 30 (table 1), 35–36. As defined, comprises most of strata referred to as Upper Huronian of previous reports, namely, Goodrich quartzite (basal formation), and Michigamme slate, the lower part of which in Marquette district includes Bijiki iron-formation member, Clarksburg volcanics member, and Greenwood iron-formation. In Iron and Dickinson Counties, six formations are represented: Goodrich quartzite (lowermost unit), Hemlock formation, Fence River formation, and its probable correlative, Amasa formation, Michigamme slate, and Badwater greenstone (new). In the sequence, Baraga is younger than Menominee group and older than Paint River group (new).

Named for Baraga County in which rocks of group are widely exposed.

Baranos Beds

See Bolanos Beds, Andesite, or Formation.

Barata Limestone (in Saavedra Member of Lowell Formation)

Lower Cretaceous: Southeastern Arizona.

A. A. Stoyanow, 1949, Geol. Soc. America Mem. 38, p. 11. Streaked calcareous sandstone near the top and fossiliferous limestone below. Thickness 2 feet. Separated from overlying Arkill (new) by 12 feet of buff 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.

Bar B Formation (in Magdalena Group)

Pennsylvanian: Southwestern New Mexico.

V. C. Kelley and Caswell Silver, 1952, New Mexico Univ. Pubs. in Geology 4, p. 93–94, 253–254, figs. 2, 11. Consists dominantly of thin-bedded limestone and shale in alternating thin intervals. Cherty and noncherty limestone present. Chert commonly mottled and weathered tan or yellowish brown. Uppermost beds intercalated with reddish-brown siltstone, limestone conglomerate, and calcareous sandstone through interval of about 50 feet. Comprises upper third of group and is 339 feet thick at type section. Underlies Abo formation with transitional contact; conformably overlies Nakaye formation (new). Whereas 80 percent of Nakaye formation is limestone and remainder shale, ratio is nearly reversed in the Bar B formation.

Type section: In Caballo Mountains on South Ridge, sec. 10, T. 15 S., R. 4 W., Sierra County. Name taken from Bar B Draw east of Blue Mountain where, near head of draw formation is widely exposed.

Barbacoas Formation

Oligocene(?): Panamá.

R. T. Hill, 1898, Harvard Coll. Mus. Comp. Zoology Bull., v. 28, no. 5, p. 183–187, 206, 209. Loosely cemented white earthy rock composed of firm fine particles, apparently siliceous, but water sorted, and showing distinct lines of lamination, in alternating degrees of fineness and coarseness. Grades down into mass of brownish rock called 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. 325. An informal name for tuff at a now submerged locality in Canal Zone. Oligocene(?).

At Barbacoas, Canal Zone.

Barberian series

Mesozoic (Early Cretacic): Southwestern Kansas and New Mexico.

Charles Keyes, 1940, Pan-Am. Geologist, v. 74, no. 2, p. 105 (chart), p. 147-149; no. 3, p. 201. Name applied to early Cretacic rocks of Kansas. Includes Kiowa and Garrett shales. Term also extended into New Mexico.

Named for Barber County, Kans.

Barboursville Silts

Pleistocene (Illinoian): Western West Virginia.

D. P. Stewart, 1952, West Virginia Acad. Sci. Proc., v. 23, p. 113–115. Name applied to silts in vicinity of Barboursville. Thickness about 85 feet. Silts believed to have been deposited during slack water stage when waters of Cincinnati River and its tributaries were backed up behind Illinoian ice.

Barboursville is on Mud River in Cabell County. Silts extend from river southward to valley walls.

†Barclay Limestone[1]

Pennsylvanian: Eastern Kansas.

Original reference: J. W. Beede, 1902, Kansas Univ. Sci. Bull., v. 1, p. 175.

Probably named for Barclay, Osage County.

Bardons Peak Grabbro (in Duluth Gabbro Complex)

Precambrian (middle Keweenawan): Northeastern Minnesota.

R. B. Taylor, 1956, Geol. Soc. America Guidebook for Field Trips Minneapolis Mtg., Field Trip 1, p. 42, 46 (table 1), 56. Name applied to a coarse-grained melagabbro in the Duluth gabbro complex. Unit is approximately 200 feet thick, dips irregularly about 35° to northeast, and can be traced for about 1½ miles.

Exposed along Canadian National Railroad, northwest of Duluth, in St. Louis County.

Bar Harbor Series[1]

Bar Harbor detrital facies (of Frenchman Bay Series)

Silurian: Southeastern Maine.

Original reference: N. S. Shaler, 1889, U.S. Geol. Survey 8th Ann. Rept., pt. 2, p. 1037, 1047–1052, 1060, map.

G. H. Chadwick, 1942, (abs.) Geol. Soc. America Bull., v. 53, no. 12, pt. 2, p. 1797. Considered facies of Frenchmans Bay series (new). Interfingers with, and is of same age as, Cranberry Island volcanic facies. Silurian.

G. H. Chadwick, 1944, New York Acad. Sci. Trans., ser. 2, v. 6, no. 6, p. 172–173. Detrital facies consists of thin-bedded or shaly-looking submetamorphosed quartzose silts. Developed extensively in northern and northeastern parts of Mount Desert Island.

C. A. Chapman and P. S. Wingard, 1958, Geol. Soc. America Bull,. v. 69, no. 9, p. 1194. Correlation table shows Bar Harbor series Lower or Middle Devonian.

Named for Bar Harbor Landing, Mount Desert Island, Hancock County.

Baring Migmatites

[Paleocene or older] : Northwestern Washington.

R. S. Yeats, 1958, Dissert. Abs., v. 19, no. 4, p. 775. Were thrust over Stillaguamish rocks, producing intense cataclasis and truncation of earlier structures in autochthon and allochthon.

In central part of Skykomish area in northwestern Cascade Mountains, 45 miles east of Seattle.

†Barker Formation[1]

Middle and Upper Cambrian: Central northern Montana.

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

A. M. Hanson, 1952, Montana Bur. Mines and Geology Mem. 33, p. 3. Mentioned in discussion of history of work on Cambrian system in and near western Montana.

Well exposed near Barker and in broad valley of Pilgrim Creek and cliffs to north, Fort Benton region.

Barker Porphyry[1]

Post-Cretaceous: Central Montana.

Original reference: W. H. Weed, 1899, U.S. Geol. Survey Geol. Atlas, Folio 56.

F. C. Armstrong, 1957, Econ. Geology, v. 52, no. 3, p. 221. Mentioned in report of Montana as a source area of uranium. Locally Flathead quartzite has been intruded by post-Cretaceous Wolf and Barker porphyries.

Forms Big Baldy Mountain to south of Barker, Little Belt Mountains.

Barker Quartzite[1]

Lower Cambrian: Southwestern Vermont.

Original reference: A. Keith, 1932, Washington Acad. Sci. Jour., v. 22, p. 360, 401.

Probably named for Barker Hill, 4 miles east of north from Castleton, Rutland County.

Barker Syenite[1]

Age(?) : Montana.

Original reference: L. V. Pirsson, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 3, p. 465–468.

Forms intrusive mass north of Barker, Cascade County.

Barker Dome Tongue (of Cliff House Sandstone)

Upper Cretaceous: Northwestern New Mexico and southwestern Colorado.

P. T. Hayes and A. D. Zapp, 1955, U.S. Geol. Survey Oil and Gas Inv. Map OM–144, sheet 1. Most extensive tongue of basal Cliff House sandstone in Menefee formation in Barker Dome-Fruitland area is here named Barker Dome tongue. Southwestern wedge-edge of this tongue trends N. 45° W., as determined by exposures in Mancos Canyon and at Barker Dome. From this depositional edge, tongue extends approximately 2½ miles northeastward before it coalesces with main body of Cliff House sandstone. Contacts are sharp.

Crops out on Barker Dome, Southern Ute Dome, and in upper drainage of Barker Creek, San Juan County, N. Mex.; also in walls of Mancos Canyon, Colo.

Barkerian series[1]

Cambrian: Montana.

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

Barkley quartzites[1]

Lower Cambrian: Utah.

Original reference: C. R. Keyes, 1924, Pan-Am. Geologist, v. 41, p. 38.

Derivation of name not stated.

Barlow Cove Formation

Permian and Triassic(?): Southeastern Alaska.

Fred Barker, 1957, U.S. Geol. Survey Geol. Quad. Map GQ–100. Largely chlorite-epidote-albite schist with minor amounts of augite-bearing volcanic flow breccia, andesite, quartz-pebble graywacke conglomerate, laminated massive homogeneous graywacke, and black slate. Well-defined member of chlorite-epidote-albite schist, slate, graywacke, and quartz-pebble conglomerate, approximately 300 to 800 feet thick extends from Barlow Cove to Lone Mountain and delineates Lone Mountain fold. Total thickness approximately 6,500 feet. In contact with Retreat group (new) along bedding fault. Underlies Symonds formation (new).

U.S. Geological Survey currently designates the age of the Barlow Cove Formation as Permian and Triassic(?) on basis of study now in progress.

Type locality: Along eastern shore of Barlow Cove, Juneau (B–3) quadrangle. Extends from south boundary of the quadrangle northward to Barlow Point and Hump Island.

Barlow Pass Volcanics

Eocene: Northwestern Washington.

J. A. Vance, 1957, Dissert, Abs., v. 17, no. 9, p. 1985. About 4,000 feet of gently folded andesitic and basaltic and subordinately acidic flows, with prominent arkosic interbeds.

Occurs in Sauk River area in northern Cascades.

Barlow Ranch Beds

Pleistocene, lower: Southern California.

J. E. Eaton, 1928, Am. Assoc. Petroleum Geologists Bull., v. 12, no. 2, p. 124. Statement is made that Arnold tentatively correlated Barlow Ranch beds with upper San Pedro series or Palos Verdes formation of typical locality.

J. E. Eaton, 1943, California Div. Mines Bull. 118, pt. 2, p. 204, 205 (fig. 86) [preprint 1941]. Shown as underlying Hall Canyon and overlying San Pedro marine beds.

Occurs in Los Angeles and Ventura Basins.

Barnard Gneiss[1]

Cambrian or Ordovician: Southeastern and east-central Vermont.

Original reference: C. H. Richardson, 1924, Vermont State Geologist Rept. 1923–1924, p. 91–92.

P. H. Osberg, 1952, Vermont Geol. Bull. 5, p. 116. Lower and Middle Ordovician.

Well exposed in Barnard Township, Windsor County.

Barnegat 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.

D. W. Fisher, 1956, Internat. Geol. Cong., 20th, Mexico, Cambrian Symposium, pt. 2, p. 329, 343. Rejected because of lack of usage.

Extends from Barnegat up Wappingers' Creek, by Pleasant Valley and Pine Plains into Columbia County, and on south it passes from Milton to Newburg; on the west down the great valley through New Jersey into Pennsylvania.

Barnes Conglomerate Member (of Dripping Spring Quartzite)

Barnes Conglomerate (in Apache Group)[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. Composed of smooth, ellipsoidal pebbles in matrix of coarse arkosic sand firmly cemented by silica in Globe quadrangle. Thickness 6 inches to 50 feet; commonly 10 to 20 feet. Overlies Pioneer formation; underlies Dripping Spring quartzite.

U.S. Geological Survey currently classifies the Barnes Conglomerate as a member of Dripping Springs Quartzite on the basis of a study now in progress.

Forms conspicuous strata girdle about Barnes Peak, Globe district.

Barneston Limestone (in Chase Group)

Barneston Formation (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, ser. 2, p. 41.

R. C. Moore, 1936, Kansas Geol. Soc. 10th Ann. Field Conf. Guidebook, p. 12 (fig. 4), 69 (fig. 45). Includes Oketo shale member (new).

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 44–45. Includes (ascending) Florence limestone, Oketo shale, and Fort Riley limestone members. Thickness 80 to 90 feet. Underlies Holmesville shale member of Doyle shale; overlies Blue Springs shale member of Matfield shale. Wolfcamp series.

Type locality: In bluffs west and southwest of Barneston, Gage County, Nebr.

Barnett Shale[1] **or Formation**

Mississippian: Central Texas.

Original references: F. B. Plummer and R. C. Moore, 1921 [1922], Texas Univ. Bull. 2132, p. 24–31; R. C. Moore and F. B. Plummer, 1922, Jour. Geology, v. 30, no. 1, p. 25 (chart), 26–28.

P. E. Cloud, Jr., and V. E. Barnes, 1948, Texas Univ. Bur. Econ. Geology Pub. 4621, p. 52–59. Sellards (1932 [1933], Texas Univ. Bull. 3232) designated unit Barnett formation, and present report [Ellenburger group of central Texas] follows this emendation. Although Barnett strata are largely shale in east and north and contain fauna similar to that of Moorefield formation and Ruddell shale of Arkansas, strata of Barnett age in southwestern part of Llano region grade laterally into detrital limestone containing fossils of strong Keokuk affinities and lesser affinities with younger strata. Only section described by Plummer and Moore (1921) was presumably above type section of Chappel limestone and about 2.2 airline miles southwest along Simpson Creek fault zone from type locality. This is locality 205–T–24 from which Plummer and Scott (1937, Texas Univ. Bull. 3707) collected goniatities, and it shows best section of the Barnett in vicinity of type locality. Formation ranges in thickness and character from 40 to 50 feet of mostly shale in vicinity of type locality to featheredge on one hand, and on the other hand to thickness of about 140 feet of mostly crinoidal limesands in Bear Spring area in Mason County. Formation was considered to be probably Pennsylvanian at time of its description but is now commonly accepted as Mississippian. Lower limit of age is fixed as Keokuk but upper limit might be as high as Ste. Genevieve. Present authors consider it unlikely that any part of Barnett is as young as Chester as it is their opinion that it is actually entirely pre-St. Louis if not pre-Spergen.

F. B. Plummer, 1950, Texas Univ. Bur. Econ. Geology Pub. 4329, p. 32–46. Formation occurs as narrow band of outcrop between Marble Falls and Ellenburger along almost entire area of Ellenburger outcrop. It is thin and entirely absent in places around Brady and absent along most of Ellenburger border south of Colorado River in Marble Falls, Spicewood, and northeast Kimble County districts. Thickness 5 to 90 feet. In some areas, underlies Sloan formation of Marble Falls group; overlies Chappel limestone which is herein subdivided into [ascending] Kings Creek marl, Ives conglomerate, Espey Creek limestone, and Whites Crossing coquina members.

W. H. Hass, 1953, U.S. Geol. Survey Prof. Paper 243–F, p. 69–94. Formation, in Llano region, contains two conodont faunal zones. Upper zone is restricted to that part of formation which in this report is regarded as being definitely of Meramec age and possibly also partly of Chester age; lower zone is regarded as being Osage (Keokuk) age. For most part, base of Barnett is easily recognized, though it is now known that, at many localities, a thin sequence of Mississippian and Devonian beds is present between the Barnett and Ellenburger groups. Opinions differ as to where base of Barnett should be drawn in southwest quadrant of region, as beds occur there which some stratigraphers place in Chappel limestone but which others place in Barnett formation (Cloud and Barnes, 1948; Plummer, 1950).

P. E. Cloud, Jr., V. E. Barnes, and W. H. Hass, 1957, Geol. Soc. America Bull., v. 68, no. 7, p. 808, 810, pl. 2. Plummer's (1950) Whites Crossing coquina member of Chappel formation is an echinodermal limestone facies in lower part of Barnett formation. In some areas, Chappel limestone is missing, and the Barnett overlies Houy formation (new).

Named from Barnett Springs, about 5 miles east of San Saba, near which is typical exposure of the shale.

Barnett Hill Formation

Bendian (Morrow Series): Southeastern Oklahoma.

B. H. Harlton, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 7, p. 854 (fig. 1), 858, 859, 902–912. Proposed for uppermost formation of series in area; unit formerly considered unnamed upper member of Wapanucka here restricted to exclude the Barnett Hill. Consists of calcareous, fossiliferous sandstones and shales; siliceous shale near base; changes laterally within short distances; typically an overlapping deposit. Thickness varies; at first type section 415 feet; at second type section 760 feet. Underlies Atoka formation; north of Arbuckles and in frontal Ouachitas overlies Wapanucka (restricted); in southern Ouachitas overlies Round Prairie formation (new). Morrow series is here included above Pushmataha series in upper part of the Bendian period.

R. B. Laudon, 1958, Oklahoma Geol. Survey Circ. 46, p. 20. Harlton suggested separation of Barnett Hill formation containing an unquestionable Morrow fauna from the Atoka. Barnett Hill has been included in the Wapanucka but lithologically is almost inseparable from the overlying Atoka, and for this reason its status as a separate formation is open to criticism. Subsequent workers have not separated the Barnett Hill from the Atoka.

Type locality: Barnett Hill, 1 mile north of Clarita, sec. 2, T. 1 S., R. 8 E., Coal County. Second type locality: Goose Creek in secs. 19 and 20, T. 1 N., R. 8 E.

Barnhart Formation

Ordovician: Eastern Missouri.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1 p. 116. Name proposed for the "Decorah" of Missouri which overlies Plattin group and underlies Kimmswick formation. Consists of about 20 feet of greenish shale with interbedded thin limestones, all abundantly fossiliferous.

Type section: At Koch Valley School on U.S. Highway 61–67, 2 miles south of Barnhart, Kimmswick (15′) quadrangle, Jefferson County.

Barnsdall Formation (in Ochelata Group)

Pennsylvanian (Missouri Series): North-central Oklahoma.

M. C. Oakes, 1951, Tulsa Geol. Soc. Digest, v. 19, p. 119, 120, 121. Consists of sandstone and limestone. At Kansas-Oklahoma line, consists of Birch Creek limestone at base and two unnamed shale members that are separated by inconspicuous unnamed sandy limestone less than 2 feet thick. Southward this unnamed sandy limestone grades into sandstone continuous with Okesa sandstone member. Farther south, the Okesa is much thicker at the expense of the two shale members, and includes, as its basal bed, limy sandstone that is equivalent to Birch Creek limestone.

Upper shale member contains Wildhorse dolomite bed only a few feet below the top of formation. Unconformably overlies Wann formation; conformably underlies Tallant formation (new). Thickness about 100 feet.

M. C. Oakes, 1959, Oklahoma Geol. Survey Bull. 81, p. 38–41, pls. Extends from Kansas-Oklahoma line southward through western Washington County, eastern Osage County, western Tulsa County, and western Okfuskee County to Canadian River. Thicknesses: 100 feet at Kansas-Oklahoma line, T. 29 N., R. 12 E.; 110 feet in T. 23 N.; 45 feet in T. 22 N.; 190 feet in T. 19 N., R. 9 E., western Tulsa County. Irregular in thickness in Creek County, ranging upward from about 140 feet in T. 18 N. to 200 feet in north part of T. 17 N., and thence downward to about 100 feet in south part of T. 14 N. Includes Okesa sandstone member. Rests unconformably upon Wann formation across Creek County, truncates Iola formation in southern Creek County, and rests unconformably upon Chanute formation. In Creek County, conformable with Tallant formation above but is overlain unconformably by lower Virgil rocks across most of Okfuskee County to south.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 18–20. Wildhorse dolomite member, which occurs near top of formation in Osage County, is not found south of Arkansas River.

Type locality: Area between Barnsdall and Wolco, T. 24 N., R. 11 E., Osage County. Name is from town of Barnsdall, formerly Bigheart. This is same town from which Bigheart sandstone was named (White and others, 1922). Type locality of Bigheart is in hills west of the town, and name of town has been changed to Barnsdall. Town now called Bigheart is in sec. 3, T. 27 N., R. 10 E., Osage County, and is on the outcrop of neither Barnsdall formation or Bigheart sandstone.

†Barnstable Series[1]

Pleistocene: Southeastern Massachusetts.

Original reference: N. S. Shaler, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 2, p. 503–593.

Named for occurrence at Barnstable, Barnstable County.

Barnwell Sand[1] or Formation[1] (in Jackson Group)

Eocene, upper: Southwestern South Carolina and eastern Georgia.

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. 12, 17

C. W. Cooke, 1943, U.S. Geol. Survey Bull. 941, p. 61–67. In this report, Cooke and Shearer's (1918, U.S. Geol. Survey Prof. Paper 120) usage is adopted, except that part of the so-called Congaree clay is restored to the McBean formation. Further subdivided in Georgia to include Sandersville limestone member in upper part. Thickness estimated as less than 200 feet in eastern Georgia and a little more than 200 feet in Twiggs County, where Twiggs member accounts for nearly half the thickness. Unconformably overlies McBean formation and overlaps beyond it across Tuscaloosa formation to crystalline rocks of Piedmont; toward southwest end of outcrop area, merges laterally into Ocala limestone; at most places, the Flint River formation or Hawthorn formation overlaps beyond seaward edge of Barnwell and lies unconformably on it.

P. E. LaMoreaux, 1946, Georgia Geol. Survey Bull. 50, pt. 1, p. 3 (fig. 1), 9–22. In east-central Georgia divided into three members: basal Twiggs clay member, Irwinton sand member (new), and unnamed thin upper member of coarse red sand with flat rounded beach pebbles. East of Ogeechee River, formation is undifferentiated. This study indicates that no part of the so-called Congaree clay or Twiggs clay is of Claiborne age, and that base of Barnwell in this area is base of Twiggs clay member which rests unconformably on the Tuscaloosa except where channel sands are present.

C. W. Cooke and F. S. MacNeil, 1952, U.S. Geol. Survey Prof. Paper 243–B, p. 20, 26–27. Discussed in South Carolina where it is undifferentiated and is only true representative of the Jackson among outcropping formations. Large part of deposits formerly mapped as Barnwell have proved to be Congaree. Name Barnwell formation was applied to leached residues of sandy limestone, and no type locality was ever designated. It now appears that actually the railroad cut at Barnwell was made in a part of Miocene Hawthorn formation, although many geologists must have regarded it as typical Barnwell. Residues of limestone of Jackson age certainly are present elsewhere in Barnwell County beneath Hawthorn cover, and there is no reason why name Barnwell cannot be applied to unleached Jackson beds farther downdip even though type area falls entirely within area of solution.

J. F. L. Connell, 1958, Southwestern Louisiana Jour., v. 2, no. 4, p. 321–322, 327–329, 343 (fig. 15). Basal part of Barnwell, extending from central Georgia to Savannah River, is termed Twiggs clay member. Conformably above the Twiggs is Irwinton sand member, which is overlain by much localized unit, the Sandersville member. In a few areas near overlap of Barnwell on Precambrian crystalline rocks, the Upper Sand member (LaMoreaux, 1946) is designated as part of the Barnwell. In present investigation, stratigraphically higher beds of argillaceous red sand making up typical uppermost Barnwell were found to crop out above the Irwinton and Upper Sand members in Glascock and Jefferson Counties. As much as 7 to 15 feet of massive brilliant- to dark-red fine-grained argillaceous unconsolidated quartz sand occurs in these two counties. To southwest, in Crawford County, 40 feet of these uppermost Barnwell sands occur at Rich Hill, and south of town of Roberta. At this locality, these sands lie with conformity on Twiggs clay, the Irwinton and Upper Sand members being absent. North of Fort Valley, Peach County, summits of highest hills are capped by dark-red argillaceous quartz sand unlike the Irwinton and Upper Sand members. The uppermost sands are herein designated Roberta sand member.

Type area: Barnwell County, S.C.

Barrack Mountain Granite Gneiss[1]

Precambrian(?): Northwestern Connecticut.

Original reference: W. M. Agar, 1929, Am. Jour. Sci., 5th, v. 17, p. 204, 211.

Rock forms Barrack Mountain, 1 mile south of Falls Village, Litchfield County.

Barranquitas Shaly Limestones[1]

Upper Cretaceous: Puerto Rico.

Original reference: C. P. Berkey, 1915, New York Acad. Sci. Annals, v. 26, p. 29.

J. D. Weaver, *in* R. Hoffstetter and others, 1956, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2b, p. 316–317, Upper Cretaceous.

Crop out in northwest-southwest belt of unknown extent, in vicinity of Barranquitas in central Puerto Rico and form crest of island in that area.

Barranquitas-Cayey Series

Lower Cretaceous: Puerto Rico.

E. T. Hodge, 1920, New York Acad. Sci., Scientific Survey of Porto Rico and the Virgin Islands, v. 1, pt. 2, p. 132–137. Chiefly shales and shaly limestones with numerous limestone lenses and an occasional bed of tuff and conglomerates. Thickness 2,000 to 3,000 feet. Lower part grades into Rio de la Plata series; upper part forms sharp contact with Sierra de Cayey series.

R. C. Mitchell, 1954, Puerto Rico Univ. Agr. Expt. Sta. Tech. Paper 13, p. 36 (table 2), 37, 38, 39. Lower Cretaceous.

Named from two villages situated on rocks in northeast corner and in eastern margin of Coamo-Guayama district.

Barre Granite[1]

Devonian: East-central Vermont.

Original reference: C. H. Richardson, 1902, Vermont State Geologist 3d Rept., p. 61–98.

V. R. Murthy, 1957, Vermont Geol. Survey Bull. 10, p. 70–73. Barre granite is an elongated, oval-shaped body that crops out in northwestern and west-central parts of East Barre quadrangle. Outcrop is confined to Westmore formation except at eastern margin, near East Barre village, where it extends a short distance in Waits River formation.

Occurs mostly in Barre Township, Washington County, with small area in Williamstown Township, Orange County.

Barre Group

Silurian: Eastern Vermont.

V. R. Murthy, 1958, Jour. Geology, v. 66, no. 3, p. 276, 278–282, 286 (fig. 4). Proposed that section regarded as Waits River formation by Currier and Jahns (1941) be elevated to status of group—to be called Barre group. Includes (ascending) Barton River, Westmore, and Waits River (redefined) formations. In its stratigraphic limits, group is identical with old Waits River formation. Overlies Northfield slate.

Type locality and derivation of name not given. Report includes Barre-East Barre area.

Barree Limestone[1]

Silurian: Central Pennsylvania.

Original reference: I. C. White, 1885, Pennsylvania 2d Geol. Survey Rept. T_3, p. 132–133.

Outcrop belt crosses Little Juniata River at Barree forge, and it is quarried for flux at Barree furnace, Huntingdon County.

Barree Shales[1]

Silurian: Central Pennsylvania.

Original reference: I. C. White, 1885, Pennsylvania 2d Geol. Survey Rept. T_3, p. 133.

Exposed along river bank below Barree furnace, Huntingdon County.

Barrelian series[1]

Cambrian: California.

Original reference: C. R. Keyes, 1931, Pan-Am. Geologist, v. 56, p. 76.

Barrel Spring Formation[1]

Barrel Spring Formation (in Eureka Group)

Middle Ordovician: East-central California.

Original reference: F. B. Phleger, 1933, Southern California Acad. Sci. Bull., v. 32, pt. 1, p. 1–6.

R. L. Langenheim, Jr., and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2086 (fig. 2), 2087 (fig. 3), 2091–2092. Described in Mazourka Canyon area, Independence quadrangle. Thickness about 100 feet at Mexican Gulch to 150 feet at Lead Canyon Trail. Consists of sandstone, shale, and limestone. Divided into four unnamed members. Overlies Mazourka formation; underlies unnamed unit referred to as undifferentiated upper part of Eureka group.

H. R. Pestana, 1960, Jour. Paleontology, v. 34, no. 5, p. 109–112. Underlies Johnson Spring formation (new), which is name proposed for undifferentiated upper part of Eureka group of Langenheim and others (1956).

Well exposed in Barrel Spring Canyon and in each of next four canyons to the north, Inyo Range.

Barrett Shale[1]

Lower Cretaceous: Northeastern Wyoming and western South Dakota.

Original reference: W. P. Jenney, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 2, p. 593, fig. 122, map.

Mapped at and around Barrett, Crook County, Wyo.

Barrigada Limestone

Miocene, upper, and Pliocene: Mariana Islands (Guam).

H. T. Stearns, 1940 (abs.) Geol. Soc. America Bull., v. 51, no. 12, pt. 2, p. 1948. Includes quantities of reef talus; now forms northern plateaus of island.

Risaburo Tayama, 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 59, table 4 [English translation in library of U.S. Geol. Survey, p. 69]. Older than Merizo limestone.

U.S. Geological Survey currently designates age of Barrigada Limestone as upper Miocene and Pliocene on basis of study now in progress.

Forms northern plateau of island.

Barrington Clays[1]

Pleistocene (Wisconsin Stage): Rhode Island.

Original reference: J. B. Woodworth, 1896, U.S. Geol. Survey 17th Ann. Rept., pt. 1, p. 987–988, chart opposite 988, pl. 62.

Present in town of Barrington, Bristol County.

Barron Quartzite[1]

Precambrian (Keweenawan): Northwestern Wisconsin.

Original reference: N. H. Winchell, 1895, Am. Geologist, v. 16, p. 150–162.

E. F. Bean, 1959, Geologic map of Wisconsin (1:1,000,000): Wisconsin Geol. Nat. History Survey. Varies from soft sandstone to hard vitreous quartzite. Maximum known thickness 600 feet. Average thickness probably not more than 200 feet. Exact correlation not known; probably Upper Keweenawan.

Present in eastern part of Barron County.

Barrow Trail Member (of Schrader Bluff Formation)

Upper Cretaceous: Northern Alaska.

C. L. Whittington, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 246, 249, 250–251, fig. 5. More than one-half the member at type locality is fine- to very fine-grained light-gray to olive-gray thick-bedded sandstone, in part bentonitic to tuffaceous. Interbedded with sandstone are clay shale, siltstone, bentonite, and tuff. Marine fossils found at five horizons from 40 feet to 525 feet above base. A minor nonmarine tongue of Prince Creek formation represented in this type section by a 2-foot coal bed about 170 feet above base. Thickness 575 feet in vicinity of Umiat, at least 700 feet and possibly as much as 900 feet at Schrader Bluff. Underlies Sentinel Hill member; overlies Rogers Creek member (new.) Rogers Creek and Barrow Trail members defined to include rocks overlying Tuluvak tongue of Prince Creek formation that were formerly included in Tuluga member.

Type locality: Bluffs along north side of Colville River, 3 to 5 miles northeast of Umiat Mountain. Named from Barrow Trail, and old tractor trail which, in the area from 13 to 28 miles west of Umiat Mountain, follows cuesta formed by sandstones of this member.

Barryville Member[1] (of Shohola Formation)

Barryville parvafacies (in Shohola facies group)

Upper Devonian: Southeastern New York and northeastern Pennsylvania.

Original reference: Bradford Willard, 1936, Geol. Soc. America Bull., v. 47, no. 4 p. 571, 586–587.

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

Well displayed on New York side of Delaware River in vicinity of Barryville, Sullivan County, N.Y.

Barstovian Age

Miocene: North America.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 12, pl. 1. Provincial time term based on Barstow formation, San Bernardino County, Calif., and specifically on fossiliferous tuff member in Barstow syncline and its fauna. Covers interval between Hemingfordian (Miocene) and Clarendonian (Pliocene) ages. Report defines 18 provincial time terms, based on mammal-bearing units, for North American continental Tertiary. [For sequence see under Puercan.]

Barstow Formation[1]

Miocene, middle and upper: Southern California.

Original reference: O. H. Hershey, 1902, Am. Geologist, v. 29, p. 369–370.

F. M. Byers, Jr., 1960, U.S. Geol. Survey Bull. 1089–A, p. 26–35, pls. 1, 2. Described in Alvord Mountain quadrangle, where it consists of three members: lower that consists of 500 to 600 feet of interbedded sandstone and pebble conglomerate overlain by 200 to 300 feet of tuff, tuffaceous sandstone, siltstone, and volcanic pebble conglomerate; tuffaceous middle member about 25 feet thick that comprises two or three, rarely more, friable white granular tuff beds and intervening clastic beds; upper member, as much as 500 feet thick, of sandstone, siltstone, and conglomerate. Maximum thickness about 1,500 feet. Conformably overlies Spanish Canyon formation (new) and rests unconformably on older formations. Upper contact conformable and gradational with overlying granitic fanglomerate in downfaulted block of fanglomerate at NW cor. sec. 30, T. 12 N., R. 4 E. Main contact around north side of Alvord Mountain is slight angular unconformity, in which upper part of Barstow and lower part of granitic fanglomerate are missing. Middle and late Miocene on basis of vertebrate fossils.

Type section: Near Barstow, San Bernardino County.

Bartholomew Siltstone Member (of Orangeville Shale)

Mississippian: Northwestern Pennsylvania.

Wallace de Witt, Jr., 1951, Geol. Soc. America Bull., v. 62, no. 11, p. 1347, 1351, 1364; J. F. Pepper, Wallace de Witt, Jr., and D. F. Demarest, 1954, U.S. Geol. Survey Prof. Paper 259, p. 18 (fig. 9), 42–43. Name proposed for gray or brownish-gray siltstone at or near base of Orangeville shale. Characterized by many short curved or curly markings which generally have a random distribution; in unweathered state, markings are darker than rest of siltstone. Thickness less than 1 foot. Occurs 8 feet above base of Orangeville at type locality; overlies Shellhammer Hollow formation (new) in some other areas. Lower Mississippian.

Type locality: Bartholomew Quarry section 1 mile northwest of Littles Corner on a small run, Hayfield Township, Crawford County. Also occurs in Erie and Venango Counties.

Bartlett Barren Member (of Crevasse Canyon Formation)

Bartlett Barren Member (of Mesaverde Formation)[1]

Upper Cretaceous: Northwestern New Mexico.

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

E. C. Beaumont, C. H. Dane, and J. D. Sears, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2153 (fig. 3), 2156, 2157. In revised nomenclature of Mesaverde group, San Juan basin, New Mexico, Bartlett barren member is reallocated to Crevasse Canyon formation. Overlies Dalton sandstone member; underlies Gibson coal member.

Named for exposures near old Bartlett mine shaft, McKinley County.

Bartlett Island Schist

Bartlett Island Series[1]

Precambrian or Cambrian: Southeastern Maine.

Original reference: N. S. Shaler, 1889, U.S. Geol. Survey 8th Ann. Rept., pt. 2, p. 1037, 1038–1041, 1060.

G. H. Chadwick, 1942, (abs.) Geol. Soc. America Bull., v. 53, no. 12, pt. 2, p. 1797. Age no greater than Cambrian. Older than Frenchmans Bay series.

G. H. Chadwick, 1944, New York Acad. Sci. Trans., ser. 2, v. 6, no. 6, p. 172, 176. Referred to as Bartlett's Island schist. Was incorrectly renamed Ellsworth schist.

Named for development on Bartlett Island located off west coast of Mount Desert Island, Hancock County.

Bartolo conglomerate

Miocene and Pliocene: Southern California.

G. J. Bellemin, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 4, p. 652 (fig. 1), 658. Named as one of five conglomerates interbedded in Miocene and Pliocene shales of Puente Hills, Los Angeles County.

Crops out in a nameless canyon in northern section of the hills, due east of Bartolo Station on Union Pacific Railroad.

Barton Clay (in Conemaugh Formation)[1]

Barton clay shale member

Pennsylvanian (Conemaugh Series): Central eastern Ohio.

Original reference: R. E. Lamborn, 1930, Ohio Geol. Survey Bull. 35, p. 137–138.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 68, 70. Barton clay shale included in Barton cyclothem although not present in area of report, Perry County.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 46–47, fig. 7. In Morgan County, Barton clay shale member (of Conemaugh series) includes the 6 to 11 feet of section between Ewing limestone member below and Barton coal member above.

First described in Jefferson County. Named for association with Barton coal.

Barton cyclothem

Pennsylvanian (Conemaugh Series): Southeastern Ohio.

N. K. Flint, 1949, Ohio Acad. Sci. [Guidebook] 24th Ann. Field Conf., p. 16. Incidental mention in road log.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 68–71, table 1, geol. map. Includes (ascending) Cow Run shale and (or) sandstone, 30 feet; Ewing limestone, 3 to 8 feet; and Barton clay shale and Barton coal (absent in Perry County). Occurs below Harlem cyclothem and above Anderson cyclothem. In area of this report, Conemaugh series is described on a cyclothemic basis; seven cyclothems are named. [For sequence see Mahoning cyclothem.]

Exposed in Perry County.

Barton Gneiss[1]

Precambrian: Northeastern New York.

Original reference: J. F. Kemp, 1898, Am. Inst. Mining Engineers Trans., v. 27, p. 178, map and cross sections.

Occurs near Port Henry, Essex County.

Barton Group (in Conemaugh Formation)[1]

Pennsylvanian: Southwestern Pennsylvania.

Original reference: J. J. Stevenson, 1877, Pennsylvania 2d Geol. Survey Rept. K_2, p. 67.

Barton Limestone (in Conemaugh Formation[1] or Group)

Pennsylvanian: Western Maryland and southwestern Pennsylvania.

Original reference: C. K. Swartz, W. A. Price, and H. Bassler, 1919, Geol. Soc. America Bull., v. 30, p. 573.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C-26, p. 96-97. In Fayette County, Barton limestone occurs 8 feet below Barton coal, which is separated from overlying Morgantown sandstone by 12 feet of black shale. Limestone is 3 feet thick, dark gray, knobby, and impure. Directly overlies Birmingham red shale.

R. R. Dutcher and others, 1959, Geol. Soc. America Guidebook for Field Trips, Pittsburgh Mtg., p. 69 (fig. 4). Barton limestone shown on generalized columnar section for Pennsylvanian of western Pennsylvania. Above upper Grafton sandstone and below Barton (Elk Lick) coal. Conemaugh series.

First described in Allegany and Garrett Counties, Md.

Barton Red Shale (in Conemaugh Formation)[1]

Pennsylvanian: Western Maryland.

Original reference: C. K. Swartz, 1922, Maryland Geol. Survey, v. 11, p. 65.

In Potomac basin.

Barton Sandstone (in Conemaugh Formation)[1]

Pennsylvanian: Western Maryland.

Original reference: C. K. Swartz, W. A. Price, and H. Bassler, 1919, Geol. Soc. America Bull., v. 30, p. 573.

Allegany and Garrett Counties.

Barton Canyon Member (of Windfall Formation)

Cambrian: Eastern Nevada.

J. C. Young, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 161. Name applied to marker bed near base of formation. Consists of 25 to 35 feet of homogeneous medium- to light-gray aphanitic or finely clastic limestone in beds 2 to 3 feet thick.

Named from exposures in Barton Canyon of Cherry Creek Range, Ely quadrangle.

†Barton Creek Limestone[1]

Lower Cretaceous (Comanche Series); Central Texas.

Original reference: R. T. Hill and R. A. F. Penrose, Jr., 1889, Am. Jour. Sci., 3d, v. 38, p. 470.

Exposed on Barton Creek near Austin above the ford, also in high bluffs of the Colorado at and opposite Johnson's quarry; also in west bluff of Mount Bonnel, Travis County.

Barton Creek Limestone (in Millsap Lake Formation)[1]

Pennsylvanian: Central northern Texas.

Original reference: F. B. Plummer, 1929, Texas Bur. Econ. Geology, geol. map of Palo Pinto County.

D. A. Zimmerman and G. D. Glover, 1956, Soc. Econ. Paleontologists and Mineralogists, Permian Basin Sec. [Guidebook] May 11-12, p. 70. Listed in summary of nomenclature of Morrow, Bend, and Strawn series, Fort Worth basin area. Millsap group, Strawn series. Lies lower in section than Santo limestone and above Buck Creek sandstone. Name not now in use.

Barton Creek, Palo Pinto County.

Barton River Formation (in Barre Group)

Barton River Member (of Waits River Formation).

Silurian or Devonian: Northeastern Vermont.

C. G. Doll, 1951, Vermont Geol. Survey Bull. 3, p. 15, 25–32. Lower part of formation consists of mostly slates and phyllites intercalated with limestones and calcareous schists. Calcareous rocks are more abundant toward top; phyllites most common at top. Thickness difficult to determine because of overturning, about 8,800 feet. Underlies Westmore formation (new); unconformably overlies Ayers Cliff formation. No recognizable fossils found; assigned to Silurian because of stratigraphic position.

J. G. Dennis, 1956, Vermont Geol. Survey Bull. 8, p. 12, 16–19, pl. 1. Rank reduced to member of Waits River formation; age given as Lower(?) to Middle(?) Devonian. Base not exposed in area of this report [Lyndonville quadrangle].

V. R. Murthy, 1958, Jour. Geology, v. 66, no. 3, p. 277, 279. Formation included in Barre group (new). Waits River formation restricted in this report. Formation crops out in belt about 1½ miles wide in northwestern corner of East Barre quadrangle, where it is in contact with Northfield slate and has total outcrop width of about 6½ miles. Average dip of beds of unit is taken at 45°, and, assuming that repetition of beds due to minor isoclinal folds is compensated by tectonic thinning, approximate thickness of formation is about 21,700 feet. Doll (1951) considered Barton River formation equivalent to middle part of present Barre group, but in view of the fact that it lies immediately above Northfield slate in Barre area, present writer [Murthy] considers this equivalent to lower part of Barre group. Age controversial.

Type locality: In Newport City in low cut along main highway to Derby and on south flank of Shattuck Hill, Memphremagog quadrangle. Named from good exposures on higher slopes of Barton River valley. Continuous from southern border of Memphremagog quadrangle, northeastward into Canada.

Basco Formation

Ordovician: Northeastern Nevada.

D. W. Lovejoy, 1959, Geol. Soc. America Bull., v. 70, no. 5, p. 545–551, 559, pl. 1. Consists of four members: basal calcareous siltstone that includes a sandstone bed and lenses of altered peridotite; lower chert; shale; upper chert. Thickness about 1,750 feet. Calcareous siltstone contains Lower Ordovician graptolites and shale contains Middle Ordovician graptolites. Underlies Silurian siltstone.

Type locality: Valley slopes north and south of Basco Creek, Elko County. Crops out in thrust slice southwest of Lone Mountain. Belt of outcrop trends northwest and is about one-half mile wide and 2½ miles long.

Bascom Formation (in Stockbridge Group)

Bascom Formation (in Beekmantown Group)

Ordovician: West-central Vermont and northwestern Massachusetts.

W. M. Cady, 1945, Geol. Soc. America Bull., v. 56, no. 5, p. 524, 539, 540, 542–545. In addition to limestone, formation contains dolomite, sandstone, quartzite, limestone breccia, and sandy calcareous shales. Variation in lithology very distinctive. Four zones recognized. Generalized section for Hinesburg synclinorium is (ascending) white marble or limestone with thin sandy or argillaceous stripes; buff dolomite and thin-bedded dolomitic quartzites; "curdled" limestone, some bedded dolomite; and thin-bedded slaty quartzites and sandstones. Thickness approximately 375 feet. Underlies Bridport dolomite (new) conformably; overlies Cutting dolomite (new) conformably. Underlies Crown Point limestone east of meridian of Cornwall, west-central Vermont. Corresponds to Division D of the "Calciferous" (Brainerd and Seely, 1890, Am. Mus. Nat. History Bull., v. 3). Strata in west-central Vermont designated as lower Chazy (Brainerd, 1891, Geol. Soc. America Bull., v. 2, p. 299) actually appear to be uppermost Bascom beds of Beekmantown group (Beekmantownian).

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, p. 27–28. In Castleton area, formation is included in Valley sequence. Overlies Columbian marble member of Boardman formation (new). Estimated thickness about 500 feet.

Norman Herz, 1958, U.S. Geol. Survey Geol. Quad. Map GQ–108. Included in Stockbridge group in Cheshire quadrangle, Massachusetts. Overlies Shelburne marble; underlies Berkshire schist, unconformity. Bascom may include beds that are equivalent in time to rocks of Chazyan age in Vermont.

W. M. Cady and E-an Zen, 1960, Am. Jour. Sci., v. 258, no. 10, p. 728–739. Bascom underlies the Chipman herein reduced to formation rank to include Burchards, Weybridge, Beldens, and Bridport members. Age of Chipman designated Lower Ordovician, Beekmantown age. [See Chipman formation, this reference.]

Named for "Bascom's Ledge" in eastern Shoreham Township, Addison County, Vt.

Baseline Sandstone

Upper Cretaceous: Southeastern Nevada.

C. R. Longwell, 1949, Geol. Soc. America Bull., v. 60, no. 5, p. 929 (table 1), 932–933, pl. 5. Friable sandstone, gray, reddish, and variegated. Contains many lenticular beds of conglomerate, some very coarse, especially in upper part. Change in textural character, together with the average higher coloration in upper part of section, is basis for dividing formation into two members. Maximum thickness of lower member about 2,000 feet; of upper member about 1,500 feet. Upper member restricted to a belt west of the Baseline fault; this member with part of lower member as well, eroded from eastern (upthrown) fault block. Overall thickness more than 3,000 feet. Underlies Overton fanglomerate with angular unconformity; overlies Willow Tank formation (new). Previously a part of Overton fanglomerate.

Exposed along Baseline Wash in Muddy Mountains, Clark County.

Basey Formation

Middle Jurassic: Northeastern Oregon.

W. R. Richardson, 1960, Dissert. Abs., v. 20, no. 11, p. 4367. Weberg, Warm Springs, and Basey (new) formations are lateral equivalents of Snowshoe formation.

Type locality and derivation of name not stated. Report discusses Izee area, Grant County.

Bashi Formation (in Wilcox Group)[1]

Bashi Marl Member (of Hatchetigbee Formation or Wilcox Formation)

Eocene, lower: Southern Alabama, Georgia, and southeastern Mississippi.

Original reference: A. Heilprin, 1882, Philadelphia Acad. Nat. Sci. Proc. 1881, p. 158–159.

V. M. Foster, 1940, Mississippi Geol. Survey Bull. 41, p. 53–61. Formation as described by Smith and Johnson (1887, U.S. Geol. Survey Bull. 43) is marked by 2 feet of lignitic and lignite clay at base overlain by 35 to 40 feet of yellowish crossbedded sand which grades upward into 25 feet or more of gray lignitic sandy clays and associated beds of lignite; top of formation is marked by 15 to 30 feet of glauconitic marl; passes up without apparent break into overlaying lignitic sands and clays of Hatchetigbee formation. Essentially same section, with exception of the basal lignite, is present in Mississippi, extending from southeastern corner of Lauderdale County to Meridian, near center of the County. In this area, typical Bashi marl is overlain by bed of sandy clay and silt which reaches thickness of 30 feet in some areas, and grades upward into lignitic sand and silt. This unit is here placed in Bashi formation although it has been considered to be basal Hatchetigbee by some earlier workers. Overlies Holly Springs formation.

L. D. Toulmin, Jr., 1944, Southeastern Geol. Soc. [Guidebook] 1st Field Trip, p. 9. Formation is here considered to be restricted to fossiliferous marine greensand marl, 6 to 20 feet thick in central and western Alabama, and to equivalent sand, clay, and fossiliferous marl beds, 40 feet thick or more, in eastern Alabama. Overlies Tuscahoma formation which includes about 70 feet of strata formerly included in the Bashi; underlies Hatchetigbee formation. Formation extends across state.

F. S. MacNeil, 1944, Southeastern Geol. Soc. [Guidebook] 2d Field Trip, p. 27–28; 1946, U.S. Geol. Survey Strategic Minerals Inv. Prelim. Rept. 3–195, p. 22. Proposed that Bashi marl be allocated to member status in Hatchetigbee formation. Thickness 2 to 25 feet; in some places splits into two or three distinct beds and there thickness is greater.

W. E. Belt and others, 1945, Geologic map of Mississippi (1:500,000): Mississippi Geol. Survey. Mapped as marl member of Wilcox 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 Bashi marl member of Hatchetigbee extending into Georgia.

R. J. Hughes, Jr., 1958, Mississippi Geol. Survey Bull. 84, p. 182–188, pls. 1, 5. Basal member of Hatchetigbee formation. Thickness about 40 feet in Kemper County. Overlies Tuscahoma sand.

Named for exposures on Bashi Creek, Clarke County, Ala., especially at Wood's Bluff, Tombigbee River, just below mouth of Bashi Creek.

†Bashi Marl[1]

Eocene, lower: Southwestern Alabama.

Original reference: E. A. Smith, 1887, U.S. Geol. Survey Bull. 43, p. 39, 43–46, 69.

Named for exposures on Bashi Creek, Clarke County.

Basic City Shale Member (of Tallahatta Formation)

†Basic Claystone (in Claiborne Group)[1]

Basic Claystone Member (of Tallahatta Formation)

Eocene, middle: Southeastern and north-central Mississippi.

Original reference: E. N. Lowe, 1919, Mississippi Geol. Survey Bull. 14, p. 74–75.

E. P. Thomas, 1942, Mississippi Geol. Survey Bull. 48, p. 15–24, fig. 1, pl. 2, profile C. Basic claystone member is stratigraphic and lithologic equivalent of type section of Tallahatta formation in Alabama. Term Basic is used here because it was found necessary to set up another member in Mississippi. Typical Tallahatta buhrstone section, herein called Basic claystone member, is well developed throughout eastern Mississippi, but, in central and western parts of its outcrop, the typical facies is largely replaced by sand section herein named Neshoba member. Thickness in eastern Mississippi 50 to 115 feet; 10 to 90 feet in central part of outcrop; 5 to 30 feet through southern and central Montgomery County. Overlies Meridian sand. At type locality, overlain by Winona greensand. In this report, base of Claiborne is placed at base of Basic member.

G. F. Brown and R. W. Adams, 1943, Mississippi Geol. Survey Bull. 55, p. 43–44, 55–56, pl. 1. Term Basic [pronounced like classic] was used by Lowe (1919) as member of Tallahatta formation for lightweight material, typically exposed in cuts on Gulf, Mobile, and Ohio Railroad in vicinity of Basic Station, Clarke County, which he described as claystone or diatomaceous earth. Other workers have indicated that indurated deposits at Basic are contemporary with Tallahatta shales and interfinger with them in northern Mississippi. As strike of member is followed northwest from Basic, beds become more fissile and laminated, although locally thin lenses retain structural characteristics of claystone or siltstone, by which terms they have long been designated. Although much of the member consists of sand in northern Mississippi, the identifying characteristic over larger areas is lightweight shale. It seems advisable to retain term "Basic" for this member and, to prevent confusion from mispronunciation, to designate it Basic City shale member. In area of this report [Grenada, Montgomery, and Yalobusha Counties], Basic City conformably overlies Meridian sand member of Tallahatta and underlies Winona sand member of Lisbon formation. Thickness irregular due to nature of lower contact; 78 feet on Gunby Hill, Montgomery County.

F. S. MacNeil, 1947, U.S. Geol. Survey Oil and Gas. Inv. Prelim. Chart 29. Correlation chart shows Basic City shale member underlies Neshoba sand member and overlies Meridian sand member; interfingers with Holly Springs sand member; in some areas underlies Winona formation.

Type locality: Deep cut on railroad just north of Basic City, a railroad station in northwestern Clarke County.

Basin Rhyolite [in Basin Ridge Group]

Tertiary: Central Colorado.

J. T. Stark and others, 1949, Geol. Soc. America Mem. 33, p. 100–101. Yellowish buff to gray and characteristically aphanitic except for a few widely scattered phenocrysts of biotite and feldspar. Maximum thickness measured 300 feet. Relationship with underlying rocks not definite, but near southern end of Basin Ridge, rhyolite thought to lie either directly on Pierre shale or very nearly so.

Caps central part of Basin Ridge and occupies center of Basin Ridge syncline. Known in outcrops extending from about middle of east line of sec. 20, T. 9 S., R. 76 W., to northern boundary of sec. 27, T. 10 S., R. 76 W., South Park, Park County. Average width of outcrop is 2 miles.

Basin Shale[1]

Upper Cretaceous: Northern Wyoming.

Original reference: F. F. Hintze, 1915, Wyoming State Geol. Bull. 10, on Basin and Greybull oil and gas fields, Bighorn County, Wyo., p. 17, 24–29.

Basin and Greybull oil fields, Bighorn County.

Basin Creek Member (of Katalla Formation)

Oligocene: Southeastern Alaska.

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), 9–10; 1945, Geologic and topographic map and sections of the Katalla area, Alaska: U.S. Geol. Survey War-Minerals Inv. Prelim. Map. Alternating beds of very fine grained massive gray sandstone and gray sandy shale. Beds range in thickness from 1 to 50 feet and average about 10 feet for sandstone and 25 feet for shale. Some sandstone beds are glauconitic. Shale contains many round calcareous concretions from 1 to 6 inches in diameter at least 40 percent of which contain fossil crabs. Thickness 550 to 1,000 feet; average about 700 feet. Underlies Burls Creek shale member; overlies Split Creek sandstone member. Name first used as member of Burls Creek formation in unpublished manuscript by oil-company geologists.

Named for Basin Creek, Katalla area, where member is well exposed.

Basin Ridge Group

Tertiary: Central Colorado.

J. T. Stark and others, 1949, Geol. Soc. America Mem. 33, p. 95–101, pl. 1. Thick series of volcanic rocks, flow breccias, tuffs, and rhyolites. The various flows thin toward the south. Thick red and white tuff-breccia and variolitic andesite breccia are the most persistent lenses. Agglomerate, which thickens southward with thinning of flows, is well exposed toward southern end of Basin Ridge. Volcanics consist of lower variolitic andesite member and upper red and white member. Near Basin Ridge gap, lower member comprises augitic variolitic andesite breccia, augitic andesite variolite, variolitic tuff, and hornblendic andesite flow variolite —thickness, 1,000 to 1,150 feet; upper member consists of gray porphyry flow, red breccia, agglomerate, red and white tuff-breccia, and hornblende andesite—thickness, 640 to 715 feet. [Uppermost in group is Basin rhyolite (new).] Mapped on plate 1 as Denver Basin group.

Underlies northern two-thirds of Basin Ridge, extending from a point about 2 miles southwest of Como, into sec. 10, T. 11 S., R. 76 W., South Park, Park County. Two outliers, structurally and lithologically similar to Basin Ridge volcanics, form hills approximating in area 1 square mile each, in sec. 7, T. 9 S., R. 76 W.; sec. 12, T. 9 S., R. 77 W.; and secs. 29 and 32, T. 8 S., R. 76 W.

Bas Obispo Formation[1]

Oligocene(?): Panamá.

Original reference: D. F. MacDonald, 1913, Geol. Soc. America Bull., v. 24, p. 708.

W. P. Woodring, 1957, U.S. Geol. Survey Prof. Paper 306–A, p. 21–32, 51 (fig. 4), pl. 1. Bas Obispo formation and Las Cascadas agglomerate are entirely volcanic. They are interpreted to represent pyroclastic rocks that accumulated at periphery of a volcanic pile. Bas Obispo is thought to grade into Bohio formation. Thickness unknown. Volcanic rocks now included in Bas Obispo formation and Las Cascadas agglomerate were named Obispo formation or Obispo breccia by Howe (1907). Emendation to Bas Obispo formation and splitting off of younger part as Las Cascadas agglomerate were proposed by MacDonald. Doubtfully referred to Oligocene because of inferred relations to Bohio formation.

Type region: Northern part of Gaillard Cut, where it is oldest formation exposed.

Bass Limestone (in Unkar Group)[1]

Precambrian (Grand Canyon Series): Northern Arizona.

Original reference: L. F. Noble, 1914, U.S. Geol. Survey Bull. 549.

Charles Keyes, 1938, Pan-Am. Geologist, v. 70, no. 2, p. 107 (table), 110. In Grand Canyon series. Rapid alternation of layers of limestone and shale, bedding surfaces of which are often notably sun cracked. Thickness 300 feet. Overlies Newberry formation (new); underlies Hakatai shale.

R. P. Sharp, 1940, Geol. Soc. America Bull., v. 51, no. 8, p. 1242. In Hotauta Canyon, overlies Hotauta conglomerate.

J. H. Maxson, 1942, (abs.) Geol. Soc. America Bull., v. 60, no. 12, pt. 2, p. 1963, 1964. Thickness 250 feet in Bright Angel quadrangle. Underlies Hakatai shale; overlies fractured Archean basement.

Named for Bass Canyon, Grand Canyon region, where typically exposed

Bassendorf Shale[1]

See **Bastendorff Shale,** correct spelling.

Bassick Agglomerate[1]

Tertiary: Central southern Colorado.

Original reference: W. Cross, 1896, U.S. Geol. Survey 17th Ann. Rept., pt. 2, p. 307.

J. W. Gabelman, 1953, Econ. Geology, v. 48, no. 3, p. 197. In Silver Cliff-Rosita region, volcanics, in order of 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.

Composes Bassick Hill and greater part of Mount Tyndall, Custer County.

†Bassimenan Lake Granite[1]

Precambrian (Laurentian): Northeastern Minnesota.

Original reference: N. H. Winchell, 1899, Minnesota Geol. Nat. History Survey Final Rept., v. 4.

Well exposed on islands and along south shores of Bassimenan Lake.

Bass Islands Dolomite[1]

Bass Islands Group

Upper Silurian: Southeastern Michigan and northern Ohio, and western Ontario, Canada.

Original reference: A. C. Lane, C. S. Prosser, W. H. Sherzer, and A. W. Grabau, 1909, Geol. Soc. America Bull., v. 19, p. 554.

Wilber Stout, 1941, Ohio Geol. Survey, 4th ser., Bull. 42, p. 38–40, chart facing p. 46. Rank raised to group in Ohio. Includes (ascending) Greenfield, Tymochtee, Put-in-Bay, and Raisin River formations. Thickness 400 to 700 feet; average about 570 feet. Unconformable above Niagara group and below Oriskany formation.

K. K. Landes, G. M. Ehlers, and G. M. Stanley, 1945, Michigan Dept. Conserv., Geol. Survey Div. Pub. 44, Geol. Ser. 37, p. 26, 32, 33, 35 (table 1), 71, 110. In proposed classification for Mackinac Straits region, term Bass Island is used as group. Includes St. Ignace formation (new). Bass Island overlies Salina formation everywhere beneath surface in Southern Peninsula. In different parts of this area, variously overlain by Garden Island(?) formation, Bois Blanc, Sylvania, and Detroit River rocks. Silurian (Cayugan). Discussion of use of term Bass Islands vs. Bass Island. Original use of term was Bass Islands. [U.S. Geological Survey retains original spelling Bass Islands.]

Named for group of islands in western Lake Erie.

Bass Mountain Diabase[1]

Bass Mountain Basalt

Mississippian: Northern California.

Original reference: J. S. Diller, 1906, U.S. Geol. Survey Geol. Atlas, Folio 138.

N. E. A. Hinds, 1940, 6th Pacific Sci. Cong. Proc. for 1939, p. 283–284. Referred to as Bass Mountain basalt. Exposed in two principal areas. Along Middle Salt Creek, volcanics rest unconformably on Copley metaandesite and Kennett formation and are interbedded with and overlain by Bragdon strata. On Bass Mountain, it appears eruptions took place contemporaneously with deposition of Bragdon sediments.

Named for fact it forms southern slope of Bass Mountain, Redding quadrangle.

†Basswood Granite[1]

Precambrian (Laurentian): Northeastern Minnesota.

Original reference: A. Winchell, 1888, Minnesota Geol. Nat. History Survey 16th Ann. Rept.

Occupies all the Minnesota shores of Basswood Lake except southwest shore of Arm 1, Vermilion district.

Bastard Limestone[1]

[Lower Devonian]: New York and Pennsylvania.

Original reference: I. C. White, 1883, Pennsylvania 2d Geol. Survey Rept. G_7, p. 97–98.

Bastendorff Shale[1]

Eocene and Oligocene: Southwestern Oregon.

Original reference (Bassendorf): H. G. Schenck, 1927, California Univ. Pub. Dept. Geol. Sci. Bull., v. 16, no. 12, p. 454, 457, 459.

J. E. Allen and E. M. Baldwin, 1944, Oregon Dept. Geology and Mineral Industries Bull. 27, p. 27–29, pl. 3. Bastendorf [Bastendorff] shale at beach section consists of 1,845 feet of shale and 60 feet of sandstone plus covered thickness of 1,000 feet which to south along creek appears to be shale, giving total of 2,905 feet. Overlies Coaledo formation of Arago group; underlies Tunnel Point sandstone. Uppermost Eocene and possibly lower Oligocene in part.

Typical exposure at Bastendorff (Bassendorf) Beach, in sec. 3, T. 26 S., R. 14 W., Coos Bay district.

Bastimentos Shale

Miocene, middle: Panamá.

R. A. Terry, 1956, California Acad. Sci. Occasional Paper 23, p. 52, 77. Massive, poorly bedded soft gray clay shale at base of Gatun formation. Interfingers with Minitimi limestone. Overlies Conch Point shale, which it resembles closely. On Columbus Island, surface structure is gently rounded dome on which early Miocene Conch Point shale crops out at crest, over an area about 1 mile in diameter, surrounded by middle Miocene Bastimentos shale. Seismograph survey indicated structure is cut by fault striking N. 24° E.

Occurs on Isla Colón (Columbus Island) and Isla Bastimentos (Provision Island).

Bastrop Park terrace deposit

Pleistocene: Southern Texas.

A. W. Weeks, 1941, 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), 1703–1704, 1717 (fig. 16). Quaternary section of Texas Coastal Plain between Brazos River and Rio Grande is divided into 11 terraces and terrace deposits. Name Bastrop Park is proposed for a terrace deposit of siliceous gravel with elevation of 525 feet at Bastrop State Park. Younger than Gay Hill (new); older than Uvalde from which it is differentiated by lack of calcareous material. Thickness as much as 20 feet.

Present at Bastrop State Park, about 1½ miles east of Bastrop, Fayette County. Part of the park and National Youth Administration camp are located on this deposit.

Batamote Andesite

Pliocene(?): Central southern Arizona.

James Gilluly, 1937, Arizona Bur. Mines Bull. 141, Geol. Ser. 9, p. 48–49, pl. 1. Comprises three principal varieties of basaltic andesite flows: dense dark-gray rock that weathers reddish brown with small rare crystals of hornblende and feldspar; platy dark-gray brown-weathering, generally more or less vesicular, finely porphyritic rock; and the most widespread variety, medium-gray, generally massive though locally platy, aphanitic olivine andesite, which forms bulk of Black, Batamote, and Childs Mountains. Some flows may be true basalts. At Black Mountain, basaltic andesite consists of dark flow breccias and massive flows that range in thickness from about 20 to 60 feet and average about 30 feet. Full thickness 1,348 feet. Unconformably overlies Childs augite latite (new) in Batamote and Childs Mountains and the Cardigan gneiss and conglomerate elsewhere.

James Gilluly, 1946, U.S. Geol. Survey Prof. Paper 209, p. 9, 45–46, pls. 3, 21 [1947]. Scoriaceous red basalt and andesite breccia form what is probably the throat of a volcano (Batamote Peak) and cinder cones (Childs Mountain).

Named from Batamote Mountains, the bulk of which are made up of the andesite. Most widespread of the bedrock formations in Ajo quadrangle.

Bat Cave 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 over 1,000 feet. Underlies Cable Canyon sandstone (new); overlies Sierrite limestone (new).

V. C. Kelley and Caswell Silver, 1952, New Mexico Univ. Pubs. in Geology 4, p. 45–52, 53, fig. 4. At type section, formation composed of a lower light-colored slope-forming unit and an upper somewhat darker and banded cliff-forming unit. Lower unit contains many biostromes and bioherms distributed irregularly in thin- to medium-bedded limestone. Biostromes and bioherms predominantly stromatolitic and surrounded and interspersed with much detrital limestone. Stromatolitic rock is light to medium gray and weathers very light gray. Upper unit consists of medium- to thick-bedded alternating dark- and medium-gray limestone, dolomitic limestone, and some dolomite. Most beds are very fine grained. Chert occasionally present in beds or intervals as nodules and bands. Chert weathered light brown to dark brown. A few beds in upper unit are biostromal. Solution caverns commonly exposed in cliffs of upper unit, and large masses of collapse breccia present. Thickness ranges irregularly from 216 feet at Molinas Canyon to 305 feet at Mud Springs Mountains. Unconformably underlies Cable Canyon sandstone; conformably overlies Sierrite limestone. Type location and areal distribution indicated.

Type locality; North side of Cable Canyon, Caballo Mountains. Formation named from Bat Cave whose opening is prominent landscape mark on sheer cliff in upper part of unit, a few hundred yards northwest of type section.

Bates Limestone

Middle Silurian: Southwestern Maine.

L. W. Fisher, 1936, Am. Mineralogist, v. 21, no. 5, p. 323. Metamorphosed limestone. Thickness of individual beds varies from a fraction of a foot to several feet. Cut by granitic, aplitic, and basic dikes. Older than Thorncrag limy gneiss of Tacoma series (both new); younger than Androscoggin gneiss and schist (new). Cambro-Ordovician(?).

L. W. Fisher, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 71. Middle Silurian.

L. W. Fisher, 1938, (abs.) Geol. Soc. America Proc. 1937, p. 81. Included in Androscoggin series.

Type locality: City quarry located in low hill known locally as "West Rose Hill", in southern part of city of Lewiston, Androscoggin County.

Bates Hole Formation[1]

Eocene: Wyoming.

Original reference: F. B. Weeks, 1902, U.S. Geol. Survey Bull. 191.

In valley of Bates Creek, Natrona County.

†Batesville Ash Bed[1]

Upper Ordovician (Richmond) : Northeastern Arkansas.

Original reference: J. F. Williams, 1891, Arkansas Geol. Survey Ann. Rept 1890, v. 2, p. 373–375.

Named for Batesville, Independence County.

Batesville Sandstone[1]

Batesville Formation

Upper Mississippian: Northern Arkansas, southern Missouri, and northeastern Oklahoma.

Original reference: J. C. Branner and F. W. Simonds, 1891, Arkansas Geol. Survey Ann. Rept. 1888, v. 4, p. xiii, 26, 49–53.

R. A. Brant, 1941, *in* Tulsa Geol. Soc. [Guidebook] Field Trip, Oct. 18, strat. sections. In Tulsa-Choteau-Grand River area, underlies Grand River formation (new) and overlies Hindsville formation.

E. B. Branson, 1944, Missouri Univ. Studies, v. 19, no. 3, p. 266–267. Geographically extended into southern Missouri where it underlies Fayetteville formation; in some areas conformably overlies Hindsville limestone and in other areas unconformably overlies Keokuk limestone.

Named for Batesville, Independence County, Ark.

Bath Sandstone Submember (of Pony Spring Siltstone Member[1] of Maroon Formation)

Permian: Central Colorado.

Original reference: D. B. Gould, 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, p. 973, 990, 995, 1000.

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 has yielded *Walchia* sp. *Walchia* has been found in Pennsylvanian strata as well as Permian and is, therefore, not a strict time marker, but rather a reflection of environment.

Forms prominent ridge that separates Platte and Arkansas drainage for several miles northwest of summit of Trout Creek Pass, where there is the abandoned town of Bath, Park and Chaffee Counties.

Battell Member (of Monastery Formation)

Lower Cambrian: West-central Vermont.

P. H. Osberg, 1952, Vermont Geol. Survey Bull. 5, p. 43, 44. Black graphitic quartz-muscovite schist with large porphyroblasts of albite. A few lenses of white to gray dolomitic marble occur at base. Beds of porphyroblastic albite-quartz-chlorite-muscovite schist are also associated with this unit. Thickness varies from a featheredge to a maximum of 80 feet. Underlies undivided part of Monastery formation (new) ; overlies Tyson member (new) of Monastery formation.

Named from exposures in Hancock Branch on southeast slope of Battell Mountain in Rochester area. No other good exposure.

Battery Formation[1]

Pleistocene: Northwesetrn California.

Original reference: J. H. Maxson, 1933, California Jour. Mines and Geology, v. 29, nos. 1–2, p. 136, map.

William Back, 1957, U.S. Geol. Survey Water-Supply Paper 1254, p. 17 (table), 24–31, pl. 5, Battery formation, as used in this report [Smith River plain, Del Norte County], includes related continental deposits consisting of contemporaneous stream gravels and elongate sand ridges. These ridges may not be of aqueous origin, but they are composed of reworked marine sediments and therefore are related to Battery formation. Thickness as much as 66 feet; 28 feet at Pebble Beach. Where Pliocene sediments [St. George formation] remain, the Battery overlies them with slight unconformity; in rest of area, overlies Dothan rocks of Jurassic age with angular unconformity; underlies terrace deposits.

Named for exposures at Battery Point southwest of Crescent City, Del Norte County.

Battery Rock cyclothem (in Caseyville Formation)

Battery Rock 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) Battery Rock (Lick Creek) sandstone or conglomerate, Sellers limestone, Battery Rock coal, and Drury shale, Type locality designated.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 52 (table 2), 54 (table 3), pl. 1. In Caseyville formation (redefined) above Lusk cyclothem and below Pounds cyclothem. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type locality: Sec. 26, T. 11 S., R. 2 E., Hardin County.

Battery Rock Sandstone Member (of Caseyville Formation)

Battery Rock Conglomerate

Battery Rock Formation (in Caseyville Group)

Lower Pennsylvanian: Southern Illinois and northern Kentucky.

D. D. Owen, 1856, Kentucky Geol. Survey Rept. 1854 and 1855, p. 49. Incidental mention as Battery Rock conglomerate.

J. M. Weller, 1940, Illinois Geol. Survey Rept. Inv. 71, p. 36, 37–38. Formation has maximum thickness of more than 200 feet and consists of two nearly equal parts: Battery Rock sandstone below and Drury shale member above. The sandstone is medium to coarse grained, crossbedded, and massive; it ranges from less than 50 to more than 100 feet in thickness. Transition from sandstone to Drury shale member is locally abrupt, but elsewhere thin-bedded and shaly sandstone beds make determination of sharp boundary impossible; thin beds of massive sandstone also are locally present above Battery Rock member so that, where exposures are discontinuous, its upper limit is difficult to determine. Underlies Pounds formation (new); probably unconformable but actual contact rarely exposed. Unconformably overlies Lusk formation (new) except in parts of northwestern Union County where it overlaps Chester strata. Relations to Lick Creek sandstone at Cedar Bluff not entirely clear, and use of this name for widespread sandstone at base of Battery Rock is questionable.

H. R. Wanless, 1944, Geol. Soc. America Mem. 13, p. 136. Lick Creek sandstone now considered to be Battery Rock.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 29, 30, 44 (table 1), 61, pl. 1. Termed sandstone member of Caseyville formation (redefined). In southeastern Illinois, occurs above Lusk shale member and below Sellers limestone member; in southwestern Illinois, occurs above Wayside sandstone member and below Drury shale member. Thickness 98 feet in type section of Caseyville. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification independent of rock-stratigraphic classification.

Type locality: Along Ohio River bluff, sec. 26, T. 11 S., R. 10 E., Shawneetown quadrangle, Hardin County, Ill.

Battie Quartzite[1]

Cambrian(?): Central southern Maine.

Original reference: G. O. Smith, E. S. Bastin, and C. W. Brown, 1907, U.S. Geol. Survey Geol. Atlas, Folio 149, p. 3.

H. W. Allen, 1951, Maine State Geologist Rept. 1949–1950, p. 79. Sequence of metamorphosed sedimentary rocks in area of Rockland quadrangle, Knox County, is (ascending) Islesboro formation containing Coombs limestone member at top; Battie quartzite; Penobscot formation; and Rockland formation consisting of Weskeag quartzite member at base, a siliceous limestone member above the quartzite, and Rockport limestone member at top.

Named for development on Mount Battie, a small mountain on mainland north of Camden, Knox County, in Rockland quadrangle.

Battiest Chert Member (of Tenmile Creek Formation)

Mississippian (Meramecian): Southeastern Oklahoma.

O. B. Shelburne, Jr., 1959, Dissert. Abs., v. 20, no. 3, p. 998; 1960, Oklahoma Geol. Survey Bull. 88, p. 16, 17 (fig. 2), 18–19, pl. 1. Proposed for chert member in middle part of formation. Battiest chert member was named Smithville chert lentil by Miser and Honess (1927); this name was little used and was abandoned by Oklahoma Geological Survey in 1957. Where best exposed, west of Battiest, member is 15 feet thick and consists of 3-inch beds of dark cherty siliceous shale interbedded with black siliceous shale; one 6-inch bed of black chert is cut by veins of milky quartz. Near Beachton (in type area of Honess' and Miser's Smithville chert) member consists of 15 feet of blue-black chert and siliceous shale which is poorly exposed in series of tight folds trending east-west.

Well exposed along half-section- and section-line roads near village of Battiest in secs. 7 and 8, T. 2 S., R. 23 E., McCurtain County. Area is Boktukola syncline.

Battle Formation or Conglomerate

Middle Pennsylvanian: North-central Nevada.

R. J. Roberts, 1951, Geology of the Antler quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–10]. Reddish-brown to dark-red conglomerate, with interbedded sandstone, shale, and thin limestone beds. Lower beds conglomerates; middle beds interbedded conglomerate, sandstone, and shaly sandstone; upper beds interbedded pebble conglomerate, sandstone, shale, calcareous shale, and limestone. Shale and limy beds metamorphosed to hornfels, and conglomerates and sandstones to quartzite near intrusive bodies; generally bleached white or light gray. Thickness at type locality 700 feet. Rests unconformably on three older formations of lower plate sequence. Lower Pennsylvanian.

H. G. Ferguson, R. J. Roberts, and S. W. Muller, 1952, Geology of the Golconda quadrangle. Nevada: U.S. Geol. Survey Quad. Map [GQ-15]. Underlies Antler Peak limestone conformably in Battle Mountain.

R. J. Roberts and others, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 12, p. 2824 (fig. 5), 2825 (fig. 6), 2841–2842. Highway limestone in Osgood and Edna Mountains is facies of Battle formation.

Type section: In Cow Canyon, a tributary of Galena Canyon, southeast flank of Antler Peak, Antler Peak quadrangle.

Battle Ax Basalts

Pliocene and Pleistocene: Northwestern Oregon.

T. P. Thayer, 1936, Jour. Geology, v. 44, no. 6, p. 706, 709 (fig. 2), 713 (fig. 3). Tentatively correlated with Minto lavas on basis of petrographic similarity and comparative amount of dissection of flows.

Source of basalts is near Battle Ax Mountain, northeast of Detroit, Marion County. Basalts form prominent cliffs for about 4 miles along north wall of Breitenbush River valley.

Battleground Schist[1]

Ordovician to Mississippian: Northwestern South Carolina and southern North Carolina.

Original reference: A. Keith and D. B. Sterrett, 1931, U.S. Geol. Survey Atlas, Folio 222.

W. R. Griffitts and J. C. Olson, 1953, U.S. Geol. Survey Prof. Paper 248–D, p. 204, 206. Mentioned in discussion of mica deposits in Shelby-Hickory district, North Carolina.

W. C. Overstreet and Henry Bell, 3d, 1960, South Carolina Div. Geology Geol. Notes, v. 4, no. 4, p. 27–30, fig. 1. Battleground schist described in Kings Mountain belt, Laurens County, S.C. Precambrian(?) or Paleozoic (?).

U.S. Geological Survey currently designates the age of the Battleground Schist as Ordovician to Mississippian on basis of study now in progress.

Named for exposures on Kings Mountain Battleground, York County, S.C.

Battle Mountain Formation

Pennsylvanian (Des Moines) : Northwestern Colorado.

C. A. Arnold, 1941, Michigan Univ. Mus. Paleontology Contr., v. 6, no. 4 p. 60, 68. Mentioned in discussion of Paleozoic plants from central Colorado. Name credited to K. G. Brill (unpub. thesis) who considered formation to be Lower Pennsylvanian (Des Moines) on basis of invertebrates.

K. G. Brill, Jr., 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 8, p. 1376 (fig. 1), 1378 (fig. 2), 1379–1385. Proposed for sequence of lower Pennsylvanian rocks which lies unconformably on Mississippian and older rocks and which is disconformably overlain by State Bridge formation. Composed chiefly of grits and sandstones with thick beds of shale and conglomerate; occasional beds of limestone and dolomite which range from a few inches to 30 feet in thickness. About 4,300 feet thick in north part of area; more than 7,900 feet farther south; nearly

1,600 feet are porphyry sills of Cenozoic age. In early reports, sequence of sediments here assigned to Battle Mountain was divided into six formations on basis of lithology or color; these were (ascending) Weber formation, Robinson limestone, White Quail limestone, Maroon formation, Jacque Mountain limestone, and Wyoming formation. As here defined Battle Mountain includes (ascending) Belden shale (new), Robinson limestone, and Jacque Mountain limestone members. Report covers Gore area, Eagle and Summit Counties.

Type section: North side Turkey Creek; section begins on top of Hill 11610 (Minturn quadrangle) west of Dagett Pass (Shrine Pass Road) about 6 miles east of Red Cliff, Eagle County. Name derived from Battle Mountain 3½ miles northeast of Red Cliff.

Battle Spring Formation

Eocene, lower and middle: Southwestern Wyoming.

G. N. Pipiringos, 1955, Wyoming Geol. Assoc. Guidebook 10th Ann. Field Conf., p. 101 (chart), 103. Very coarse grained to pebbly arkosic sandstone with small amounts of bright-green claystone that contains abundant large angular grains of clear quartz. Sandstone crossbedded. Inferred thickness about 3,300 feet but probably is greater. Unconformably overlies Fort Union formation; partly underlies and intertongues with Morrow Creek member of Green River formation. Intertongues to the south with Red Desert (new), Niland (new), and Cathedral Bluffs tongues of Wasatch formation; and with Luman (new) and Tipton tongues of Green River formation.

Typical exposures southwest of Battle Spring Flat and southeast of Lost Creek Butte, Sweetwater County. Underlies most of eastern part of Great Divide Basin. Base of formation exposed on north slope of Flattop Buttes and at a point about 10 miles west of Rawlins in NW pt. T. 21 N., R. 89 W.

Bauers Tuff Member (of Quichapa Formation)

Oligocene: Southwestern Utah and eastern Nevada.

J. H. Mackin, 1960, Am. Jour. Sci., v. 258, no. 2, p. 90, 91–94. An ignimbrite that differs from younger Leach Canyon tuff member by (1) lower content of pyrogenic mineral grains, (2) absence of foreign rock fragments, and (3) higher induration. In about 95 percent of its outcrop, consists of three intergrading but sharply contrasted phases: basal vitrophyre, about 10 feet thick; middle lithoidal phase characterized by a conspicuous compaction foliation, 150 to 200 feet thick; and an upper nonfoliated lithoidal phase, 10 to 40 feet thick. At type locality, overlies Swett tuff member and underlies Harmony Hills tuff member (both new); elsewhere lava flows or other volcanic rocks of local origin and extent are present at contacts. Zircon age of Leach Canyon tuff member is 28 million years; this suggest that Quichapa formation is Oligocene. Discussion of ignimbrites of area.

E. F. Cook, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 138 (fig. 3). Geographically extended into eastern Nevada.

E. F. Cook, 1960, Utah Geol. and Mineralog. Survey Bull. 70, p. 18 (fig. 1), 37. Described in Washington County where it is as much as 200 feet thick. Overlies Leach Canyon tuff member; underlies Little Creek breccia member (new).

Type locality: Bauers Knoll, Cedar City Northwest quadrangle, Iron Springs district, Utah.

Baum Limestone Member (of Paluxy Sand)

Baum Lentil or Limestone (in Trinity Formation)

Lower Cretaceous: Southern Oklahoma.

Ardmore Geological Society, 1938, Ardmore Geol. Soc. [Guidebook] Field trip to the Lower Pennsylvanian of the Berwyn and Baum areas, Apr. 23, p. 7 (stop 3). Name Baum lentil proposed for marly limestone in basal Trinity. Type locality stated.

C. W. Tomlinson, 1952, *in* Ardmore Geol. Soc. [Guidebook] Field Trip, p. 3, 4. Mentioned in road log as Baum limestone at base of Trinity.

J. R. Wayland, 1954, Am. Assoc. Petroleum Geologist Bull., v. 38, no. 11, p. 2400–2406. Formally proposed. Consists of four intergrading lithofacies: (1) basal red clay, which disappears eastward, (2) limestone conglomerate, which is best developed at northern margin of outcrop near Arbuckle Mountains, (3) massive fine-grained limestone, which is the thickest and most widely distributed of the units, and (4) arkosic limestone and calcareous arkose, present only in eastern outcrop area near Ravia. Because of irregular distribution, each of these units locally is at base of the Baum. Thickness ranges from 13 feet on Turkey Creek, where top and base are exposed, to maximum of 73 feet on Washita River where base is not exposed and top is eroded. In vicinity of type locality, the Baum rests on steeply dipping Pennsylvanian rocks; it disappears westward, apparently by interfingering with Paluxy sand; in easternmost outcrop rests on Precambrian granite and pre-Pennsylvanian highly folded rocks; in Ardmore basin, rests on steeply dipping Pennsylvanian shales and sandstones, northern extent is marked here by steep escarpment at top of Sycamore limestone (Mississippian).

Type locality: Hill in NE¼SE¼ sec. 36, T. 3 S., R. 3 E., 1.2 miles east of Baum, Carter County. Three of the lithofacies are exposed here.

Bautista Beds[1]

Pleistocene: Southern California.

Original reference: C. Frick, 1921, California Univ. Pub., Dept. Geol. Bull., v. 12, p. 283–288.

Occur in Bautista Badlands or Bautista Creek area, San Jacinto quadrangle.

Baxter Shale[1]

Upper Cretaceous: Southwestern Wyoming.

Original reference: A. R. Schultz, 1920, U.S. Geol. Survey Bull. 702.

J. D. Love, J. L. Weitz, and R. R. Hose, 1955, Geologic map of Wyoming (1:500,000): U.S. Geol. Survey. Mapped in southwestern Wyoming. According to map legend, occurs above Frontier formation and below Blair formation.

R. J. Weimer, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 1, p. 8, 9. Discussion of Upper Cretaceous stratigraphy, Rocky Mountain area. Baxter (Mancos) shale consists of 3,000 to 4,000 feet of marine shale between Mesaverde group and Frontier formation.

Exposed in Baxter Basin. Named for exposures in vicinity of Baxter, Sweetwater County.

Baxter Hollow Granite

Age not stated: South-central Wisconsin.

R. M. Gates, 1942, Am. Mineralogist, v. 27, no. 10, p. 699–711. The "normal" granite is red to light pink and very fine grained and contains few dark minerals. Only some of the pegmatoid veins approach coarseness of a normal granite. Other rock types associated with the granite and which generally grade into one another are biotite hybrid, pegmatite hybrid, porphyroblastic hybrid, arkose, sheared rock, and cleavelandite dike rock. Intrusive into Baraboo quartzite.

Granite found only at Baxter Hollow of Baraboo district [Sauk County].

Bayard Formation[1]

Lower Pennsylvanian: Northeastern West Virginia and western Maryland.

Original reference: N. H. Darton and J. A. Taff, 1896, U.S. Geol. Survey Geol. Atlas, Folio 28.

Exposed all around Bayard, Grant County, W. Va.

Bayard paleosol complex

Oligocene, upper, to Miocene: Northwestern Nebraska.

C. B. Schultz and T. M. Stout, 1955, Nebraska Univ. State Mus. Bull., v. 4, no. 2, p. 46, fig. 10. Proposed for paleosol soil capping top of Whitney member of Brule formation and extending into Gering formation.

Occurs in Castle Rock section near Bayard, Morrill County.

Bay de Noc Limestone

Bay de Noc Member (of Stonington Beds)[1]

Upper Ordovician: Northern Michigan.

Original reference: R. C. Hussey, 1926, Michigan Univ. Mus. Geol. Contr., v. 2, no. 8, p. 113–150.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2 (column 46). Shown on correlation chart as Bay de Noc limestone underlying Ogontz limestone and overlying Bills Creek shale.

Well exposed along east shore of Little Bay de Noc, from 1½ miles north of Stratton's farm northward, and also south to Stonington post office, Delta County.

Bayfield Gravel[1]

Pliocene(?): Southwestern Colorado and northwestern New Mexico.

Original reference: W. W. Atwood and K. F. Mather, 1932, U.S. Geol. Survey Prof. Paper 166.

V. C. Kelley, 1949, New Mexico Univ. Pubs. in Geology 4, fig. 2. Geographically extended into San Juan County, N. Mex. Name appears only on chart.

Named for occurrence on several hills a few miles north of Bayfield, La Plata County, Colo.

Bayfield Group[1]

Precambrian: Northwestern Wisconsin.

Original reference: F. T. Thwaites, 1912, Wisconsin Geol. Nat. History Survey Bull. 25, p. 25.

S. A. Tyler and others, 1940, Geol. Soc. America Bull., v. 51, no. 10, p. 1480–1483. Group subdivided by Thwaites into (ascending) Orienta, Devils Island, and Chequamegon sandstones. Overlies Oronto group.

Jacobsville sandstone in Michigan believed to be eastern equivalent of Bayfield group.

G. O. Raasch, 1950, Illinois Acad. Sci. Trans., v. 43, p. 137–150. Discussion of Cambrian-Keweenawan boundary. Suggested that Bayfield sediments are continental deposits of Middle and quite possibly also of Early Cambrian age laid down in structural basins at or after close of the Algonkian. Term Chequamegon dropped; unit is Port Wing brownstone member (new) or Orienta formation repeated by faulting. In this report, term Bayfield embraces the following: Red Clastics, Fond du Lac, or Hinckley in Minnesota and in Michigan the Jacobsville sandstone.

Named for occurrences in Bayfield County.

Bayhorse Dolomite[1]

Cambrian(?): Southern central Idaho.

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

C. P. Ross, 1937, U.S. Geol. Survey Bull. 877, p. 11 (correlation chart), 12-14. Commonly massive thick-bedded dolomite, in part oolitic. Thickness about 1,000 feet. Overlies Garden Creek phyllite; underlies Ramshorn slate. Cambrian(?).

Named for town and creek in Custer County. Best exposed near town.

Bayloran series[1]

[Permian]: North-central Texas.

Original reference: C. R. Keyes, Pan-Am. Geologist, 1932, v. 57, p. 337, 350–355.

Named for Baylor County.

Bay Mud Formation

Quaternary, late: Western California.

P. D. Trask and J. W. Ralston, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 1081, 1082. Silty clay containing grains of wind-blown sand; upper part includes thin layers of fine- to medium-grained sand alternating with silty clay. Thickness ranges from a few inches to as much as 150 feet. Overlies Merritt sand; youngest formation in area.

D. H. Radbruch, 1957, U.S. Geol. Survey Misc. Geol. Inv. Map I–239. Overlies Temescal formation, Merritt sand, or Alameda formation.

Crops out on east side of San Francisco Bay near Francisco-Oakland Bay Bridge.

Bayne Formation } (in Puget Group)
Bayne Series[1] }

Eocene: Western Washington.

Original reference: G. W. Evans, 1912, Washington Geol. Survey Bull. 3, p. 42–49.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology 4, p. 55, 56, 60. Lowest formation of group in Green River area. Consists of alternating strata of massive sandstone, shaly sandstone, sandy shale, carbonaceous shale, and coal beds of varying degrees of purity. Thickness in Green River Canyon about 3,000 feet; base not exposed. Underlies Franklin formation; eastward from Green River Canyon, formation passes unconformably beneath Pleistocene lavas and tuffs. Formations in Green River Canyon are involved in anticlinal and synclinal folds whose axes trend northeast.

Named for town of Bayne, King County.

Bayou Calamus Lentil (in Verda Member of Yazoo Clay)

Eocene (Jackson): Central Louisiana.

J. Huner, Jr., 1939, Louisiana Dept. Conserv. Geol. Bull. 15, p. 159–161. Term applied to fossiliferous marine lentil about 32 feet thick in Verda member; stratigraphically and lithologically similar to Saddle Bayou lentil described by Fisk (1938) in Grant Parish; may be equivalent of Saddle Bayou, but the two units are separated by many miles of territory in which no similar beds occur.

Typical exposure occurs in erosion gully 75 yards east of road in SW¼ NW¼ sec. 24, T. 12 N., R. 4 E., Caldwell Parish. Named for exposure in ravines at head of Bayou Calamus.

Bayou Chicot Limestone[1]

Upper Cretaceous(?): Southwestern Louisiana.

Original reference: G. D. Harris and A. C. Veatch, 1899, Louisiana Geol. Survey, pt. 5, Rept. for 1899, p. 61.

Outcrops about 8 miles southwest of Bayou Chicot post office, Evangeline County.

Bayou Lenann Member (of Pendleton Formation)

Eocene, lower: Northwestern Louisiana and northeastern Texas.

Richard Wasem and L. J. Wilbert, Jr., 1943, Jour. Paleontology, v. 17, no. 2, p. 184 (fig. 4), 186. Consists of glauconitic fossiliferous marine sand that grades upward into lignitic silt. Thickness approximately 90 feet. Underlies Slaughter Creek member (new); overlies beds of Marthaville age.

Typically exposed on Bayou Lenann, sec. 12, T. 6 N., R. 13 W., Sabine Parish, La. Traced from vicinity of Geneva, Tex., to Hagewood, Natchitoches Parish, La.

Bayou Manard Member (of Moorefield Formation)

Mississippian (Chesterian): Northeastern Oklahoma.

G. G. Huffman and others, 1958, Oklahoma Geol. Survey Bull. 77, p. 51–54, pls. 1–5. At type locality, composed of black argillaceous limestones and interbedded black calcareous shales; limestones vary from lithographic to medium crystalline; strata are commonly jointed in proximity to major faulting, forming large rectangular blocks; lithology fairly constant eastward to vicinity of Stilwell where it intergrades with medium-crystalline limestone of overlying Lindsey Bridge member (new). Northward along Grand River in Mayes and Wagoner Counties, consists of lower sequence of blue-gray dense fine-grained to lithographic limestone with thin beds and nodules of black chert succeeded by upper thin to platy weathering limestone. Maximum thickness 65 feet. Lies unconformably upon Tahlequah member and, in different areas, upon other older Mississippian rocks, Keokuk chert, Reeds Spring formation, and Chattanooga black shale.

Type locality: Southeast of Muskogee and Fort Gibson in SE¼ sec. 19, T. 15 N., R. 20 E., southwest of bridge over Bayou Manard, Muskogee County. Named for exposures along Bayou Manard.

Bay Point Formation

Pleistocene: Southern California.

L. G. Hertlein and U. S. Grant 4th, 1939, California Jour. Mines and Geology, v. 35, no. 1, p. 63 (fig. 4), 71–72. A deposit of crossbedded sands and silt. Thickness generally 5 to 10 feet, but maximum thickness may be 20 feet or more. Overlies Sweitzer formation.

Named from its exposures along west shore of Bay Point in Mission Bay, San Diego County.

Bayport Limestone[1] (in Grand Rapids Group)

Mississippian: Michigan.

Original reference: A. C. Lane, 1899, U.S. Geol. Survey Water-Supply Paper 30, p. 81.

G. H. Pringle, 1937, Michigan Dept. of Conserv., Geol. Survey Div. Prog. Rept. 3, p. 14. At Point au Gres, 6 feet of Bayport limestone occur along lake shore on west side of 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. 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 for limestone under discussion. Usage is based on definition of Point au Gres by Douglass (1841 [1839]). Continued reference to limestone as "Bayport" would be unfortunate because this name and "Grand Rapids" were used only in casual manner by Lane.

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

Bays Formation

Bays Sandstone[1] or Limestone[1]

Middle Ordovician: Northeastern Tennessee and southwestern Virginia.

[Original reference]: Bailey Willis, 1893, U.S. Geol. Survey 13th Ann. Rept., pt. 2, pls. 60, 61.

C. E. Prouty, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 7, p. 1178. Discussion of lower Middle Ordovician of southwest Virginia and northeast Tennessee. Measured sections compared with revised classification of Tazewell County, Va., (Cooper and Prouty, 1943, Geol. Soc. America Bull., v. 54, no. 6). "Mosheim," "Ottosee," and "Bays" should be discontinued as definite formational names. Moccasin is equivalent to "Bays" formation in its type area along Bays Mountain. It is equal to Bays as mapped in Knoxville folio (Keith, 1895), but not equivalent to "Bays" of other folios in area, where it is mapped for younger Juniata formation. As Bays has been often misused and is not as widely used as the Moccasin, it would best be discontinued.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, p. 68, 78, fig. 4. Includes much siltstone and shale and some limestone as well as sandstone; hence, here called Bays formation. Overlies Ottosee shale.

R. B. Neuman, 1955, U.S. Geol. Survey Prof. Paper 274–F, p. 145 (chart), 164–165, 166 (table 3), pl. 28. Formation described in Tellico-Sevier belt, eastern Tennessee, where it is characterized by red calcareous mudrock and siltstone. Thickness 400 feet at northeastern end of exposures; about

1,000 feet at southwest. Overlies Bacon Bend member (new) of Sevier formation; underlies Chattanooga shale. Term Bays sandstone was first used by Willis (1893), who gave its thickness for several sections but did not describe the rocks. Term was subsequently used in Estilville (Campbell, 1894). Knoxville (Keith, 1895), Morristown (Keith, 1896), and Greenville (Keith, 1905) folios; the latter two contain the type locality of the formation. In latter two folios, the name was applied erroneously in Clinch Mountain belt to a unit of Upper Ordovician rocks now known as Juniata formation. Outcrops of Bays formation in present report are in same structural belt as type area of formation. Middle Ordovician.

J. M. Cattermole, 1955, U.S. Geol. Survey Geol. Quad. May GQ–76. Formation described in Shooks Gap quadrangle, Tennessee, where it is about 700 feet thick. Overlies Ottosee shale; underlies Martinsburg shale. Bays is correlative, at least in large part and possibly exactly, with Moccasin formation of northwestern part of Ridge and Valley province.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 45, 97. Overlies Wassum formation (new).

Named for exposures in Bays Mountains of Hawkins and Greene Counties, Tenn.

Bay State 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, 45–46, pl. 2. Proposed for massive-bedded and dark-colored dolomites overlying Woodpecker limestone member (new) in vicinity of Eureka. Thickness 600 to 850 feet. Slight thickening to the north and west. Basal unit of member is a light-gray dolomite sand, that locally contains fragments of boulders of dolomite and siltstone, which forms a sharp contact with underlying Woodpecker limestone member. Contact with overlying Devils Gate limestone is gradational.

Type locality: Section above the mine in Mining Canyon. Well exposed in vicinity of Bay State mine on Newark Mountain.

Bayview Granodiorite[1]

Probably Jurassic or Cretaceous: Northern Idaho.

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

Named for exposures around Bayview, Kootenai County.

Bay View Avenue lenses[1]

Upper Cretaceous: Southeastern New Jersey.

Original reference: J. K. Prather, 1905, Am. Geologist, v. 36, p. 171, 172.

Bay View Avenue Sand[1]

Upper Cretaceous: Southeastern New Jersey.

Original reference: J. K. Prather, 1905, Am. Geologist, v. 36, p. 171, 172, 175.

Extends from Bay View Avenue Station near Atlantic Highlands some 800 feet in direction of Hiltons.

†Bazoo Porphyry[1]

Eocene: Colorado.

Original reference not given.

Named from its occurrence in Bazoo claim, Leadville district.

Beach Mountain Paramphibolite[1]

Precambrian: New York.

Original reference: H. L. Alling, 1927, Geol. Soc. America Bull., v. 38, p. 798–799.

In eastern Adirondacks.

Beacon Flat Formation

Permian (Wolfcampian-Leonardian): Northeastern Nevada.

T. G. Fails, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 10, p. 1695 (fig. 1), 1697–1699. Proposed for a three-member unit 2,800 feet thick. The 550-foot lower member of gray silty calcarenites and chert beds contains Wolfcampian-Leonardian boundary; alluvium covers undescribed middle member; cherty fossiliferous, gray calcarenites make up the 1,150-foot-thick upper member. Conformably overlies Buckskin Mountain formation (new); conformably underlies Carlin Canyon formation (new).

Type section: Lower member, on north side Humboldt River at Carlin Canyon, in SE¼SE¼NW¼ sec. 15, and NE¼NE¼SW¼ sec. 15, T. 33 N., R. 53 E.; upper member, SW¼SE¼ sec. 14 and NW¼ sec. 23, T. 33 N., R. 53 E., Elko County. Poorly exposed on a broad almost featureless plateau, Beacon Flat, north and east of low hills formed by Buckskin Mountain formation.

Beacon Hill Gravel[1]

Pliocene(?): New Jersey.

Original reference: R. D. Salisbury, 1894, New Jersey Geol. Survey Ann. Rept. 1893, p. 47–57, 67–72.

W. B. Spangler and J. J. Peterson, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 1, p. 4 (fig. 2), 61–62. Continental; consists of quartz gravel with some chert and sandstone. Thickness 0 to 20 feet. Overlies Cohansey sand. Youngest Tertiary formation in New Jersey. Considered Pliocene, but difficult to differentiate from supposed Pleistocene material [Bridgeton, Pensauken, and Cape May].

Well developed and exposed on summit of Beacon Hill, 3 miles south of Matawan, Monmouth County.

Beacon Peak Dolomite Member (of Nevada Formation)

Lower Devonian: Central Nevada.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 41, 42, pl. 2. Composed of beds of dense, sometimes porcellaneous, light-olive-gray to slightly brownish creamy-gray dolomite that weather to a pale gray to white and has a faint blue tinge. Some is clastic in origin. Individual beds probably average a foot in thickness. A number of thin brown-weathering sandstone interbeds in upper half of member. Thickness 470 to 940 feet, the larger thickness being to the north. Unconformably overlies Lone Mountain dolomite and is rather sharply gradational with overlying Oxyoke Canyon sandstone member (new).

Type locality: Well exposed on lower west slope of Beacon Peak in Oxyoke Canyon, vicinity of Eureka.

Bead Lake Formation (in Newport Group)

Precambrian: Northeastern Washington and western Idaho.

M. C. Schroeder, 1952, Washington Div. Mines and Geology Bull. 40, p. 7 (table), 10–11, pl. 1. Fine-grained argillaceous and quartzitic sandstones with quantities of light-colored argillite and light-colored arenaceous argillite. Thickness about 12,500 feet. Injected by Marshall diorite (new).

Underlies No Name argillite (new), contact gradational; base of formation not exposed.

Crops out in Bead Lake district, Pend Oreille County, Wash.

Beadle Green Granite[1]

Age(?): Northeastern Vermont.

Original reference: C. H. Richardson and C. K. Cabeen, 1923, Vermont State Geologist Rept. 1921–1922.

Occurs on Crompton Hill in southwest corner of Randolph Township, Randolph quadrangle, Orange County.

Bead Mountain Limestone Member (of Belle Plains Formation)[1]

Bead Mountain Formation (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 the Belle Plains herein redefined and given group status. Includes Beaverburk member. Overlies Valera shale and anhydrite; underlies Grape Creek formation of Clyde group.

R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80, sheet 2. Described in Colorodo River valley as uppermost member of Belle Plains formation. Overlies Valera shale member; underlies Grape Creek limestone member of Clyde formation; boundary somewhat arbitrarily defined.

P. T. Stafford, 1960, U.S. Geol. Survey Bull. 1081–G, p. 274, pls. 11, 12. Member forms prominent escarpment in Brazos River drainage area. Consists of alternating beds of limestone and shale; limestone beds range in thickness from 1 to about 15 feet, and shale beds range in thickness from less than 1 foot to 65 feet. Overlies Valera shale member; underlies unnamed shale member at base of Clyde formation.

Named for Bead Mountain, Coleman County.

Bealville Fanglomerate

Oligocene: Southern California.

T. W. Dibblee, Jr., and C. W. Chesterman, 1953, California Div. Mines Bull. 168, p. 12 (fig. 2), 36-37, pls. 1, 2, 3. Defined as the unsorted boulder-gravel facies of both overlying Walker and Bena formations. At type section, formation consists of granitic fanglomerate that dips southward and attains a thickness of over 7,000 feet. West of type section, grades laterally into both Walker and Bena (new) formations.

Type section: Exposed along highway southward from Ilmon, Breckenridge Mountain quadrangle, Kern County.

Bean Canyon Formation[1]

Bean Canyon Series[1]

Paleozoic(?): Southern California.

Original reference: E. C. Simpson, 1934, California Jour. Mines and Geology, v. 30, no. 4, p. 371–401, map.

U.S. Geological Survey currently designates the age of the Bean Canyon Formation as Paleozoic(?) on basis of study now in progress.

Named for exposure in Bean Canyon in northwest corner of Elizabeth Lake quadrangle, Los Angeles and Kern Counties.

Bear Formation

Paleocene: Central Montana.

G. G. Simpson, 1937, U.S. Natl. Mus. Bull. 169, p. 15 (chart), 17–20, pls. 1, 2. Name applied to unit, 500 to 600 feet thick, that occurs above Hell Creek formation and below the Fort Union (No. 1 or Lebo). Consists of alternating pale crossbedded sandstones and shales. Contains turtle bones but no dinosaurs or mammals. All beds are tilted, but no evidence of angular unconformity. Change from Hell Creek to Bear is more abrupt than from Bear to Fort Union No. 1, the latter being transitional through a thickness of 15 to 20 feet, boundary here being taken arbitrarily at a local shell lens. Discussion of Cretaceous-Tertiary transition.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, pl. 1. Shown on correlation chart below Lebo formation and above Hell Creek formation. Fort Union series, Puercan.

Typically developed around Bear Butte, Sweetgrass and Wheatland Counties.

Bear Branch Limestone Member (of Olive Hill Formation)[1]

Bear Branch facies (of Ross Limestone Member of Ross Formation)

Lower Devonian: Western and central Tennessee.

Original reference: C. O. Dunbar, 1918, Am. Jour. Sci., 4th, v. 46, p. 738.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 282 (fig. 3), 283, 297–299. In this report [Pre-Chattanooga stratigraphy of central Tennessee], Dunbar's (1919, Tennessee Div. Geology Bull. 21) classification of Lower Devonian is modified. Bear Branch limestone is interpreted as a restricted facies equivalent to upper part of Ross limestone member of Ross formation herein defined to include all beds overlying Decatur limestone and underlying Flat Gap or Harriman formations. Facies is unconformably overlain by Flat Gap limestone or by Hardin sandstone member of Chattanooga shale. Includes interbeds referred to as Decaturville chert zone. Thickness at Olivehill approximately 45 feet.

Named for exposure on Bear Branch, about 2 miles southeast of Olive Hill [Olivehill], Hardin County.

Bear Canyon Sandstone Member (of Kreyenhagen Formation)

Eocene, upper: Northern California.

I. F. Wilson, 1943, California Jour. Mines and Geology, v. 39, no. 2, p. 211 (fig. 5), pl. 3. Proposed for persistent sandstone occurring about one-third of distance above base of Kreyenhagen on southwest side of Butts Ranch syncline. Thickness 100 to 300 feet. Overlies an unnamed unit, 300 to 1,000 feet thick, of foraminiferal clay-shales and platy shales, with some interbedded sandstone and limestone, and a thin glauconitic sandstone at base. Unit is faunally equivalent to Canoas siltstone member in Coalinga district. Underlies an unnamed upper member 500 to 1,500 feet thick consisting of siliceous and calcareous foraminiferal platy shales and some limestone.

Type locality: Bear Canyon, 1 mile north of Big Oak Flat, San Benito County.

Bear Creek Shale (in Clinton Formation)[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. 53–54, 154, 155. Chadwick used term Bear Creek to designate dark pelecypod-bearing shales which were supposed to underlie the Furnaceville in town of Wolcott. However, no such shale exists beneath the Furnaceville, but there is a shale above the ore which contains the fauna. Bear Creek is herein redefined to apply to pelecypod-bearing shales and argillaceous limestones on Bear Creek, in eastern part of town of Wolcott. As redefined, is argillaceous facies of Reynales limestone. At type locality, is a dark-gray thin-bedded silty slightly calcareous shale with argillaceous limestone layers; both shales and limestones pyritic. Lower 7 feet are about half shale and half argillaceous limestone; next 6 feet are mostly shale. Top of formation is marked by an 8-inch limestone layer which in turn is overlain by 3 inches of hematitic limestone. Underlies lower Sodus shale.

Type locality: Town of Wolcott, Wayne County. Exposed on small tributary of Black Creek which is known locally as Bear Creek; tributary enters Black Creek a little north of where southwest road from Fair Haven crosses Black Creek.

Bear Gulch Limestone Member or Lentil (in Tyler Formation)

Bear Gulch Tongue (in Cameron Creek Member of Tyler Formation)

Mississippian: Central Montana.

G. H. Norton, 1956, Billings Geol. Soc. Guidebook 7th Ann. Field Conf., p. 58, 59 (fig. 5), 60 (fig. 6), 62. Limestone lentil or member in the Tyler formation. Overlain by Amsden sandstone.

R. P. Willis, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 1942 (fig. 2), 1953, 1954. Bear Gulch referred to as tongue in Cameron Creek member.

Named for exposures in Bear Gulch, sec. 35, T. 14 N., R. 21 E., Fergus County.

Bear Island Granodiorite

Age uncertain: District of Columbia and eastern Maryland.

Ernst Cloos *in* Ernst Cloos and C. W. Cooke, 1953, Geologic map of Montgomery County and District of Columbia (1:62,500): Maryland Dept. Geology, Mines and Water Resources. Light discordant granodiorite, mostly unfoliated and massive. Contains plagioclase, quartz, potash feldspar, muscovite, biotite, and, as accessories, topaz, rutile, zircon, and garnet. Composition variable. Alteration common.

Mapped in District of Columbia and northward to vicinity of Bethesda, Md. Named for occurrence near Bear Island on the Potomac.

Bear Mountain Basalt

Pliocene: Northern California.

H. A. Powers, 1932, Am. Mineralogist, v. 17, no. 7, p. 260–261. Light-gray loose-textured uniform-grained rock in which clear yellow olivine grains are conspicuous in network of colorless plagioclase crystals. Covered by Warner basalt on northern and eastern sides.

Occurs on Bear Mountain in Modoc Lava-Bed quadrangle.

Bear Mountain Granite[1]

Precambrian(?): Central northern Colorado.

Original reference: H. B. Patton, 1909, Colorado Geol. Survey 1st Rept., p. 128, map.

Forms summit of Bear Mountain, Summit County.

Bear Mountain Granite

[Precambrian]: Central Texas.

R. E. McAdams, 1936, Am. Mineralogist, v. 21, p. 129, 133, 134, 135. Bear Mountain granite believed to be younger than Wolf Mountain (new) and Lone Grove granites.

Present near Fredericksburg, Llano County.

Bearpaw Shale (in Montana Group)[1]

Upper Cretaceous: Northern, eastern, and southern Montana and central Wyoming, and Alberta, Canada.

Original references: J. B. Hatcher and T. W. Stanton, 1903, Science, new ser., v. 18, p. 211–212; 1905, U.S. Geol. Survey Bull. 257.

R. K. Hose, 1955, U.S. Geol. Survey Bull. 1027–B, p. 6–65, pl. 6. Described in Crazy Woman Creek area, Johnson County, Wyo., where it overlies Parkman sandstone and underlies Lance formation. Consists mainly of dark-greenish-gray shale with light-gray siltstone laminae. Upper Cretaceous.

W. A. Cobban, 1955, Billings Geol. Soc. Guidebook 6th Ann. Field Conf., p. 108 (fig. 1), 116 (fig. 7), 117–118. On northwest flank of Sweetgrass arch, northwestern Montana, present only in area north of Dupuyer Creek. Consists largely of dark-gray marine shale that contains ferruginous concretions, bentonite, and thin layers of sandstone. Thickness 225 to 400 feet. Overlies Two Medicine formation. Upper part of Bearpaw passes westward and southwestward into shallow-water sandy unit that is treated herein as a separate unit and designated as Bearpaw-Horsethief transition.

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.

W. P. Mapel, 1959, U.S. Geol. Survey Bull. 1078, p. 59, pls. In Buffalo-Lake De Smet area, northeastern Wyoming, consists of thin sequence of marine shale that is conformable with both underlying Parkman sandstone and overlying Lance formation. Thickness about 200 feet.

Named for exposures around north, east, and south borders of Bearpaw Mountains, Mont.

Bear Pond Limestone Member (of Seboomook Formation)

Lower Devonian: West-central Maine.

A. J. Boucot, Charles Harper, and Keith Rhea, 1959, Maine Geol. Survey Spec. Geol. Studies Ser. 1, p. 7, 8, map. Blue gray on fresh surfaces and gray on weathered surfaces; contains subrounded to subangular granite pebbles up to 2 inches across; fragments of brachiopods, corals, and crinoid stems; angular black calcite crystals or fragments up to coarse sand size; brown and white mica flakes; some pyrite and other iron-sulfide crystals. Observed only at one outcrop where it is 10 feet stratigraphically above a slate exposure; neither top nor bottom of unit exposed. Thickness about 10 feet.

Exposed in NW cor. T. 3, R. 5, in area west of Beck Pond and Bear Pond, Spencer quadrangle, Somerset County.

Bear Pond Schist[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 Catamount schist and below Beech Mountain amphibolite.

Type locality: Bear Pond, Ticonderoga Township, Essex County.

Bear River Formation[1]

Lower Cretaceous: Southern Wyoming, southeastern Idaho, and northeastern Utah.

Original reference: F. V. Hayden, 1869, U.S. Geol. Survey Colorado and New Mexico, 3d Ann. Rept. Hayden Survey, p. 91, 92.

D. A. Andrews and C. B. Hunt, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 70. Mapped in Utah. Lower Cretaceous.

J. D. Vine and G. W. Moore, 1952, U.S. Geol. Survey Circ. 212, p. 3, 4, 5. In Bonneville County, Idaho, underlies Wayan formation and overlies Tygee sandstone of Gannett group. Thickness 152 feet. Lower Cretaceous.

R. W. Imlay, 1952, Geol. Soc. America Bull., v. 63, no. 9, p. 958. Age mentioned as Lower Cretaceous.

Teng-Chien Yen, 1952, Geol. Soc. America Bull., v. 63, no. 8, p. 757–764. In type area, overlain by Aspen shale and underlain by Beckwith formation. Aspen shale has been considered Lower Cretaceous on basis of ammonite fauna. If this age determination is considered conclusive, then Bear River beds should be assigned to Lower Cretaceous. However, on basis of fauna, Bear River strata are here assigned to level near base of Upper Cretaceous (Cenomanian).

A. La Rocque and C. D. Edwards, 1954, Geol. Soc. America Bull., v. 65, no. 4, p. 315–326. Cretaceous Bear River and Aspen section in Willow Creek, 6 miles southeast of junction of Hoback and Snake Rivers, Teton County, Wyo., described in detail including position and nature of its faunas. Bear River is 539 feet thick, and Aspen 1,307 feet. On lithologic and paleontologic grounds, Bear River-Aspen contact is placed lower than in earlier reports. Conflicting age assignments for Bear River and Aspen discussed. Suggested that this conflict may be due to complex intertonguing between the two formations.

J. D. Vine, 1959, U.S. Geol. Survey Bull. 1055–I, p. 259 (table), 262–263. In Bonneville County Idaho, unconformably underlies Wayan formation and conformably overlies Tygee sandstone of Gannett group. Thickness 300 to 500 feet. Lower two-thirds of formation consists of dark-gray ferruginous carbonaceous shale and siltstone interbedded with thin beds of dark-brown sandstone. Upper third consists of prominent ledge of medium-grained gray to brown quartzite or sandstone 75 feet thick. Overlain by black shale, thin beds of fine-grained brown sandstone, coaly shale, and black fossiliferous granular limestone. Upper and lower contacts of formation, as described herein follow usage of

L. S. Gardner (oral commun. 1952). Bear River formation, as used herein, includes strata included in Tygee formation by Kirkham (1924). Lower Cretaceous.

First mentioned in vicinity of Bear River City, Wyo.

Bear River Formation

Bear River Series[1]

Miocene, upper: Northern California.

Original reference: W. Stalder, 1915, California State Mining Bur. Bull. 69, p. 447–449.

G. C. Gester, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 2, p. 205. Referred to as Bear River formation in Eel River basin. Consists of marine shale with hard calcareous members. Thickness 1,000 feet. Underlies Wildcat series; overlies Franciscan.

Occurs in Humboldt County.

Bear Run cyclothem

Pennsylvanian (Pottsville Series): Southeastern Ohio.

N. K. Flint, 1949, Ohio Acad. Sci. [Guidebook] 24th Ann. Field Conf., p. 4. Incidental mention in road log.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser.. Bull. 48, p. 24–28, table 1, geol. map. Includes (ascending) Massillon shale and (or) sandstone, 20 feet thick; Bear Run clay, 3 feet; and Bear Run coal. Occurs above Quakertown cyclothem and below Vandusen cyclothem. In area of this report, Pottsville series is described on cyclothemic basis; 10 cyclothems are named. [For sequence see Anthony cyclothem.]

Exposed in Perry County.

Bear Run Member (of Pottsville Formation)[1]

Pennsylvanian (Pottsville Series): Southern Ohio.

Original reference: H. Morningstar, 1922, Ohio Geol. Survey Bull. 25, p. 13, 25–28, 299–300.

R. E. Lamborn, C. R. Austin, and Downs Schaaf, 1938, Ohio Geol. Survey, 4th ser., Bull, 39, p. 86–89. Sandstone and shale member varies from about 20 to 60 feet; average 30 feet; proportions of sandstone and shale vary locally. Horizon is defined by Bear Run coal and clay beds beneath and Vandusen clay and coal above.

Type locality and derivation of name not given.

Bear Spring Formation

Middle Devonian: Central Texas.

V. E. Barnes, P. E. Cloud, Jr., and L. E. Warren, 1947, Geol. Soc. America Bull., v. 58, no. 2, p. 136–138. Name applied to fossiliferous and in part cherty limestones of lower Middle Devonian age that occur in an ancient collapse structure. Rocks are fine to coarse grained; color varies—white to cream colored, yellowish or greenish brown to buff, bronze, olive brown, ivory, or nutria; over lower part of collapsed area, considerable dull-white to speckled-gray porcelaneous to semiporcelaneous chert occurs in float. At type locality, a patch of rocks, 240 feet long in northeast-southwest direction and 140 to 160 feet wide, has collapsed into limestones of Lower Ordovician Gorman formation and is in part overlapped by rocks of Mississippian age.

Type locality: Near head of east fork of a draw that enters south side of valley of Honey Creek about 280 feet upstream from rock cabin on Roy Zesch Ranch, Mason County.

Bear Springs Basalt

Tertiary, upper: Southwestern New Mexico.

H. L. Jicha, Jr., 1954, New Mexico Bur. Mines Mineral Resources Bull. 37, p. 39 (table 3), 48–49, pl. 1. Flows of purple fine-grained porphyritic iddingsite-bearing rock, at times scoriaceous. Thickness about 150 feet. Unconformable contacts with Razorback formation below and Santa Fe(?) formation above.

W. E, Elston, 1957, New Mexico Bur. Mines Mineral Resources Bull. 38, p. 17 (table 1), 34–36, pl. 1. In Dwyer quadrangle, composed of flows, breccias, agglomerates, conglomerates, and, rarely, chocolate-colored sandy tuffs. Groundmass is gray to black.

Elston (1957) cites Jicha (1954) as designating type locality in sec. 25, T. 18 S., R. 9 W., Lake Valley quadrangle. Named from outcrop at intersection of secs. 17, 18, 19, and 20, T. 20 S., R. 8 W., about one-half mile distant from Bear Springs Canyon (Jicha, 1954, p. 48). [However, pl. 1 does not show unit mapped at this locality.]

Beartooth Quartzite[1]

Upper(?) Cretaceous: Southwestern New Mexico.

Original reference: S. Paige, 1916, U.S. Geol. Survey Geol. Atlas, Folio 199.

P. F. Kerr and others, 1950, Geol. Soc. America Bull., v. 61, no. 4, p. 283 (fig. 5), 285, pl. 1. In Santa Rita area, is 50 to 120 feet thick and consists of light-colored massive conglomerate, vitreous quartzite, and sandstone with a few shaly layers. Underlies Colorado formation; unconformably overlies Syrena (upper Magdelena) or Abo.

C. H. Hewitt, 1959, New Mexico Bur. Mines Mineral Resources Bull. 60, p. 78–80. Described in northern Big Burro Mountains-Redrock area, where, in vicinity of Slate Creek and Fox Tail Creek, it forms cliffs 100 to 125 feet high. Lies unconformably on Precambrian granite (Burro Mountain granite). In many areas, Colorado shale crops out in valleys or saddles between Beartooth quartzite and overlying lavas.

Named for Beartooth Creek, near Fort Bayard, Silver City region.

Beartooth Butte Formation[1]

Lower Devonian: Northwestern Wyoming and Montana.

Original reference: E. Dorf, 1934, Jour. Geology, v. 42, p. 723–737.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1746, chart 4. Placed in Oriskany lower Onondaga position opposite that portion of Nevada limestone, only other known Lower Devonian of the West. Lower, and Lower or Middle Devonian.

Named for occurrence on Beartooth Butte, in SW cor. T. 58 N., R. 105 W., Park County, 3 miles south of Montana line, just northwest of Beartooth Lake, and in Crandall quadrangle (of Absaroka folio).

Bearwallow Conglomerate (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 Bearwallow Ridge, west of Dry Fork, McDowell County, W. Va.

Bear Wallow facies[1] (of Edwardsville Formation)

Lower Mississippian: Indiana.

Original reference: P. B. Stockdale, 1931, Indiana Dept. Conserv., Div. Geology Pub. 98, p. 76, 288–293.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 127–128, p. 1. Facies nomenclature discussed. Correlation chart lists Bear Wallow facies of Edwardsville formation.

Name derived from Bear Wallow, a prominent upland, 3 miles northeast of Nashville, Brown County.

Bearwallow Schist

Age not stated: Western North Carolina.

C. E. Hunter and P. W. Mattocks, 1936, TVA Div. Geology Bull. 4, p. 13–14. Essentially mica, garnet, and kyanite schist. Kyanite only makes small part of schist. Division of the Buck Ridge schist (new).

Outcrops on west side of gap at head of Bear Creek and also one-half mile southwest of Ledger Schoolhouse, Spruce Pine quadrangle.

Beattie Limestone (in Council Grove Group)

Beattie Formation (in Council Grove Group)[1]

Permian: Northeastern Kansas and southeastern Nebraska.

Original reference: G. E. Condra and C. E. Busby, 1933, Nebraska Geol. Survey Paper 1, p. 13.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 46–47. Beattie limestone includes (ascending) Cottonwood limestone, Florena shale, and Morrill limestone members. Thickness 15 to 25 feet. Underlies Stearns shale; overlies Eskridge shale. Wolfcamp series.

Type locality: Beattie, Marshall County, Kans.

Beattyville Shale (in Pottsville Group)[1]

Pennsylvanian: Southeastern Kentucky.

Original references: A. M. Miller, 1917, Table of geological formations of Kentucky: Lexington, Ky., Univ. Book Store, p. 2; 1919, Kentucky Dept. Geology and Forestry, ser. 5, Bull. 2, p. 10 (table), 147 (table).

A. C. McFarlan, 1954, Kentucky Geol. Survey Spec. Pub. 4, p. 11–14. In Natural Bridge State Park, area consists of succession of shales and thin sandstones up to 30 feet thick. Underlies Rock Castle conglomerate; overlies Mississippian Mammoth Cave limestone. Locally absent.

Apparently named for Beattyville, Lee County.

Beaufort Formation

Paleocene: Eastern North Carolina (subsurface).

P. M. Brown, 1959, North Carolina Div. Mineral Resources Bull. 73, p. 8 (table 4), 12–13, 29–30, 37–38, 45, 51–52, 64, 71. Variable composition, ranging from green glauconite sands containing about 90 percent glauconite to gray argillaceous sands containing about 5 percent glauconite; indurated shell-limestone intercalations common; euhedral pyrite common accessory; fossiliferous. Type well penetrated 65 feet of Paleocene strata between depths of 150 and 215 feet. Well logs show formation underlies Castle Hayne limestone or Yorktown formation, or locally, an unnamed middle(?) Miocene unit; overlies Upper Cretaceous Peedee formation. Midway age.

Type locality: Well 215 feet deep, drilled in 1952 for Nelson Motel at Chicowinity, Beaufort County. Recognized in wells in Martin, Bertie, Hertford, Gates, and Chowan Counties.

Beaumont Clay[1]

Beaumont Formation

Pleistocene: Eastern Texas and southwestern Louisiana.

Original reference: W. Kennedy, 1903, U.S. Geol. Survey Bull. 212, p. 20, 27, pls. 1, 2.

W. A. Price, 1939, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 23, no. 12, p. 1875. Lake Charles and Ingleside formations (both new) replace Beaumont formation.

A. W. Weeks, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 12, p. 1695 (fig. 1), 1708–1709. Quaternary deposits of Texas Coastal Plain between Brazos River and Rio Grande are divided into (ascending) Willis, Gay Hill, Bastrou Park, Uvalde, Asylum, Capitol, Beaumont (Sixth Street), Live Oak Bar (approximately of Beaumont age), First Street, Riverview, and Sand Beach terrace deposits.

J. A. Doering, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 8, p. 1830–1831. In southwestern Louisiana, Beaumont formation is divided into Oberlin (Lower Beaumont) and Eunice (upper Beaumont).

Named for Beaumont, Jefferson County, Tex.

Beauvais Sandstone[1]

Middle Devonian: Eastern Missouri.

Original reference: C. L. Dake, 1918, Missouri Bur. Geology and Mines, v. 15, 2d ser., p. 88, 174–175.

E. B. Branson, 1944, Missouri Univ. Studies, v. 19, no. 3, p. 123–124. Predominantly white sand. Thickness as much as 50 feet. Overlies Grand Tower limestone; underlies St. Laurent.

Type exposures along Little Saline Creek, in Beauvais Township, Ste. Genevieve County.

Beaver division[1] (of Leon Series)

Upper Cambrian or Lower Ordovician: Central Texas.

Original reference: T. B. Comstock and E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept., p. 259–306, pl. 3.

Named for Beaver Creek, Burnet County.

Beaver Gypsum[1]

Permian: Western Oklahoma.

Original reference: F. W. Cragin, 1897, Am. Geologist, v. 19, p. 359, 363.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 106. Rejected by Oklahoma Geological Survey. Name preoccupied.

Named for occurrence near Beaver City and in Beaver County.

†Beaver Limestone[1]

Lower Cambrian: Eastern Tennessee.

Original reference: A. Keith, 1895, U.S. Geol. Survey Geol. Atlas, Folio 16.

Named for Beaver Ridge, north of Knoxville, Knox County.

†Beaver Sandstone (in Pottsville Group)[1]

Pennsylvanian: Eastern Kentucky.

Original reference: I. B. Browning and P. G. Russell, 1919, Kentucky Geol. Survey, 4th ser., v. 5, pt. 2, p. 11–18.

Exposed in Magoffin County.

Beaver Basin Formation

Pleistocene: Southeastern Utah.

G. M. Richmond, 1956, Dissert. Abs., v. 16, no. 6, p. 1128. Consists of two members that comprise 10 lithofacies, including till, rock glaciers, and various alluvial, colluvial, and eolian deposits. Tills form two sets of upper canyon end moraines. Weakly developed Pack Creek soil is formed on lower member where it is overlain by upper member. Moderately developed Castle Creek soil is formed on upper member and on deposits of the lower member not overlain by the upper member. Older than Gold Basin formation (new); younger than Placer Creek formation (new).

Located in La Sal Mountains area.

Beaver Bay Complex (in Keweenawan Group)

†Beaver Bay Diabase[1]

†Beaver Bay Group[1]

Precambrian: Northeastern Minnesota.

Original reference (Beaver Bay Group): R. D. Irving, 1883, U.S. Geol. Survey, 3d Ann. Rept., p. 143–146, pl. 14.

F. F. Grout and G. M. Schwartz, 1939, Minnesota Geol. Survey Bull. 28, p. 12, 13, 32–33. Beaver Bay complex is an expansion of phrase Beaver Bay group as used by Irving and Beaver Bay diabase as used by Winchell (1899, Minnesota Geol. and Nat. History Survey Final Rept., v. 4). Diabases and related basic rocks of complex form largest exposures in southern Lake County; they form bluffs and ridges up to 300 feet high. Intrusives that follow the structure, dipping toward Lake Superior, form northward-facing escarpments and more gentle back slopes, but transgressive and dikelike masses may form bluffs facing in other directions. Beaver Bay diabase is sill-like with minor irregularities and several petrographic facies. In table of formations, Beaver Bay complex is listed above Keweenaw Point volcanics (new); ages of both are middle Keweenawan.

F. F. Grout and others, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 1021 (table 3). Beaver Bay complex included in middle part of Keweenawan group.

H. M. Gehman, 1958, Minnesota Univ. Center for Continuation Study, Gen. Ext. Div., Inst. of Lake Superior Geology, Apr. 21–22, p. 1. Complex comprises three gabbroic intrusions: Beaver River gabbro, Beaver Bay ferrogabbro, and Black Bay gabbro (all new). Gabbros intrude North Shore Volcanic group (new) which is considered middle Keweenawan.

Exposed on Beaver Bay.

Beaver Bay Ferrogabbro (in Beaver Bay Complex)

Precambrian: Northeastern Minnesota.

H. M. Gehman, 1958, Minnesota Univ. Center for Continuation Study, Gen. Ext. Div., Inst. of Lake Superior Geology, Apr. 21–22, p. 1. Second intrusion of the complex. Younger than Beaver River gabbro (new). Surrounded and intruded by Black Bay gabbro (new).

In southeastern Lake County.

Beaver Bend Limestone[1]

Beaver Bend Limestone (in West Baden Group)

Beaver Bend Limestone Member (of Renault Formation)

Mississippian (Chester Series) : Southwestern Indiana and central northern 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. 3), 271, 273. In Meade, Hardin, and Breckinridge Counties, Ky., Beaver Bend limestone is considered member of Renault formation. Overlies Mooretown sandstone member; underlies Sample sandstone. Unit has been placed in Gasper oolite and referred to as Renault limestone, but always undifferentiated. Thickness 14½ feet at Ohio River and as far south as Webster and Lodiburg, both in Breckinridge County; 38 feet in western part of Big Clifty quadrangle.

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 4 (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, Mich., The Edwards Letter Shop, p. 7, 13. 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. Thicker sections of Beaver Bend are downdip away from eastern outcrop margin; in places along higher margin, unit is quite thin and locally absent. In western Putnam County, cut out and overlapped by Pennsylvanian Mansfield sandstone.

T. G. Perry and N. M. Smith, 1958, Indiana Geol. Survey Bull. 12, p. 24, pl. 1. Beaver Bend limestone in Indiana is light gray, oolitic, crystalline, and thick bedded to massive. Thickness 1 to 20 feet. Overlies Mooretown sandstone: underlies Sample sandstone.

H. H. Gray, R. D. Jenkins, and R. M. Weidman, 1960, Indiana Geol. Survey Bull. 20, p. 36 (table 5), 46–47, pl. 1. Included in West Baden group (redefined). Brown-gray thick-bedded finely crystalline fossiliferous limestone 8 to 27 feet thick. Overlies Bethel formation; underlies Sample formation.

Named for exposures at conspicuous bend in Beaver Creek, just east of Huron, Lawrence County, Ind.

Beaverburk Limestone (in Wichita Group)[1]

Beaverburk Member (of Bead Mountain Formation)

Permian (Leonard Series) : North-central Texas.

Original reference: J. A. Udden and D. M. Phillips, 1912, Texas Univ. Bull. 246, p. 31–36, 42–43.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Shown on chart as a member of Bead Mountain formation.

Named for exposures in basin of Beaver Creek and around Burk, Wichita County.

†Beaver Creek Chalky Member (of Niobrara Formation)[1]

Upper Cretaceous: Northeastern Wyoming and southeastern Montana.

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

Abandoned by U.S. Geological Survey as corollary of action transferring Sage Breaks member to Carlile shale; this left Beaver Creek as only representative of Niobrara formation. Consequently, formation name only is used in the area.

Named for exposures along Beaver Creek, in T. 46 N., R. 64 W., Weston County, Wyo.

Beaver Creek Member (of New Providence Formation)

Beaver Creek sand[1]

Lower Mississippian: South-central Kentucky.

Original reference: D. C. MacLachlan, 1928, Michigan Acad. Sci. Arts, and Letters, Papers, v. 8, p. 298, 302.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 77. Beaver Creek member of New Providence formation in area of Forbush facies.

Occurs in Pulaski, Russell, and Wayne Counties.

Beaver Dam Black Shale Member (of Needmore Shale)

Middle Devonian: Central Pennsylvania.

Bradford Willard *in* Bradford Willard, F. M. Swartz, and A. B. Cleaves, 1939, Pennsylvania Geol. Survey, ser. 4, Bull. G–19, p. 141, 153. Name proposed for thick black shale near middle of Needmore shale. Unit also listed in table 20 as part of Selinsgrove limestone which overlies Needmore shale. Contains few scattered calcareous concretions; none near base. Thin sandstone partings in lower part. Thickness 78 feet.

F. M. Swain, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 12, p. 2867. Redefined as Beaverdam Run member of Newton Hamilton formation (new).

Type locality: In large cuts on the Pennsylvania Railroad east of Newton Hamilton, Mifflin County. Named from brook at type locality.

Beaverdam Sand

Pleistocene (Aftonian): Southeastern Maryland (subsurface and surface)

W. C. Rasmussen and T. H. Slaughter, 1955, Maryland Dept. Geology, Mines and Water Resources Bull. 16, p. 113, 115 (table 17), 116. Composed of unconsolidated white to buff medium-grained quartz sand, with small quantities of coarse and fine sand, pebbles and granules, and a minor admixture of white silt. Thickness as much as 72 feet. In some places, underlies Walston silt (new); in others the Pamlico formation.

Reference locality: Test hole, Wi-Cf 63, 2 miles east of Salisbury, Wicomico County. Crops out in banks and roadcuts surrounding Schumaker Pond. Named for Beaverdam Creek, each branch of Wicomico River, because of its prominent occurrence in and beneath drainage basin of that stream.

Beaverdam Creek Augen Gneiss

Precambrian: Southwestern Virginia.

A. J. Stose and G. W. Stose, 1957, Virginia Geol. Survey Bull. 72, p. 32-34, pl. 1. Dark-gray rock banded by red-brown biotite, with coarse gray microcline metacrysts, which are deformed into augen, and blue quartz grains. Derived when granitic solutions related to Striped Rock granite injected Saddle gneiss (new).

Named from occurrence on Beaverdam Creek southeast of Independence, Grayson County. Wide distribution in belt that extends from Baxter Ferry on New River southwestward to Penitentiary Ford on same river.

Beaverdam Run Member (of Newton Hamilton Formation)

Upper Devonian: Central Pennsylvania.

F. M. Swain, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 12, p. 2860 (fig. 2), 2867. At type section, consists of 18 to 20 feet of dark-gray to black thinly laminated to fissile and papery shale, weathering greenish gray; pyritiferous nodules of black chert occur at several levels; at base is 6-inch unit of dark-gray very argillaceous and carbonaceous fine- to coarse-grained calcareous sandstone representing reworked Ridgeley and resting with sharp contact on that formation. Underlies Hares Valley limestone and shale member (new). This member was named Beaver Dam black shale member of Needmore by Willard and others (1939). Willard's original definition as the black shale in the middle part of the section is here discarded and member redefined.

Type section: In railroad cut northeast of Newton Hamilton, Mount Union quadrangle, corresponding with type section of formation. Named from Beaverdam Run which empties into Juniata River, 1½ miles northeast of Newton Hamilton.

Beaver Divide Conglomerate Member (of White River Formation)

Beaver Divide Conglomerate Member (of Chadron Formation)

Oligocene, lower: Southwestern Wyoming.

R. L. Nace, 1939, Wyoming Geol. Survey Bull. 27, p. 11 (table), 32–34, pl. 1. Proposed for basal conglomerate of Chadron. Gray to nearly black cross-bedded boulder and pebble conglomerate in matrix of coarse tuffaceous calcareous sandstone. Thickness varies; as much as 68 feet. Disconformable above Continental Peak formation (new).

F. B. Van Houten, 1950, U.S. Geol. Survey Oil and Gas Inv. Map OM–113. In this report, unit is referred to as Beaver Divide conglomerate member of White River formation.

F. B. Van Houten, 1954, U.S. Geol. Survey Oil and Gas Inv. Map OM–140. Member of White River formation. Conformably overlies Sand Draw sandstone lentil (new) in Long Creek-Beaver Divide area, Fremont County. Maximum thickness about 80 feet. Grades upward into typical Wind River rocks by introduction of more sandy and silty matrix and reduction in number of conglomerate lenses.

Named for occurrence in Beaver Divide area. Well exposed on east side North Oregon Butte, west-central part sec. 2, T. 26 N., R. 101 W., Sweetwater County.

Beaverhead Formation

Beaverhead Conglomerate

Upper Cretaceous, Paleocene, and Eocene: Southwestern Montana and east-central Idaho.

A. J. Eardley, 1950, (abs.) Geol. Soc. America Bull., v. 61, no. 12, pt. 2, p. 1552. Cited as conglomerate of Upper Cretaceous or Paleocene age.

W. R. Lowell and M. R. Klepper, 1953, Geol. Soc. America Bull., v. 64, no. 2, p. 235–243. Beaverhead formation proposed for sequence of conglomerate, sandstone, siltstone, and limestone that crops out over area of at least 400 square miles in Beaverhead County, Mont., and extends across Montana-Idaho boundary. Divided into four mappable units at type section. Top and bottom members dominantly conglomerate; intermediate member consists of two mappable units: a lower thick massive limestone, locally concretionary, and an upper sequence of interbedded siltstone, sandstone, arkose, limestone, and subordinate conglomerate. Approximately 9,700 feet thick at incomplete section where neither top nor base is exposed. Rests unconformably upon rocks as young as Colorado group and as old as early Paleozoic, and it probably rests unconformably upon rocks as young as Montana group and as old as Precambrian. Unconformably overlies Kootenai, Dinwoody, Thaynes, Phosphoria, Quadrant, and Madison. At McKnight Canyon section, base of section is marked by high-angle normal faults which have dropped the Beaverhead against Triassic Thaynes formation and Mississippian Madison. Contact between Beaverhead and Pennsylvanian Quadrant obscured by talus. At top of section, a plate of Madison limestone has been thrust over Beaverhead formation. Unconformably overlain by fluviatile or lacustrine beds of Eocene or Oligocene age. Age designated as probably late Cretaceous to early Eocene.

Type locality: Near mouth of McKnight Canyon, 6 miles west of Dell, Beaverhead County, Mont.

Beaverhead Granite

Eocene: Southwestern Montana and east-central Idaho.

Robert Scholten, K. A. Keenmon, and W. O. Kupsch, 1955, Geol. Soc. America Bull., v. 66, no. 4, p. 370–372, pl. 1. Moderately coarse-grained granite ranging from light gray to pink and light green. Cut by coarse quartz veins and small aplite dikes of same composition as main body but of much finer texture. More than 6 miles long and 2 miles wide in outcrop. Underlies Medicine Lodge volcanics (new).

Crops out in Beaverhead Range along Idaho-Montana state line. Described from occurrences in Beaverhead County, Mont.

Beaver Lake Alluvium

Quaternary: Southwestern Utah.

P. J. Barosh, 1960, Utah Geol. and Mineralog. Survey Bull. 68, p. 28–29. Most extensive alluvium formation in area. Consists mainly of silt, sand, and gravels with only small amount of pebbles and larger clasts.

Present in Beaver Lake Mountains, Beaver County.

Beaver Lake Dolomite

Upper Ordovician(?)-Silurian: West-central Utah.

P. J. Barosh, 1960, Utah Geol. and Mineralog. Survey Bull. 68, p. 14, 20–22, 49. Chiefly dark- to medium-gray mottled or laminated dolomite, which weathers a lighter gray; contains few beds of edgewise conglomerate; fossiliferous. Base not exposed; thickest measurable section is 200 feet on northwest side of Lime Mountain; estimated minimum exposed thickness 400 feet. Conformable below Lime Mountain dolomite (new); stratigraphically above but not in contact with Burrows(?) limestone. Metamorphosed rocks on west flank of Lime Mountain are considered altered equivalent of the Beaver Lake.

Crops out in northern part of Beaver Lake Mountains area around northern base of Lime Mountain and ridges to northwest of it, Beaver County.

Beaver Mountain Group[1]

Mesozoic or Tertiary: Southern British Columbia, Canada, and northeastern Washington.

Original reference: R. A. Daly, 1912, Canada Geol. Survey Dept. Mines Mem. 38, maps 7, 8.

Exposed in section running from Champion Station eastward into Beaver Mountain, British Columbia.

Beaver River Formation (in Pottsville Group)[1]

Pennsylvanian: Pennsylvania, western Maryland, eastern Ohio, and northern West Virginia(?).

Original reference: J. P. Lesley and I. C. White, 1876, Pennsylvania 2d Geol. Survey map of Beaver County.

Typical section is along Big Beaver River and Connoquenessing Creek in Beaver County, Pa.

Beaver River Gabbro (in Beaver Bay Complex)

Precambrian: Northeastern Minnesota.

H. M. Gehman, 1958, Minnesota Univ. Center for Continuation Study, Gen. Ext. Div., Inst. of Lake Superior Geology, Apr. 21–22, p. 1. Oldest intrusion of complex. Followed by Beaver Bay ferrogabbro intrusion (new). Intrudes North Shore volcanic group (new).

In southeastern Lake County.

Beavertown Marl (in Brassfield Limestone)[1]

Silurian: Southwestern Ohio.

Original reference: A. F. Foerste, 1885, Denison Univ. Sci. Lab. Bull. 1, p. 65.

Located at various localities in vicinity of Dayton and near Beavertown, southeast of city and southeast of Soldiers Home, west of city.

Bechler Conglomerate,[1] Redbeds, Shale, or Formation (in Gannett Group)

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.

L. S. Gardner, 1944, U.S. Geol. Survey Bull. 944–A, p. 7. In Irwin quadrangle, referred to as Bechler shale, 35 feet thick. Underlies Draney limestone; overlies Peterson limestone.

G. R. Mansfield, 1952, U.S. Geol. Survey Prof. Paper 238, p. 17, 43, pl. 1. In Ammon quadrangle, Idaho, predominantly sandstone with scattered beds of conglomerate. Unit involved in folds and faults; full thickness not exposed; 1,000 feet of formation may be present. Overlies Peterson limestone; unconformably underlies Wayan formation. Early Cretaceous.

C. A. Moritz, 1953, Intermountain Assoc. Petroleum Geologists [Guidebook] 4th Ann. Field Conf., p. 65 (table 1), 67 (fig. 2), 68. Referred to as Bechler formation in Gannett Hills area, Wyoming, where it is about 1,000 feet thick and consists of sandstones, siltstones, conglomerates, a few thin coarsely crystalline limestones, shales, and mudstones. Overlies Peterson limestone; underlies Draney limestone.

H. R. Wanless, R. L. Belknap, and Helen Foster, 1955, Geol. Soc. America Mem. 63, p. 56, pl. 21. In Jackson Hole area, Bechler "conglomerate" member of Gannett group is a 100- to 150-foot interval of weak beds consisting almost entirely of light-blue, purplish, or reddish-gray shale.

Overlies Peterson limestone member and underlies Draney limestone member.

W. L. Stokes, 1955, Wyoming Geol. Assoc. Guidebook 10th Ann. Field Conf., p. 80, 81 (fig. 1). In western Wyoming, normally underlies Draney limestone and overlies Peterson limestone; where in contact with Ephraim conglomerate, separation of the two is difficult.

Named for Bechler Creek which enters Stump Creek from north about one-fourth mile north of mouth of Boulder Creek, T. 6 S., R. 45 E., Boise meridian, Bannock County, Idaho.

Becket Granite Gneiss[1]

Precambrian: Western Massachusetts, western Connecticut, and southwestern Vermont.

Original references: B. K. Emerson, 1898, U.S. Geol. Survey Geol. Atlas, Folio 50; 1898, U.S. Geol. Survey Mon. 29, p. 18, 31–38, pl. 34.

J. W. Clarke, 1958, Connecticut Geol. Nat. History Survey Quad. Rept. 7, p. 4. Informaly called gneissic granite and trondhjemite in report on Danbury quadrangle.

Named for occurrence at Becket, Mass.

Beckett Limestone (in Plattin Group)

Middle Ordovician: Southwestern Missouri.

E. R. Larson, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 9, p. 2049–2052. Named as the second of four formations in the group. Fucoidal fine-textured calcite limestone having layers of intraformational calcarenite and carbonate pebble conglomerate; nodular chert common in upper part. Thickness at type section 117 feet. Overlies Bloomsdale formation (new); in southern areas, disconformably overlain by Hager formation (new); north of western St. Louis County, overlain by Macy formation (new); in Franklin, Montgomery, and Callaway Counties, succeeding beds are Devonian and Mississippian.

Type section: Below roadcuts along Missouri Highway 25, in NW¼ sec. 27, T. 38 N., R. 8 E., Ste. Genevieve County. Name derived from Beckett Hills.

Beckler Quartz Diorite

[Paleocene or older]: Northwestern Washington.

R. S. Yeats, 1958, Dissert. Abs., v. 19, no. 4, p. 775. Probably an offshoot from the Mount Stuart batholith. Intruded Tonga formation (new). Produced late-kinematic contact minerals up to warm-mesozonal grade.

Between central and eastern part of Skyhomish area in northwestern Cascade Mountains, 45 miles east of Seattle.

Beck Pond Limestone

Lower Devonian: West-central Maine.

A. J. Boucot, Charles Harper, and Keith Rhea, 1959, Maine Geol. Survey Spec. Geol. Studies, Ser. 1, p. 9–19, 24, map. Subdivided into five members (ascending): member 1, predominantly coarse gray-green quartzose limestone containing one or two stromatoporoid biostromes with some of the sandy layers well crossbedded; member 2, chiefly stromatoporoid biostromes interlayered with minor amounts of gray-green quartz-rich limestone containing some coral and stromatoporoid fragments; member 3, similar to member 1 and has also distinct bedding and crossbedding;

member 4, light-colored granite-boulder conglomerate containing boulders but to 15 feet across; member 5, coarse-grained gray-green calcareous quartz conglomerate similar to member 4 but containing more fossils, which are concentrated in certain layers. Thickness about 750 feet. In some areas, unconformably overlain by slate of Seboomook formation. Overlies pre-Silurian granitic basement complex; contact not exposed. A body of diabase intrudes both the Beck Pond and the granite.

W. A. Oliver, Jr., 1960, U.S. Geol. Survey Bull. 1111–A, p. 1–22, pls. Rugose corals described. Corals comparable to Beck Pond species are found in Coeymans limestone in New York and in Keyser limestone of Late Silurian and Early Devonian(?) age in Maryland and West Virginia.

Type area: On south part of low hill in NW cor. T. 3, R. 5, in area west of Beck Pond and Bear Pond, Spencer quadrangle, Somerset County.

Becks Limestone

Upper Devonian: Northern Utah.

N. C. Williams, 1940, Compass, v. 20, no. 2, p. 76 (fig. 1), 77. Becks limestone overlies Swan Peak(?) formation and is in turn overlain by Madison-Brazer limestones of Mississippian age.

J. E. Brooks, 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 55. In areas of Becks Spur and City Creek Canyon, Edvalson (1947, unpub. thesis) described section of Upper Devonian rocks to which he applied name Becks formation. Underlies the Madison and rests on quartzose sandstones and quartzites which were provisionally referred to Swan Peak quartzite. Granger and Sharp (1952) applied name City Creek to these same rocks. Granger (1953, p. 2) abandoned name City Creek and applied name Pinyon Peak.

Granger (1953, U.S. Geol. Survey Circ. 296) did not use term City Creek. It is inferred that he abandoned the term in favor of Pinyon Peak.

Probably named for Becks Spur, Wasatch Mountains, Salt Lake County. Also recognized in City Creek Canyon.

Beck Spring Dolomite

Precambrian (Pahrump Series): Southern California.

D. F. Hewett, 1940, Washington Acad. Sci. Jour., v. 30, no. 6, p. 240; 1956, U.S. Geol. Survey Prof. Paper 275, p. 26, 28, pl. 1. Consists largely of beds of light-bluish-gray dolomite, 2 to 4 feet thick, separated by layers of shaly material; contains numerous beds of oolite several feet thick. No clearly identifiable fossils present, but layers of roundish concretions about one-half inch in diameter may be of algal origin. Thickness about 1,000 feet. Conformably underlies Kingston Peak formation (new); conformably overlies Crystal Spring formation (new).

L. A. Wright, 1952, California Div. Mines Spec. Rept. 20, p. 7 (fig. 3), 12, 13. Described in Superior talc area, Death Valley region. This is most westerly known occurrence of unit. Composed mostly of light-brown fine-grained dolomite containing subordinate olive-gray to light-brown quartzite and shale; dolomite beds are commonly 2 to 10 feet thick and locally contain thin siliceous layers parallel with bedding; quartzite and shale layers range in thickness from a few inches to as much as 20 feet and are most abundant in upper 200 feet of formation. Thickness about 1,300 feet. Overlies Crystal Spring formation; underlies Kingston Peak formation.

Crops out in belt 6 miles long on north slope of Kingston Range, Ivanpah quadrangle. Name derived from Beck Spring on north slope of range.

Beckwith Formation[1]

Jurassic and Cretaceous: Southwestern Wyoming and northeastern Utah.

Original reference: A. C. Veatch, 1907, U.S. Geol. Survey Prof. Paper 56.

D. A. Andrews and C. B. Hunt, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 70. Shown on map legend of northeastern Utah. Jurassic and Cretaceous.

W. L. Stokes, 1955, Wyoming Geol. Soc. Guidebook 10th Ann. Field Conf., p. 80. Originally included beds now constituting Preuss, Stump, and present Gannett group. Remainder of Beckwith has been treated differently. Some workers have retained name Beckwith for restricted part, others have attempted to distinguish members of Gannett within it, and still others have treated it as undifferentiated Gannett. This situation has led to general abandonment of term Beckwith, but problem of just which members, if any, of the Gannett can be recognized in areas where Beckwith has long been used is not settled.

J. D. Love, J. L. Weitz, and R. K. Hose, 1955, Geologic map of Wyoming (1:500,000): U.S. Geol. Survey. Mapped in southwestern Wyoming.

Named for development on Beckwith Ranch, just east of Beckwith Station on Oregon Short Line, Lincoln County, Wyo.

Becraft Limestone[1] **or Sandstone** (in Helderberg Group)

Becraft Limestone Member (of Helderberg Limestone)

Lower Devonian: Eastern New York, western Maryland, New Jersey, Pennsylvania, Virginia, and northern West Virginia.

Original reference: J. Hall, 1893, New York State Geol. 12th Ann. Rept., p. 9-13.

Winifred Goldring, 1931, New York State Mus. Handb. 10, p. 190, 370, 377. Underlies Alsen limestone (new).

F. M. Swartz, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G-19, p. 62-65. At Becraft Mountain, opposite Catskill, N.Y., New Scotland beds are overlain by Becraft limestone, 45 feet thick and consisting of light-gray crystalline in part crinoidal beds. Above Becraft are 25 feet of Alsen limestone. Becraft continues southward to Kingston, where it is 35 feet thick, and into New Jersey, where it is 15 to 20 feet thick. Alsen beds disappear southward and are displaced by Port Ewen beds. In Pennsylvania, Becraft and Port Ewen occur as units to which these names can be applied only in eastern part of Monroe County. Mandata shale and Licking Creek limestone of central and south-central Pennsylvania are partially of these ages.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 279-286. Referred to as member of Helderberg in Virginia and West Virginia. In Virginia, the Becraft is generally bounded by New Scotland limestone but, in places perhaps, by Tonoloway limestone where rest of Helderberg is absent. Bounded above by either Oriskany sandstone or Onondaga formation, as the sequence varies from place to place. Thickness about 50 feet to about 100 feet.

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 126. Swartz (1929) named Rocky Gap sandstone from Rocky Gap, Bland County. Butts

(1940) used name Becraft for this sandstone throughout southwestern Virginia; this use should be abandoned, and term Rocky Gap continued.

H. P. Woodward, 1948, West Virginia Geol. Survey, v. 15, p. 95–97. In most previous reports dealing with Helderberg group in the Virginias, a so-called Becraft limestone has been recognized and described. It is now believed, on evidence presented by F. M. Swartz, that the horizon so identified lies at a higher level than the true Becraft in New York. According to this interpretation, whatever representation the true Becraft has in West Virginia must come below cherty beds of Port Ewen (previously called, in part "Shriver" chert) and above cherty beds of New Scotland. This interval is occupied by soft gray calcareous shale that contains late New Scotland fauna with sparse forms of probable Becraft affinity.

Ernst Cloos, 1951, Maryland Dept. Geology, Mines and Water Resources Washington County [Rept. 14], p. 83–84. In Maryland, Becraft member of Helderberg is an arenaceous limestone interbedded with black chert. Present only in Washington County where it is 85 feet thick. In Cumberland and Keyser sections, member is missing, but it continues into Virginia where it was described by Butts (1940). Overlies New Scotland member.

Named from Becraft Mountain, Columbia County, N.Y.

Bedford Augen Gneiss[1]

Age(?): Southeastern New York.

Original reference: C. R. Fettke, 1914, New York Acad. Sci. Annals, v. 23, p. 239.

Southeast and south of Bedford village, Westchester County.

Bedford Clay (in Pottsville Formation)[1]

Bedford clay member

Pennsylvanian: Eastern Ohio.

[Original reference]: Wilber Stout, 1918, Ohio Geol. Survey, 4th ser., Bull. 21, p. 93.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 36, table 1. Member of Bedford cyclothem in report on Perry County. Average thickness 3 feet. Lies below Bedford coal and above Bedford shale and sandstone member. Pottsville series.

Bedford cyclothem

Pennsylvanian (Pottsville Series): Southeastern Ohio.

N. K. Flint, 1949, Ohio Acad. Sci. [Guidebook] 24th Ann. Field Conf., p. 7. Incidental mention in road log.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 36–39, table 1. geol. map. Includes (ascending) Bedford shale and (or) sandstone, 17 feet thick; Bedford clay, 3 feet thick; coal; and upper Mercer flint and limestone, 2 feet thick. Occurs below Tionesta cyclothem and above Middle 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.

†Bedford Limestone[1]

Mississippian: Indiana.

Original reference: C. E. Siebenthal and T. C. Hopkins, 1897, Indiana Dept. Geol. and Nat. Res. 21st Ann. Rept., p. 291.

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

Bedford shale and (or) sandstone member

See Bedford cyclothem.

Bedford Shale[1] or **Formation**

Devonian and Mississippian(?): Eastern Ohio, northeastern Kentucky, and southwestern Pennsylvania.

Original reference: J. S. Newberry, 1870, Ohio Geol. Survey Rept. Prog. 1869, p. 21.

Wallace de Witt, Jr., 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 21. Bedford shale has been traced across Ohio and into Pennsylvania where it lies below the Berea and above Cussewago sandstone. In Pennsylvania, name Cussewago was first applied to this shale by White (1881, Pennsylvania 2d Geol. Survey Rept. Q_4), and later name Hayfield was substituted by Chadwick (1925, Geol. Soc. America Bull., v. 36, no. 3). The Hayfield has been found to be Bedford in present investigation. Name Bedford has priority; hence term Hayfield is invalid.

Wallace de Witt, Jr., 1951, Geol. Soc. America Bull., v. 62, no. 11, p. 1354–1357; J. F. Pepper, Wallace de Witt, Jr., and D. F. Demarest, 1954, U.S. Geol. Survey Paper 259, p. 13, 21–25. At type locality, composed of about 85 feet of light-gray silty shale, many platy siltstones, and some hard discordal limy nodules. A wedge of red shale, which is 25 feet thick in Independence Township and thins to featheredge on Cuyahoga-Lake County line, present in upper part of formation north of type locality. In eastern half of Cuyahoga County, contains two members: Sagamore siltstone and Euclid siltstone. Thins eastward from type locality to about 45 feet in western Trumbull County. Overlies Cleveland shale member of Ohio shale; contact gradational. Upper contact irregular in area between Cuyahoga County and Trumbull County, because Berea sandstone fills deep channels into, and in some places through, the Bedford. Traced into vicinity of Meadville, Crawford County, Pa. East of Grand River, underlain by Cussewago sandstone and overlain by siltstone facies of Berea. In vicinity of Meadville, Bedford shale and overlying siltstones of Berea sandstone grade laterally into Shellhammer Hollow formation (new) and lose identity as individual formations.

U.S. Geological Survey currently designates age of Bedford as Devonian and Mississippian(?) on basis of study now in progress.

Type locality: On Tinkers Creek, near Bedford, Bedford Township, Cuyahoga County, Ohio.

Bedford Canyon Formation

Triassic(?) and Jurassic: Southern California.

E. S. Larsen, 1948, Geol. Soc. America Mem. 29, p. 18–22, pl. 1. Name proposed for group of mildly metamorphosed slates and argillites with some quartzites and a few thin lenses of limestone. Thickness unknown because base is not exposed and top is a surface of erosion; probably 20,000 feet exposed in Santa Ana Mountains. Unconformably underlies Santiago Peak volcanics (new). Smith (1898) used term Santa Ana for a limestone in these slates in western part of Santa Ana Mountains.

Merrill (1914) called the slates the Santa Ana metamorphic strata. Since Santa Ana has been used for Tertiary strata in California, name Bedford Canyon is used here.

Rene Engel, 1959, California Div. Mines Bull. 146, p. 17. Santa Ana formation includes Bedford Canyon formation and Santiago Peak volcanics of Larsen (1948).

U.S. Geological Survey currently designates age of Bedford Canyon Formation as Triassic(?) and Jurassic on the basis of a study now in progress.

Named for Bedford Canyon, Orange County, where formation is well exposed. Formation lies west of main batholith (of southern California) and underlies much of Santa Ana Mountains. Regional strike of formation is about N. 30° W., approximately parallel to Santa Ana Mountains and the coast. Regional dip is to east; averages about 50° in Santa Ana Mountains and a little steeper to the east.

Bedias Sandstone Member[1] (of Wellborn Formation)

Eocene, upper: Southeastern Texas.

Original reference: B. C. Renick, 1936, Texas Univ. Bull. 3619, p. 26–28, table opposite p. 17.

D. H. Eargle, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 11, p. 2627, 2628. Incidental mention in discussion of Wellborn sandstone which is here considered a formation, undivided.

Named for exposures at Bedias, Grimes County.

Beebe Beds

Middle Devonian: Northeastern Michigan.

W. A. Kelly, 1940, Michigan Acad. Sci., Arts and Letters Sec. Geology and Mineralogy [Guidebook] 10th Ann. Field Excursion [p. 1]. Upper half of section at Afton cannot be definitely correlated with section near Lake Huron, and provisional names, Afton beds, Marvin beds, and Beebe beds, are used in place of Alpena, Norway Point, Potter Farm, Partridge Point, and Squaw Bay, employment of which would imply stricter correlation than is justified.

Present in Black Lake-Afton area.

Beebe Limestone[1]

Beebe Limestone (in West Castleton Formation)

Lower Cambrian: Southwestern Vermont.

Original reference: A. Keith, 1932, Washington Acad. Sci. Jour., v. 22, p. 360, 402.

E-an Zen, 1959, New England Intercollegiate Geol. Conf. Guidebook 51st Ann. Mtg., p. 2. Massive but discontinuous unit in West Castleton formation (new).

Named for exposures near Beebe Pond, in Hubbardton, Rutland County.

Beebe Limestone[1]

Upper Devonian: Central New York.

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

In Ithaca region.

Beebe School Formation (in Traverse Group)

Middle Devonian: Northern Michigan.

W. A. Kelly and G. W. Smith, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 3, p. 448 (fig. 1), 449, 450 (fig. 2), 456 (fig. 3), 459 (fig. 5), 460–461. Name applied to limestone and shale beds which overlie Gravel Point formation and underlie Antrim shale. Subdivided into four unnamed members (ascending): massive biostrome composed of unoriented coralla, fragmentary remains of crinoids, Bryozoa, and Brachiopoda; thin-bedded light-gray brown-weathering cherty limestone with some very fossiliferous layers; yellow-weathering calcareous shale interbedded with thin highly fossiliferous limestone layers; prevailingly thin-bedded dark-gray, weathering to light-gray and buff, fine- to medium-textured limestone interbedded with shaly limestone and shale. Thickness 70 feet.

Exposed in front and back slopes of a series of low cuestas which trend in northwest direction from Beebe School which is in sec. 14, T. 34 N., R. 2 W., Cheboygan County.

Bee Branch Limestone Member (of Caloosahatchee Marl)

Pleistocene: Southern Florida.

J. R. DuBar, 1957, Illinois Acad Sci. Trans., v. 57, p. 192 (table 1). Table shows Bee Branch limestone as middle member of Caloosahatchee underlies Ayers Landing member (new); overlies Fort Denaud member (new).

J. R. DuBar, 1958, Gulf Coast Assoc. Geol. Soc. Trans., v. 8, p. 136 (fig. 4), 143-144. Relatively hard solution-riddled marine limestone or marl unit. Consists of two principal facies, one of which, represented at type locality, is a massive hard calcareous ledge-forming bed; the other is softer, less consolidated, more arenaceous, and more distinctly concretionary. Thickness a few inches to about 5 feet; average about 2½ feet. Conformably overlies Fort Denaud member; conformably underlies Ayers Landing member. Where erosion has been extensive, overying beds may belong to either Fort Thompson or Pamlico formation, and contact is unconformable.

J. R. DuBar, 1958, Florida Geol. Survey Bull. 40, p. 58–61. Report does not use either Fort Denaud member or Ayers Landing marl member; underlying and overlying units referred to as lower Caloosahatchee beds and upper Caloosahatchee shell bed.

Type locality: Along Caloosahatchee River in Hendry County near its confluence with tributary called Bee Branch.

Beech Granite[1]

Beech Granite Gneiss

Precambrian: Western North Carolina and eastern Tennessee.

Original reference: A. Keith, 1903, U.S. Geol. Survey Geol. Atlas, Folio 90, p. 3.

J. L. Stuckey and S. G. Conrad, 1958, North Carolina Div. Mineral Resources Bull. 71, p. 19; J. L. Stuckey, 1958, Geologic map of North Carolina (1:500,000): North Carolina Div. Mineral Resources. Beech granite gneiss consists of Beech granite as mapped by Keith. Three varieties of granite are present: one is a coarse-grained, usually porphyritic rock, another is medium to fine grained, and the third is a coarse red variety. Unit has been greatly changed by metamorphism. Precambrian(?).

Named for Beech Mountain, Cranberry quadrangle, Watauga (now Avery) County, N.C.

Beech Member (of Valcour Formation)

Middle Ordovician (Chazyan): Northwestern Vermont, and northeastern New York.

Philip Oxley and Marshall Kay, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 4, p. 825 (fig. 4), 826 (fig. 5), 833, 836–838. Upper member of formation. Overlies Hero member (new) from which it differs both lithologically and faunally, being essentially the *Rostricellula plena* zone. Well exposed beds at Rockwell Bay include principal lithic variants. Basal 35 feet is fossiliferous calcarenite somewhat dolomitized and enclosing two reef lenticles. Succeeding 41 feet has medium-bedded calcarenites, irregularly dolomitized, succeeded by shaly calcargillite with massive zoaria of *Anolotichia* sp. and *Stromatotrypa* sp. Upper 51 feet is gray medium- to coarse-grained calcarenite having cross-stratified beds, with *Rosticellula, Mimella,* and ramose trepostomes. Top contact not exposed here but where it is exposed on northern tip of Valcour Island, brown-weathering dolomite is succeeded by "Lowville" calcilutite. Thickness near Rutland Station, South Hero, 86 feet.

Type section: Along Beech Bay, South Hero, Vt.

Beechatuda Tongue (of Cliff House Sandstone)

Upper Cretaceous: Northwestern New Mexico.

P. T. Hayes and A. D. Zapp, 1955, U.S. Geol. Survey Oil and Gas Inv. Map OM–144, sheet 1. Described as tongue of Cliff House sandstone in Menefee formation. Southeastward rise of about 90 feet in stratigraphic position of base of Cliff House sandstone is involved. Contacts are sharp.

Exposed in Beechatuda Draw in northwestern part of secs. 5 and 6, T. 30 N., R. 15 W., San Juan County, and can be traced approximately 2½ miles along the outcrop.

Beech Creek Limestone Member (of Golconda Formation)

Beech Creek Limestone[1] (in Stephensport Group)

Beech Creek Limestone Member (of Paint Creek Formation)

Upper Mississippian (Chester Series): Southwestern Indiana and central northern Kentucky.

Original reference: C. A. Malott, 1919, Indiana Univ. Studies, v. 6, no. 40, p. 7–20.

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 of southern Indiana: Ann Arbor, Mich., The Edwards Letter Shop, p. 7, 14–17, 73. 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 a name in its own right. At designated type section, Beech Creek limestone is 24½ feet thick. Persistent through area of outcrop except where it is truncated and overlapped by Pennsylvanian Mansfield.

A. C. McFarlan and others, 1955, Kentucky Geol. Survey, ser. 9, Bull. 16, p. 18, 20. Beech Creek (lower Golconda) underlies Fraileys (middle Golconda) shale (new).

T. G. Perry and N. M. Smith, 1958, Indiana Geol. Survey Bull. 12, p. 25, 72–78, pl. 1. Thickness 8 to 33 feet in Indiana. Gray fine- to coarse-grained crystalline limestone weathering to rough cubical blocks; large crinoid stems common. Underlies Cypress sandstone; locally transition contact separates the two. Overlies Elwren sandstone.

H. H. Gray, R. D. Jenkins, and R. M. Weidman. 1960. Indiana Geol. Survey Bull. 20, p. 36 (table 5), 41–42, pl. 1. Lowermost formation in Stephensport group (redefined). Thickness 12 to 18 feet. Underlies Big Clifty formation; overlies Elwren formation of West Baden group.

U.S. Geological Survey currently classifies the Beech Creek as a member of Golconda Formation in Kentucky, on basis of study now in progress.

Type section: At Ray's Cave, NE¼NW¼ sec. 13, T. 7 N., R. 4 W., one-fourth mile north of State Road 54 at Ridgeport, and 3½ miles southwest of Solsberry, Greene County, Ind. Named for exposures along Beech Creek.

Beech Creek Shale (in Chester Group)[1]

Mississippian: Southwestern Indiana.

Original reference: W. N. Logan, 1926, Indiana Dept. Conserv., Div. Geol. Pub. 55.

Beecher Dolomite Member (of Bluebell Formation)

Upper Ordovician and Silurian: Central Utah.

Paul Billingsley *in* J. M. Boutwell, 1933, 16th Internat. Geol. Cong. [United States] Guidebook 17, Excursion C–1, p. 110 (fig. 14). Name appears on stratigraphic column of Tintic district. Overlies Eagle member (new); underlies Dora member (new).

T. S. Lovering and others, 1949, Econ. Geology Mon. 1, p. 7 (table 1). Upper 60 feet light-gray lithographic dolomite; overlies well-bedded fine-grained blue-gray dolomite; 26-foot bed strongly mottled blue-gray dolomite 62 feet above base. Thickness 212 feet.

H. J. Bissell, 1959, Utah Geol. Soc. Guidebook 14, p. 141. Suggested that strata which comprise Beecher dolomite of older reports be referred to Laketown dolomite in Boulter Mountains quadrangle.

Type locality and derivation of name not stated.

Beecher Member (of Dunleith Formation)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., p. 33, figs. 3, 9. Dolomite, pure, nonshaly, noncherty; thick bedded. Thickness about 3½ feet. Shown on columnar section as underlying Eagle Point member (new) and overlying St. James member (new).

Occurs in Dixon-Oregon area.

Beecher Island Shale Member (of Pierre Shale)[1]

Upper Cretaceous (Gulf Series): Northeastern Colorado and northwestern Kansas.

Original reference: M. K. Elias, 1931, Kansas Univ. Bull. 32, no. 7.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 22. Gray shale; irregular concretionary limestone near top; limonite concretions throughout; thin beds of bentonite and limestone concretions in lower part. Thickness 100 feet. Uppermost member of Pierre shale; overlies an unnamed shale member, 500 to 600 feet thick, that in turn overlies Salt Grass shale member.

Named for exposures at Beecher Island, Yuma County, Colo.

Beech Mountain Amphibolite[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 Bear Pond schist.

Named for occurrence on Beech Mountain, southeast of Graphite, Warren County.

Beech River Shaly Limestone Member (of Brownsport Formation)[1]

Beech River Formation (in Brownsport Group)

Middle Silurian: Western and central Tennessee.

Original reference: W. F. Pate and R. S. Bassler, 1908, U.S. Natl. Mus. Proc., v. 34, p. 410-432.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Shown on correlation chart as basal formation of Brownsport group.

T. W. Amsden, 1949, Yale Univ. Peabody Mus. Nat. History Bull. 5, p. 25. In area of this report [western Tennessee], there does not seem to be any valid basis for subdividing the Brownsport into three members or formations. Here proposed that terms "Beech River," "Bob," and "Lobelville" be abandoned.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 257-262, figs. 77, 78, 80, 81, 82. Beech River formation included in Brownsport group. Argillaceous formation consisting of interbedded shaly limestone and calcareous shale that begins with widespread basal limestone that ranges from 1 to 12 feet in thickness. Thickness of formation as much as 60 feet. Overlies Dixon formation with apparent conformity; underlies Bob limestone into which it seems to grade by progressive replacement of one by the other or by interbedding of the two facies; locally contact is sharp. Where Bob limestone has been removed by erosion, Beech River is overlain by Decatur limestone, a Devonian formation, or the Chattanooga shale; where the Bob may be locally absent due probably to nondeposition, the Beech River is overlain by Lobelville formation, and in such cases the two cannot be separated lithologically.

Named for Beech River, Decatur County.

Beechwood Limestone Member (of Sellersburg Limestone)[1]

Beechwood Formation (in Hamilton Group)

Middle Devonian: Central northern Kentucky and southern Indiana.

Original reference: C. Butts, 1915, Kentucky Geol. Survey, 4th ser., v. 3, pt. 2, p. 118, 120.

Guy Campbell, 1942, Geol. Soc. America Bull., v. 53, no. 7, p. 1057, 1064-1065, 1067. Rank raised to formation at top of Hamilton group. Overlies Silver Creek formation in Clark County, Deputy formation (new) in Jennings County, and Jeffersonville formation in Bartholomew County. Difficult to distinguish from Swanville formation (new) on lithology alone. and unit termed Swanville has been regarded as a continuous bed of Beechwood; however, the two have not been found in the same section at any place. Close relationship of Silver Creek and Beechwood implied by their treatment as member of Sellersburg does not exist; their fossils represent separate time divisions in standard Hamilton scale. The two are separated by an erosional disconformity.

J. B. Patton and T. A. Dawson *in* H. H. Murray, 1955, Indiana Geol. Survey Field Conf. Guidebook 8, p. 42, pl. 1. Beechwood is not necessarily younger than all other Hamilton beds of southeastern Indiana. It is present nearly everywhere the Silver Creek is identifiable, but its thickness varies within small areas, and at places it is absent. At such places, Silver Creek lithology extends to top of Hamilton section; absence of Beechwood does not decrease thickness of Hamilton; this fact suggests that the same time of deposition is represented, where Beechwood is not found, by beds that have Silver Creek lithology. Indiana Geological Survey used term Beechwood for a member at top of Hamilton sequence.

Named for Beechwood Station, Jefferson County, Ky. Exposed in stream a few rods north of Shelbyville turnpike, one-half mile south of Beechwood.

Beehive Formation[1]

Precambrian: Southern British Columbia, Canada, and northeastern Washington.

Original reference: R. A. Daly, 1912, Canada Geol. Survey Dept. Mines Mem. 38, map 7.

Typical occurrence on Beehive Mountain, north of Lost Creek, British Columbia.

Beehive Rhyolite

Tertiary: Southeastern Arizona.

W. H. Brown, 1939, Geol. Soc. America Bull., v. 50, no. 5, p. 740–741. Described as massive porphyritic biotite rhyolite. Makes up two intersecting dikes which form a small but prominent spire called Beehive Peak. Believed to represent a volcanic neck. Spire rises above a mass of biotite rhyolite believed to have come from the volcanic neck.

Exposed in and around Beehive Peak, Tucson Mountains, Pima County.

Beehive Mesa Alluvium

Pleistocene or Recent: Southern California.

B. F. Howell, Jr., 1954, California Div. Mines Bull. 170, map sheet 10. Shown on stratigraphic column as bedded dark fan remnants as much as 100 feet thick. May be same age as Kagel or Lopez alluvium.

Occurs in Little Tujunga area, Los Angeles County.

Beekmantown Group,[1] Limestone,[1] Shale, or Dolomite

Lower Ordovician: New York, western Maryland, Pennsylvania, Tennessee, Vermont, and Virginia.

Original reference: J. M. Clark and C. Schuchert, 1899, Science, new ser., v. 10, p. 874–878.

John Rodgers, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 98. There were three major pre-Chazy invasions of Champlain area during early Paleozoic, instead of two as commonly suggested. The first corresponds to Potsdam-Little Falls sequence in Mohawk Valley; the third gave the type "Beekmantown" (including Fort Cassin strata). Middle invasion, newly recognized, correlates with the Chepultepec and Gasconade formations. These facts indicate that name "Beekmantown" should be redefined or perhaps abandoned altogether.

John Rodgers, 1937, Geol. Soc. America Bull., v. 48, no. 11, p. 1573–1588. Name Beekmantown was originally proposed for entire Calciferous (Brainerd and Seely, 1890, Am. Mus. Nat. History Bull., v. 3), but since it became evident that Calciferous spanned break between Cambrian and Ordovician (or Ozarkian and Canadian of Ulrich), term has been restricted to Ordovician (Canadian part of sequence). There has been no general agreement as to position of this break in Champlain sequence. Ulrich and Cushing (1911, New York State Mus. Bull. 140) considered break to lie between middle of Division A [of Calciferous] and base of Division C [of Calciferous] in section at Ticonderoga where upper part of Division B [of Calciferous] is lacking. They considered that the missing beds were part of the overlying formation, whereas actually they form a unit with the underlying, but in any case they excluded the Whitehall beds (new) at Ticonderoga from the Beekmantown. However, Whitehall is now correlated with beds considered basal Ordovician (although Ulrich holds they are upper Ozarkian), and hence, if term Beekmantown is to be used for Ordovician Calciferous, in its use in Champlain Valley it should be extended to cover Whitehall formation.

E. O. Ulrich and G. A. Cooper, 1938, Geol. Soc. America Spec. Paper 13, p. 23. Term should either be abandoned entirely or restricted to beds between Upper Cambrian Potsdam and Theresa sandstones and base of Chazyan in vicinity of Beekmantown. As term is used in this paper [Ozarkian and Canadian brachiopods], it refers solely to Middle Cambrian lithological and faunal facies on west side of Champlain basin and to north at Beauharnois near southwestern angle of Province of Quebec. The fauna, characterized by species of *Lecanospira*, is of northern origin and widely distributed in both Cordilleran and Appalachian troughs and in Missouri, Oklahoma, and Texas.

B. L. Miller, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. C–48, p. 241–249. Formation described in Northampton County where it constitutes surface indurated rocks in broad band from 1½ to 4 miles in width extending continuously across the county between Lehigh and Delaware Rivers. An isolated fault block area of Allentown, Beekmantown, and Jacksonburg in vicinity of Portland extends from Delaware River in gradually narrowing band to Johnsonville. The band of Beekmantown limestones is bounded on south by older and underlying Allentown strata and on north by younger and overlying Jacksonburg limestones. Estimated thickness 1,000 to 1,200 feet, perhaps less in vicinity of Delaware River.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 102–119. In Virginia, Beekmantown group (formation) is overlain by limestones of Chazyan age (Murfreesboro, Lenoir, and Mosheim) and underlain by Chepultepec limestone. Three distinct facies present: dolomite in area southwest of Lexington and in northwestern belts from Lee County to Highland County; dolomite and limestone southwest of Frederick County; and dominantly limestone in Frederick and Clarke Counties.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 53–66. Term Beekmantownian series used to include the following formations in Minnesota: Kasota sandstone, Blue Earth siltstone, Oneota dolomite, Root Valley sandstone, and Shakopee dolomite. Formations carry fauna distinctly older than usual formations of Ordovician or those commonly referred to as Canadian. Shakopee dolomite underlies St. Peter sandstone of Chazyan series. Term Ozarkian has been applied to these Minnesota formations.

R. R. Wheeler, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 2036. Upper Cambrian (Hoyt) fossils have been found in upper part of Division B of "Calciferous" formation. Previous workers have considered these beds Tribes Hill (Beekmantown) in age. Tribes Hill and *Lecanospira* faunas were found above crossbedded base of Division C. Thus, Hoyt fauna overlies Little Falls dolomite in Champlain and Mohawk Valleys instead of underlying it as previously designated. Since a recognized late Upper Cambrian fauna underlies standstone at base of Division C and an accepted Lower Ordovician fauna overlies it, base of the Beekmantown must be moved up to base of Division C. Thus Cambrian-Ordovician boundary should be placed at base of Division C.

R. R. Wheeler, 1942, Am. Jour. Sci., v. 240, no. 7, p. 518–524. Cambro-Ordovician correlations revised in Champlain, Hudson, Mohawk, and St. Lawrence Valleys. Revisions involve definitions and succession of previously accepted Cambro-Ordovician formations (Upper Cambrian Potsdam, Theresa, Hoyt, and Little Falls and Lower Ordovician Whitehall, Tribes Hill, and Beekmantown). Lower "typical" Theresa is physically and faunally differentiated from "Upper Theresa" (now Heuvelton member of Tribes Hill formation); Hoyt fauna occurs in lower half of emended Whitehall formation above Little Falls dolomite; a new, upper (Skeene) member of Whitehall formation represents late Cambrian offlap; two marine cycles, represented by Tribes Hill formation (containing Norton-Heuvelton, Fort Ann-Bucks Bridge, Benson-Ogdensburg members) and Cassin formation, constitute Beekmantown series. Each revised unit is tied in with Division A through E of original "Calciferous" formation.

B. N. Cooper and C. E. Prouty, 1943, Geol. Soc. America Bull., v. 54 no. 1, p. 862–865. In Tazewell County, Va., Cliffield formation (new) disconformably overlies Beekmantown dolomite.

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 27-33. Formation described in Burkes Garden quadrangle where its maximum thickness is about 1,000 feet. Equivalents of the Nittany and Bellefonte are present, but Stonehenge or its equivalent, the Chepultepec, does not appear to be present. Overlies Copper Ridge formation; underlies Blackford member of Cliffield formation.

W. M. Cady, 1945, Geol. Soc. America Bull., v. 56, no. 5, p. 522 (fig. 3), 524 (table), 539–548. Mappable units of Beekmantown group of west-central Vermont correspond with few exceptions to "Divisions B, C, D, and E" of Brainerd and Seely (1890, Am. Mus. Nat. History Bull. 3). They are here called (ascending) Shelburne marble, Cutting dolomite (new), Bascom formation (new), and Bridport dolomite (new), respectively. Overlies Upper Cambrian Clarendon Springs dolomite; underlies Chazyan Crown Point limestone.

Charles Butts, 1945, U.S. Geol. Survey Geol. Atlas, Folio 227. Group, in Hollidaysburg-Huntingdon quadrangles, Pennsylvania, comprises (ascending) Mines dolomite, Larke dolomite, Nittany dolomite, Axemann limestone, and Bellefonte limestone. Overlies Gatesburg formation; underlies Carlim limestone.

B. N. Cooper and G. A. Cooper, 1946, Geol. Soc. America Bull., v. 57, no. 1, p. 71, 72. In Shenandoah Valley, New Market limestone (new) overlies Beekmantown group.

Marshall Kay, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1402 (fig. 2). Term Beekmantownian series used on table of classification of sections along Allegheny synclinorium. Followed by Chazyan series.

C. R. Fettke, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1460 (fig. 2). Term Beekmantownian used on correlation chart of Middle and Lower Ordovician and Cambrian formations around northern rim of Appalachian basin. It is interval between Upper Cambrian Croixian and Middle Ordovician Chazyan.

F. M. Swartz, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1550–1563. Discussion of outcrop areas of Lower Ordovician Beekmantown sediments in New York, Pennsylvania. and Maryland. Tribes Hill limestone of Tribes Hill region, Mohawk Valley, represents thin featheredge of Beekmantown deposits lapping from south onto margin of old Adirondack Peninsula. In Taconic plate, Beekmantown sediments of overthrust mass or allochthone consist of Schagticoke shale and all but topmost part of Deepkill shale. In central Pennsylvania, Beekmantown group consists of (ascending) Stonehenge limestone, Nittany dolomite, Axemann limestone, and Bellefonte dolomite.

C. E. Prouty, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1598 (fig. 1). Discussion of Trenton and sub-Trenton stratigraphy of northwest belts of Virginia and Tennessee. Generalized section shows Beekmantown group comprises (ascending) Chepultepec, Longview, Kingsport, and Mascot dolomites. [These formations included in Knox group by some authors.] Occurs above Upper Cambrian Copper Ridge dolomite and below Blackford formation of Cliffield group (Chazyan).

P. B. King, 1950, U.S. Geol. Survey Prof. Paper 230, p. 35–37. Described as Beekmantown dolomite in Elkton, Va., area. Overlies Conococheague limestone; underlies unit of thin limestones of Middle Ordovician age.

R. B. Neuman, 1951, Geol. Soc. America Bull., v. 62, no. 3, p. 278. Group underlies St. Paul group (new), which name replaces Stones River group of Maryland and adjacent states. Thickness about 2,500 feet near Pinesburg Station, Washington County, Md.

Carlyle Gray, 1951, Pennsylvania Geol. Survey, 4th ser., Prog. Rept. 136, p. 7–12. Described in Berks County. Thickness 1,000 to 2,000 feet. Subdivided into lower limestone member, middle interbedded member, middle dolomite member, upper limestone member, and an uppermost member of massive dolomites and interbedded limestone and dolomite. Underlies Annville limestone. Beekmantown fossils were reported in Coplay formation by Miller (1911, Pennsylvania Geol. Survey, 3d ser, Rept. 4). Thereafter term Beekmantown gradually replaced term Coplay for rocks between Allentown and Jacksonburg formations.

H. P. Woodward, 1951, West Virginia Geol. Survey, v. 21, p. 70–107. Beekmantown group (limestone or dolomite) described in West Virginia. As used herein, term refers to body of calcareous Lower Ordovician rocks above Stonehenge-Chepultepec limestone, which formation has been withdrawn from Beekmantown and treated separately. Believed that representatives of Nittany and Bellefonte dolomites occur in Beekmantown, but precise identification is withheld until further correlations and field evidence have been reviewed and studied. Underlies Chazyan group.

D. W. Fisher, 1954, Geol. Soc. America Bull., v. 65, no. 1, p. 73. Advocates discontinuation of name Beekmantown unless it is relegated to Middle Cambrian (Roubidoux), the only known Canadian rocks outcropping in vicinity of Beekmantown, N.Y.

W. J. Sando, 1956, Geol. Soc. America Bull., v. 67, no. 7, p. 935-936; 1957, Geol. Soc. America Mem. 68, 161 p, pls. Beekmantown group of Maryland comprises (ascending) Stonehenge limestone, Rockdale Run formation (new), and Pinesburg Station dolomite (new). Aggregate thickness about 3,600 feet. Term Beekmantown as used herein applies to beds between Conococheague formation below and St. Paul (Stones River) group above. This usage, however, does not necessarily imply exact equivalence with type section. Reference section designated.

J. P. Hobson, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 12, p. 2710–2722. Group, in Berks County, comprises (ascending) Stonehenge, Rickenbach (new), Epler (new), and Ontelaunee (new) formations. Thickness about 2,305 feet. Underlies Jacksonburg limestone. Lower boundary drawn at base of exposures above concealed interval. Hence Cambrian-Ordovician boundary cannot be placed in area of this report because of poor exposure.

F. M. Swartz and R. B. Thompson, 1958, Pennsylvania State Univ. Mineral Industries Expt. Sta. Bull. 71, p. 1–14. In Franklin County, Beekmantown dolomite is 2,300 feet thick, including at base Stonehenge limestone member, 500 feet thick. Underlies Social Island limestone memper (new) of Row Park limestone of St. Paul group.

Bradford Willard, 1958, Pennsylvania Acad. Sci. Proc., v. 32, p. 177–182. Beekmantown has for some years been used to include Ordovician part of dolomitic limestones in Lehigh and Delaware Valleys. Name is not appropriate because of lack of correlation with type Beekmantown and because of presence of post-Beekmantown fossils. Wherry's (1909) Coplay limestone is reinstated for Lower and lower Middle Ordovician beds between Upper Cambrian Allentown and Middle Ordovician Jacksonburg formations.

C. W. Welby, 1959, New England Intercollegiate Geol. Conf. Guidebook 51st Ann. Mtg., p. 22–23. Group, in central Champlain Valley comprises (ascending) Whitehall formation, Cutting formation, Cassin limestone, and Bridport dolostone. Overlies Ticonderoga formation (new); underlies Day Point formation of Chazy group.

C. E. Prouty, 1959, Pennsylvania Geol. Survey, 4th ser., Bull. G–31, p. 5. Stose and Jonas (1927) mapped argillaceous limestone between Susquehanna and Lehigh Rivers that have same stratigraphic position as Jacksonburg, below Martinsburg and above Beekmantown. They assigned name Leesport formation to these rocks. Name Leesport as defined and mapped should not be considered a valid formation and should be redefined or renamed. Interval between Beekmantown group and Martinsburg formation, embodying essentially the Leesport in east-central Pennsylvania and in a restricted sense, the Jacksonburg of eastern Pennsylvania and western New Jersey is herein divided into (ascending) Annville, Myerstown, and Hershey limestone.

W. M. Cady and E-an Zen, 1960, Am. Jour. Sci., v. 258, no. 10, p. 735 (fig. 4). In west-central Vermont, group comprises (ascending) Shelburne formation, Cutting dolomite, Bascom formation, and Chipman formation. Overlies Clarendon Springs dolomite; underlies Middlebury limestone.

Reference section (Sando): Begins at top of Beekmantown group exposed in Potomac River bluff about 1,000 feet west of intersection with southwest face of Pinesburg Station quarry and continues westward along abandoned Chesapeake and Ohio Canal for 1 mile, Washington County, Md. Named for exposures at Beekmantown, Clinton County, N.Y.

Beekmantownian[1] Series

Lower Ordovician: North America.

Original reference: A. W. Grabau, 1909, Jour. Geology, v. 17, p. 209–252.

See **Beekmantown Group, Limestone, Shale,** or **Dolomite.**

Beeman Formation (in Magdalena Group)

Pennsylvanian (Missourian): Southeastern New Mexico.

L. C. Pray, 1954, New Mexico Geol. Soc. Guidebook 5th Field Conf., p. 93. Appears only on columnar section. Consists of shale, argillaceous limestone, and conglomerate. Bioherms at base locally. Thickness as much as 500 feet. Underlies newly named Holder formation and overlies newly named Gobbler formation.

In Sacramento Mountains, Otero County.

Bee Rock Sandstone Member (of Lee Formation)

Bee Rock[1] Conglomerate or Sandstone Member (of Lee Formation)

Lower Pennsylvanian: Southwestern Virginia.

Original reference: J. J. Stevenson, 1881, Am. Philos. Soc. Proc., v. 19, p. 96.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 88; 1946, Geol. Soc. America Mem. 13, p. 136. Topmost conglomeratic sandstone of Lee formation.

Exposed at Bee Rock in Big Stone Gap, Wise County.

Bee Spring Sandstone[1] Member (of Caseyville Formation)

Pennsylvanian (Pottsville): Western central Kentucky.

Original reference: C. J. Norwood, 1876, Kentucky Geol. Survey, v. 1, new ser., pt. 6, p. 16, 42, 52–55.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 77. Massive slightly conglomerate sandstone. Top member of Caseyville formation. Equivalent to Makanda sandstone.

Named from Bee Spring Edmonson County.

Bee Tree Shale (in Breathitt Formation)

Pennsylvanian: Southeastern Kentucky.

A. F. Crider, 1916, Kentucky Geol. Survey [Rept.], 4th ser., pt. 1, p. 138, 142; H. R. Wanless, 1946, Geol. Soc. America Mem. 13, p. 88, 136. Name applied to bed of shales 45 or more feet thick that overlies a 25- to 30-foot shale interval above Elkhorn coal and below Amburgy coal.

Exposed on Bee Tree branch of Smoot Creek, Letcher County.

Begg 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.

Beidell Quartz Latite

Beidell Latite-Andesite[1]

Miocene(?): Southwestern Colorado.

Original reference: Whitman Cross and E. S. Larsen, 1935, U.S. Geol. Survey Bull, 843, p. 63–64, pl. 1.

E. S. Larsen, Jr., and Whitman Cross, 1956, U.S. Geol. Survey Prof. Paper 258, p. 83–86, pl. 1. Flow and clastic beds redescribed as quartz latite. Underlies Conejos quartz latite in most places; on its northern borders, it irregularly underlies Tracy Creek quartz latite.

Receives its name from old mining camp of Beidell, around which it is best developed, Del Norte quadrangle, Saguache County. Also present in adjacent Saguache quadrangle.

Beil Limestone Member (of Lecompton Limestone)[1]

Pennsylvanian (Virgil Series): Southeastern Nebraska, southwestern Iowa, and eastern Kansas.

Original reference: G. E. Condra, 1930, Nebraska Geol. Survey Bull. 3, 2d ser., p. 48.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 23–24; R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 66. Consists of two limestones separated by shale. Thickness 3 to 6 feet in Nebraska and 4 to 12 feet in Kansas. Underlies King Hill shale member; overlies Queen Hill shale member.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 19, fig. 5. Consists of two limestones separated by shale. Upper limestone light gray, dense, massive, with abundant *Osagia.* Shale is buff and calcareous, grading into limestones above and below, and carries profusion of coral *Campophyllum torquim.* Lower limestone fossiliferous and argillaceous. Thickness 3 to 6 feet. Underlies King Hill shale member; overlies Queen Hill shale member.

Type locality: Missouri River bluff near mouth of Kenosha Valley, 2 miles south and 1 mile east of Rock Bluff, Cass County, Nebr. Name derived from Beil Farm. Occurs from southwestern Iowa to Oklahoma.

Beirdneau Sandstone Member (of Jefferson Formation)

Upper Devonian: Northern Utah.

J. S. Williams, 1948, Geol. Soc. America Bull., v. 59, no. 11, p. 1139, 1140. Composed wholly of buff-weathering sandstones. Thickness 820 to 920 feet. Overlies Hyrum dolomite member (new); gradational contact. Unconformably underlies Madison formation.

Named for continuous exposure about base of Beirdneau Peak, Logan quadrangle.

Belcher Member (of Bluestone Formation)

Mississippian (Chester Series): Southeastern West Virginia and southwestern Virginia.

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 184–185, pl. 15. Beds classified by Reger (1926) as Lower Belcher shale, Lower Belcher sandstone, Upper Belcher shale, and Upper Belcher sandstone, are grouped into single member and named Belcher member of Bluestone formation. Thickness 80 to 100 feet. Underlies Bratton member; overlies Mud Fork member (new).

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (columns 97, 98). Shown on correlation chart as Belcher beds in Bluestone formation or group.

Type locality: Along Bluefield-Princeton Road across Big Ridge, near Belcher School, Mercer County, W. Va. Well exposed along Road 656 about 1½ miles north of Bailey, Tazewell County, Va.

Belcher Sandstone (in Bluestone Formation)[1]

Belcher Shale (in Bluestone Formation)[1]

Mississippian (Chester Series): Southeastern West Virginia and southwestern Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 294, 318–320.

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 184. Beds classified by Reger (1926) as Lower Belcher shale, Lower Belcher sandstone, Upper Belcher shale, and Upper Belcher sandstone are herein grouped together and defined as Belcher member of Bluestone formation.

Units are exposed just north of Belcher School, Mercer County, W. Va.

Belchertown Tonalite[1]

Carboniferous(?): Central 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. 243–248, pl. 34.

M. E. Willard, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–85. Described in Williamsburg quadrangle, Massachusetts, as typically light-gray equigranular medium- to coarse-grained tonalite Contains orbicular and lenticular concentrations of hornblende. Angular to subrounded xenoliths of quartzite, quartz-mica schist, phyllite, and amphibolite present. Foliation present throughout. Cut by small aplitic dikes of similar composition. Intrudes Brimfield schist at type locality. Carboniferous(?).

Named for occurrence at Belchertown, Mass.

Belden 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 135.7 million years. Pluton from which collections were made is intrusive into slates of Carboniferous age and into metavolcanic rocks of possible Jurassic age.

Present near town of Belden on Feather River Highway, Plumas County.

Belden Shale or **Formation**

Belden Shale Member (of Battle Mountain Formation)

Pennsylvanian: Northwestern Colorado.

K. G. Brill, Jr., 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 8, p. 1376 (fig. 1), 1383–1384, 1385–1387. Proposed as member of Battle Mountain formation to replace name Weber shale in area. Composed of 100 to 200 feet of black and dark-gray carbonaceous shale and argillaceous limestone with thin beds of dark-colored sandstone; thin seams of impure coal present locally. Thickness at type locality about 125 feet. Underlies Robinson limestone member; unconformably overlies Leadville limestone.

K. G. Brill, Jr., 1944, Geol. Soc. America Bull., v. 55, no. 5, p. 624–627. Rank raised to formation. Replaces Weber shale as applied to basal Pennsylvanian in Colorado, and is Des Moines in age. Base is clearly defined erosional contact with the pre-Pennsylvanian; underlies Maroon formation.

Ogden Tweto, 1949, Colorado Sci. Soc. Proc., v. 15, no. 4, p. 152 (table 1), 192–193. Described in Pando area. Following usage of Brill (1944), term Belden shale is applied to dark Pennsylvanian shales and limestones unconformably overlying Leadville dolomite—the beds formerly called Weber(?) shale. Thickness 25 to 200 feet. Underlies Minturn formation (new). Grades upward into overlying Minturn formation.

R. L. Langenheim, Jr., 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 4, p. 552 (fig. 3), 556, 557, 559–561. Described in Crested Butte quadrangle, Gunnison County, where it is 451 to 555 feet thick, and underlies Gothic formation (new).

M. G. Dings and C. S. Robinson, 1957, U.S. Geol. Survey Prof. Paper 289, p. 16–17. Discussed in Garfield quadrangle, Chaffee and Gunnison Counties. Maximum thickness about 1,110 feet. At most places, three units can be distinguished: lower, 200 to 500 feet, chiefly dark shale or argillite; middle, 400 to 700 feet, limestone and shale in which either one or the other may predominate: upper, about 200 feet, contains more quartzite than underlying beds. Grades into overlying Minturn; contact arbitrarily placed where quartzite and micaceous shales of Minturn exceed limestone and shale of Belden. Overlies Leadville; locally overlies Manitou. In Monarch and Tomichi districts, Crawford (1913) used term Garfield formation for lower 2,600 feet of Pennsylvanian section. In present usage, Belden shale corresponds to lower 1,110 feet of Crawford's Garfield formation.

Type section: North side of Rock Creek Valley along U.S. Highway 24 (1938) 0.2 mile north of Gilman, Eagle County. Name derived from station of Belden on Denver and Rio Grande Western Railroad.

Beldens Formation

Beldens Member (of Chipman Formation)

Lower Ordovician: West-central Vermont, and southern Quebec, Canada.

W. M. Cady, 1945, Geol. Soc. America Bull., v. 56, no. 5, p. 524, 550–552. Bright, orange-buff-weathering dolomite in beds 1 or 2 feet thick interbedded with snow-white marbly limestone. Near base, rock is duller buff or gray and less dolomitic, marble beds are less abundant, and mottled blue-gray limestones are the interbeds. Includes Weybridge member (new). Maximum thickness 600 to 700 feet. Underlies Middlebury limestone (new); overlies Crown Point limestone. Inasmuch as Day Point beds thin or pinch out, north of west-central Vermont, and inasmuch as the Valcour undergoes considerable change in lithology and obliteration of fossils eastward from Lake Champlain, Crown Point limestone is only term used along Lake Champlain appropriate in eastern area. Terms Beldens formation, Weybridge member of Beldens, and Middlebury limestone are here applied to beds probably mainly equivalent to the Valcour. Middle Ordovician (Chazyan).

Marshall Kay, 1945, (abs.) Geol. Soc. America Bull., v. 56, no. 12, pt. 2, p. 1172. In Highgate Springs sequence, the Beldens, about 500 feet thick, underlies Carman quartzite (new). Oldest exposed formation. Chazy.

Marshall Kay and W. M. Cary, 1947, Science, v. 105, no. 2736, p. 601. Included in Chipman group (new). Overlies Burchards limestone (new).

Marshall Kay, 1950, (abs.) Geol. Soc. America Bull., v. 61, no. 12, pt. 2, p. 1476. Beldens calcite marble of Middlebury synclinorium, west-central Vermont, has been classed as upper Chazyan because it succeeds *Maclurites*-bearing beds, recently called Burchards, long thought to be middle Chazy Crown Point. The Beldens in Middlebury synclinorium underlies Middlebury slaty argillicalcilutite; in Highgate Springs sequence to northwest, the Beldens is separated by succeeding Carman quartzite from Youngman slate in Vermont, and near St. Dominique, Quebec, the Beldens and Carman underlie calcarenites like those in the Day Point. The Beldens is interpreted as a calcitic facies of Bridport dolomite and of the upper Canadian series; the two facies are continuous in outcrop in Cornwall and Shoreham, and each has interbeds of the dominant lithology of the other; Weybridge quartz-silty facies of Beldens in Middlebury synclinorium has such genera as *Goniotelus* and *Syntrophia* in Orwell, Cornwall, and Weybridge, supporting late Canadian classification. Bridport is uppermost part of Beekmantown.

Marshall Kay, 1958, Am. Jour. Sci., v. 256, no. 2, p. 65–96. Described in detail in Highgate Springs slice that extends from north of St. Dominique, Bagot County, Quebec, to northwestern Chittenden County, Vt., a distance of about 90 miles. Best sections of Beldens are (1) in lowland northwest of escarpment west of St. Dominque, one-half mile north of highway; (2) in hill south of Highway 104, one-half mile east of Swanton, Vt.; (3) west of road to Tuller School, one-half mile northeast of St. Albans Bay village, Vermont; and (4) on Mill River south of St. Albans Bay. The sections near St. Albans expose contact with younger Carman quartzite. Most striking feature about Beldens in Highgate slice is that it is persistent throughout belt of exposure, yet in no place has underlying Burchards been definitely recognized, yet the Beldens commonly lies directly beneath Lower Cambrian rocks of Rosenberg slice, as well displayed in Fonda quarry. Canadian. Ordovician classification discussed.

W. M. Cady and E-an Zen. 1960, Am. Jour. Sci., v. 258, no. 10, p. 728–739. Rank reduced to member status in the Chipman, herein reduced to rank of formation. Lower Ordovician (Beekmantown). [See Chipman formation, this reference.]

Named for exposures southeast of Beldens and west of highway north from Middlebury, Addison County, Vt.

Belfast Bed[1]

Upper Ordovician(?): Southwestern Ohio.

Original reference: A. F. Foerste, 1896, Cincinnati Soc. Nat. History Jour. v. 18, p. 161, 189, 190.

Named for Belfast, Highland County.

†Belfast Beds[1]

Mississippian: Southeastern Iowa.

Original reference: F. M. Van Tuyl, 1925, Iowa Geol. Survey, v. 30, p. 43, 47, 214.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 812. Name Belfast has been proposed for Salem formation in Iowa. [Van Tuyl's proposal referred to representatives of Spergen limestone.]

Named for exposures near town of Belfast, Lee County.

Belgium Member[1] (of Lake Church Formation)

Devonian: Southeastern Wisconsin.

Original reference: G. O. Raasch, 1935, Kansas Geol. Soc. Rept. 9th Ann. Field Conf., p. 260, 262, 263.

Probably named for town in Ozaukee County.

Belknap Flows, Tuff

Recent: Southwestern Oregon.

Howel Williams, 1944, California Univ. Pub., Dept. Geol. Sci. Bull. 27, no. 3, p. 56, 62, pl. 10. Discussion of volcanoes of Three Sisters region. Name Belknap is applied to flow that issued from Belknap Crater.

Belknap Crater is south of Mount Washington and west of Little Belknap Crater.

Belknap Limestone Member (of Thrifty Formation)

Belknap Limestone Member (of Harpersville Formation)[1]

Upper Pennsylvanian: Central northern Texas.

Original reference: F. B. Plummer and R. C. Moore, 1922, Jour. Geology, v. 30, p. 24, 31, 39.

U.S. Geological Survey currently classifies the Belknap as a member of the Thrifty Formation. Term Harpersville is abandoned.

Named for old Fort Belknap, Young County. Typical exposures are in vicinity of Newcastle.

Belknap Syenite[1]

Devonian or Carboniferous: East-central New Hampshire.

David Modell, 1936, Geol. Soc. America Bull., v. 47, no. 12, p. 1903–1904, pl. 1. Typically coarse-grained aggregate of feldspar and hornblende without visible quartz. Fracture of rock rough and hackly. Intrudes older schists of the area. Angular blocks occur as inclusions in Sawyer quartz syenite. Contact with Albany syenite shows latter chilled against the Belknap. Assigned to White Mountain magma series.

Type locality: Elliptical body occurring on Belknap and Gunstock Mountains in the Belknap Range.

Belkofski Tuff

Tertiary, upper: Southwestern Alaska.

G. C. Kennedy and H. H. Waldron, 1947, U.S. Geol. Survey Alaskan Volcano Inv. Rept. 2, p. 12, pl. 2; 1955, U.S. Geol. Survey Bull. 1028–A, p. 6–7, pl. 3. Thick series of well-bedded tuff composed largely of fine to coarse lithic tuff, ranging in color from green to purple to gray. Beds have been intensely silicified and sericitized in vicinity of diorite stocks that intrude them. Beds are gently undulating with average dips of 5° to 10°. Plant fossils, principally silicified and carbonized trunks of trees and impressions of conifer needles, present in lower part of formation beds 1 to 5 centimeters thick of silicified and carbonized plant remains present. Thickness more than 3,000 feet. Unit cut by stocks of quartz diorite, by basaltic plugs and necks, by thick sills of andesite, and by smaller sills and dikes of basalt and andesite. Conformably overlies nonfossiliferous beds of green arkose; lava flow units —Black Point basalt, Arch Point basalt, and Dushkin basalt (all new) —fill canyons and gullies carved in tuff and intrusive diorite stocks; probably comparable in age to Cathedral Valley agglomerate (new). Evidence indicates a post-Eocene, pre-Pleistocene age; tentatively assigned to late Tertiary.

Beds crop out principally around Belkofski Bay and on Belkofski Point, vicinity of Pavlof Volcano, Alaska Peninsula.

Bell Shale[1] (in Traverse Group)

Middle Devonian: Northeastern Michigan.

Original reference: A. W. Grabau, 1902, Michigan Geol. Survey Rept. 1901, p. 191, 210.

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. 442. Base of Traverse group. Overlies Rogers City limestone (new).

A. S. Warthin, Jr., and G. A. Cooper, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 5, p. 578–580. Underlies Rockport Quarry formation and overlies Rogers City limestone in Thunder Bay area. Thickness 11 feet. Data on Grabau's locality.

Type locality not mentioned by Grabau, but he probably named formation from claypits (now abandoned) near former settlement of Bell. Workings still visible along country road in SE¼ sec. 11, T. 33 N. R. 8 E., Presque Isle County. Bell was situated on False Presque Isle Harbor in sec. 13, T. 33 N., R. 8 E. Bell post office was in SE cor. NE¼ sec. 34, same township.

Bella Shale[1]

Bella Shale Member (of Percha Shale)

Upper Devonian or Lower Mississippian: Southwestern New Mexico.

Original reference: C. R. Keyes, 1908, Am. Inst. Mining Engineers Bi-Monthly Bull. 19, p. 7-21.

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 upper member of Percha shale. Upper part of Percha also termed Box member by Stevenson (1944). There is little doubt that the Bella and Box were proposed for identical divisions of Percha, and there is little reason to replace earlier name. Percha of early Mississippian age.

Named for Bella mine, near Lake Valley, Sierra County.

Bellaire Sandstone (in Conemaugh Formation)[1]

Bellaire sandstone and shale member

Pennsylvanian: Eastern Ohio.

Original reference: D. D. Condit, 1912, Ohio Geol. Survey, 4th ser., Bull. 17, p. 20, 22.

D. L. Norling, 1958, Ohio. Geol. Survey Bull. 56, p. 62–63. Bellaire sandstone well represented in Morgan County [this report]. Occurs between Upper and Lower Little Pittsburgh coals when those thin beds are present. In absence of nonpersistent coaly streaks, Bellaire comprises interval between Lower Pittsburgh and Upper Pittsburgh limestone. Thickness of Bellaire member 10 to 20 feet. Strata consist of tan to buff fine- to medium-grained thin platy bedded sandstone which varies in amount of included sandy shales. Conemaugh series.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 156. Condit (1912) named a sandstone closely underlying the Pittsburgh coal Bellaire for city of Bellaire, Ohio. He stated in same description that it [Bellaire] "is also prominent in Pennsylvania where it has been called Lower Pittsburgh sandstone." Stout (in Brownocker and Dean, 1929, Ohio Geol, Survey Bull. 34) placed the Bellaire 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 Bellaire sandstone, then Stout's correlation of Bellaire sandstone is in error as indicated by Condit's original definition.

Named for Bellaire, Belmont County.

Bell Canyon Formation (in Delaware Mountain Group)

Permian (Guadalupe Series): Western Texas and southern New Mexico.

P. B. King, 1940, *in* R. K. DeFord and E. R. Lloyd, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 4 (fig. 2), 8. Shown on correlation chart as uppermost formation in group. Occurs above Cherry Canyon formation (new).

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 581–586, pl. 2. Consists of sandstones and interbedded limestones. Thickness about 700 feet. Includes (ascending) Hegler limestone, Pinery limestone, Rader limestone. and Lamar limestone members. Conformably underlies anhydrites and limestones of Castile formation; overlies Cherry Canyon formation. Grades northwestward into Capitan limestone.

P. B. King, 1948, U.S. Geol. Survey Prof. Paper 215, p. 53–59, pl. 3 [1949]. In southern part of Guadalupe Mountains, the Bell Canyon is 670 to 1,040 feet thick and consists of sandstone with some thin dark-gray limestone beds. In northern Guadalupe Mountains, grades into Capitan limestone; here it is 1,500 to 2,000 feet thick. Hegler, Pinery, and

Rader members are closely spaced in lower fourth of formation, and are separated by several hundred feet of sandstone from Lamar member; about half way between Rader and Lamar member is an unnamed "flaggy limestone bed."

N. D. Newell and others, 1953, The Permian reef complex of the Guadalupe Mountains region, Texas and New Mexico: San Francisco, W. H. Freeman and Co., p. 15, 53. Includes McCombs limestone member (new) between Lamar limestone member above and Rader limestone member below.

Named for Bell Canyon, a gorge that drains eastward from Rader Ridge to old route of U.S. Highway 62, where it joins Lamar Canyon, Culberson County, Tex. Crops out in broad belt between crest of Delaware Mountains and Gypsum Plain on the east; lower part extends into Guadalupe Mountains, or into reef zone at margin of Delaware basin.

Belle City Limestone[1]

Pennsylvanian (Missouri Series): Central Oklahoma.

Original reference: G. D. Morgan, 1924, [Oklahoma] Bur. Geology Bull. 2, p. 123–125, pls. 3, 27, map.

W. F. Tanner, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 8, p. 2047 (fig. 2), 2048 (fig. 3). Underlies Hilltop formation (new); overlies Nellie Bly formation or Francis formation.

W. F. Tanner, 1956, Oklahoma Geol. Survey Bull. 74, p. 78–84, pls. 1, 2. In Seminole County, consists of upper and lower limestones separated by a dark shale. Maximum thickness 36 feet, thins northward. In central part of county, lies conformably between Nellie Bly and Hilltop formations; in southern part, the Vamoosa locally rests unconformably on the Belle City, which in turn is conformable with underlying Nellie Bly; between Belle City and Vamoosa are isolated outliers of red or blue shale which probably belong to Hilltop. In Pontotoc County, to the south, the Belle City is truncated by Ada formation. Type locality stated.

Type locality: Village of Belle City, SW¼ sec. 35, T. 8 N., R. 7 E., Seminole County.

Bellefonte Dolomite (in Beekmantown Group)[1]

Lower Ordovician: Central Pennsylvania and northern Virginia.

Original reference: E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, p. 552, 553, 652–660, pl. 27.

B. N. Cooper, 1939, Virginia Geol. Survey Bull. 55, p. 20–22, pls. 1, 3. Present locally in Draper Mountain area, Virginia. Maximum thickness less than 50 feet. Conformably overlies Draper dolomite member (new) of Nittany formation; unconformably underlies Mosheim limestone of Stones River group. Canadian. [Term Beekmantown not used in this report.]

Charles Butts, 1945, U.S. Geol. Survey Geol. Atlas, Folio 227. Bellefonte dolomite includes all dolomite above Axemann limestone and below Carlim limestone in Hollidaysburg-Huntingdon quadrangles. Thickness about 1,000 feet south of Roaring Spring; about 1,250 feet east of Williamsburg. Beekmantown group.

H. P. Woodward, 1951, West Virginia Geol. Survey, v. 21, p. 72, 74–76. Term Bellefonte tentatively applied to upper member of Beekmantown.

Application of term Bellefonte here does not necessarily imply precise correlation with Bellefonte of central Pennsylvania. Term Beekmantown used as both formation and group.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Uppermost formation in Beekmantown group.

Named for exposures at Bellefonte, Centre County, Pa.

Belle Fourche Shale

Belle Fourche Shale Member (of Cody Shale or Colorado Shale)

Belle Fourche Shale Member (of Graneros Shale)[1]

Upper Cretaceous: Wyoming, Montana, North Dakota, and South Dakota.

Original reference: A. J. Collier, 1920, U.S. Geol. Survey Press Bull. 9065.

J. B. Reeside, Jr., 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 10. Shown on correlation chart as Belle Fourche shale; occurs above Mowry shale and below Greenhorn limestone.

B. C. Petsch, 1949, South Dakota Geol. Survey Rept. Inv. 65, p. 8, 9–10. Belle Fourche shale member is uppermost part of Graneros. Estimated thickness 580 feet. Includes Orman Lake limestone (new) near middle. Overlies Mowry shale member; underlies Greenhorn formation.

W. A. Cobban, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 10, p. 2197. Formations in Black Hills that are equivalent in Colorado shale are Fall River sandstone, Skull Creek shale, Newcastle sandstone, Mowry shale, Belle Fourche shale, Greenhorn formation, Carlile shale, and Niobrara formation. Belle Fourche shale of northern Black Hills consists of 565 feet of dark bluish shale, with many beds of bentonite and ferruginous concretions. In central Montana, it is represented by 240 to more than 315 feet of similar beds in middle of Colorado shale. Westward these beds become increasingly sandier and much thinner, and on west flank of Sweetgrass arch as little as 13 feet of sandy shale is of Belle Fourche age.

M. M. Knechtel and S. H. Patterson, 1956, U.S. Geol. Survey Bull. 1023, p. 12 (fig. 3), 17–21, pls. 1, 2. Basal member of Cody shale in Hardin district, Montana and Wyoming. Underlies Greenhorn member; overlies Mowry shale. Thickness about 482 feet. Includes Soap Creek bentonite bed in upper half. Rocks of this interval have, in part, been designated Frontier formation in publications dealing with this district (Thom and others, 1953; Richards and Rogers, 1951; Knechtel and Patterson, 1952).

U.S. Geological Survey currently classifies the Belle Fourche as a member of the Colorado Shale in Montana on the basis of a study now in progress.

Named for exposure along Belle Fourche River in vicinity of Wind Creek, Crook County, Wyo.

Belle Plains Formation (in Wichita Group)[1]

Belle Plains Group

Permian: Central and central northern Texas.

Original reference: F. B. Plummer and R. C. Moore, 1922, Texas Univ. Bull. 2132, p. 192–198, charts.

M. G. Cheney, 1904, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 93. Rank raised to group and expanded below to include Elm Creek limestone and Jim Ned shale (new), which strata had been included in the Admiral herein given group status and stratigraphically restricted above. As redefined, the Belle Plains includes (ascending) Jim Ned Shale, Elm Creek limestone, Jagger Bend limestone, Valera shale and anhydrite, and Bead Mountain limestone. Underlies Clyde group.

R. C. Moore, 1948, *in* M. G. Cheney, Abilene Geol. Soc. [Guidebook] Spring Field Trip, June 11–12, sheets 3, 4. Formation further subdivided to include Voss shale member between Jagger Bend limestone member above and the Elm Creek limestone member below.

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. Consists mainly of gray limestone beds, 1 to 5 feet thick, separated by shale or marl in beds of comparable thickness. Near Colorado River is 400 feet thick. Includes (ascending) Jim Ned shale, Elm Creek limestone, Voss shale, Jagger Bend limestone, Valera shale, and Bead Mountain limestone members. Overlies Admiral formation; underlies Grape Creek member of Clyde formation; boundary somewhat arbitrarily defined.

P. T. Stafford, 1960, U.S. Geol. Survey Bull. 1081–G, p. 272–274, pls. 11, 12. Formation described in Brazos River area where it is 525 to 640 feet thick. Consists of six members as listed by Moore (1949). Overlies Admiral formation; underlies Clyde formation.

Named for town of Belle Plains, Callahan County.

Bellepoint 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. 298, 365.

Type locality: In vicinity of Bellepoint, Summers County, and well exposed on Keeney Mountain road east of Hinton.

Bellepoint Member (of Columbus Limestone)[1]

Middle Devonian: 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). Shown on generalized section of Franklin and Delaware Counties as underlying Ebersole chert member or Marblehead member where the Eversole is absent; overlies Bass Island.

Named for Bellepoint, Delaware County.

Bellepoint 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. 297–298, 360–368.

Type locality: In bluffs of New and Greenbrier Rivers near Bellepoint, Summers County; also seen in Mercer County.

Bellepoint 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. 297–298, 362–371.

Type locality: In road which ascends Wolf Creek Mountain just southeast of Bellepoint; also observed in Giles and Tazewell Counties, Va.

Belleville Formation[1]

Pleistocene: Central northern Kansas.

Original reference: M. E. Wing, 1930, Kansas Geol. Survey Bull. 15, p. 12, 19.

V. C. Fishel, 1948, Kansas Geol. Survey Bull. 73, p. 89–95. Does not agree with Lugn's (1934) proposal to abandon name in favor of Grand Island formation. Name Belleville is retained in this report to designate stream-deposited sand and gravel in Republican that occurs in and near channel of ancestral Republican River and below loess. Overlies Greenhorn limestone. Pleistocene.

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 110. Used by Wing (1930) for beds which are now, at least in part, Sanborn formation.

Probably named for occurrence near Belleville, Republic County, Kans.

Bellevue Limestone Member (of McMillan Formation)[1]

Bellevue Formation (in Maysville Group)

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

Original reference: J. M. Nickles, 1902, Cincinnati Soc. Nat. History Jour., v. 20, p. 82.

J. B. Patton, T. G. Perry, and W. J. Wayne, 1953, Indiana Geol. Survey Field Conf. Guidebook 6, pl. 1. Shown on chart of Ordovician rocks exposed in Jefferson and Switzerland Counties as Bellevue formation. Blue to dark-gray irregularly bedded rubbly highly argillaceous limestone; contains clay partings and fossils. Thickness 25 to 35 feet. Underlies Corryville formation; overlies Fairmount formation.

Named for old Bellevue House, a landmark, now disappeared, at bend in Clifton Avenue, Cincinnati, Ohio.

Bell Hill Dolomite

Middle Silurian: Northwestern Utah.

F. W. Osterwald, 1953, U.S. Geol. Survey Trace Elements Inv. Rept. TEI-330, p. 105; M. H. Staatz and F. W. Osterwald, 1959, U.S. Geol. Survey Bull. 1069, p. 19 (fig. 2), 23–25, pl. 1. Made up of two members: lower eight-ninths is dark-gray coarse-grained clastic dolomite; upper one-ninth is light-gray fine-grained dolomite. In northern part of Spor Mountain, a 28-foot-thick dolomite bed with distinctive contorted, convoluted appearance occurs approximately 40 feet from top of unit. Thickness 395 to 430 feet. Overlies Floride dolomite and underlies Harrisite dolomite (both new).

Type section: On steep mountainside one-half mile north of Floride mine, NE¼ sec. 3, T. 13 S., R. 12 W., Juab County. Named for Bell Hill mine on southern end of Spor Mountain.

Bellingham Beds[1]

Eocene: Northwestern Washington.

Original reference: L. G. Hertlein and C. H. Crickmay, 1925, Am. Philos. Soc. Proc., v. 64, no. 2, p. 225–226.

Bellingham Bay region.

Bellingham Conglomerate[1]

Pennsylvanian: Southeastern Massachusetts and northeastern Rhode Island.

Original reference: G. R. Mansfield, 1906, Harvard Coll. Mus. Comp. Zool. Bull., v. 49, geol. ser., v. 8, no. 4, p. 99.

G. M. Richmond, 1951, *in* G. M. Richmond and W. B. Allen, Rhode Island Port and Indus. Devel. Comm. Geol. Bull. 5, p. 15–16, pl. 1. Described in two small structural basins in Georgiaville quadrangle, Rhode Island. Unconformably overlies Absalona and Woonasquatucket formations (both new) and Blackstone series. Age considered Carboniferous and probably Pennsylvanian.

Outcrop area extends from near North Bellingham, Mass., southward into Rhode Island.

Bellisle 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, 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. Bellisle Mountain is fourth in known sequence; younger than Mud Hill and older than Robinson Mountain. Consists of single flow 15 to 20 feet thick and with well-developed platy structure.

Bellisle Mountain is small volcanic peak 10 miles west of Union County on Johnson Mesa in northeastern Colfax County.

Bell Mountain Quartz Diorite

Late Paleozoic or Mesozoic: Southern California.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 504. Cuts Paleozoic metasediments and is intruded by Victorville quartz monzonite.

Occurs in several parts of Victorville area, San Bernardino County.

†Bell Mountain Sandstone Member (of Miguel Formation)[1]

Upper Cretaceous: Southwestern New Mexico.

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

C. H. Dane, A. A. Wanek, and J. B. Reeside, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 2, p. 187. Abandoned because unit that was so named is merely an upfaulted duplication of Gallego sandstone member of Gallup sandstone.

Well exposed near foot of Bell Mountain, T. 3 N., R. 9 W., Socorro County.

Bellows Falls Granite Gneiss[1]

Post-Ordovician: Southeastern Vermont and southwestern New Hampshire.

Original reference: E. Hitchcock, 1823, Am. Jour. Sci., 1st, v. 6, p. 11–12, map dated 1822.

Extends from village of Bellows Falls, Vt., south into Westminster and east across Connecticut River into Walpole, N.H.

†Bellowspipe Formation[1]

Ordovician: Northwestern Massachusetts.

Original reference: T. N. Dale, 1894, U.S. Geol. Survey 14th Ann. Rept., pt. 2, p. 559, 562.

On Mount Greylock, Berkshire County.

Bellowspipe Limestone[1]

Ordovician: Northwestern Massachusetts.

Original reference: T. N. Dale, 1891, Am. Geologist, v. 8, p. 1–7.

Norman Herz, 1958, U.S. Geol. Survey Geol. Quad. Map GQ–108. Most previous authors have drawn upper contact of Berkshire schist below Bellowspipe limestone but validity of this limestone as a formation is questionable. Within Cheshire quadrangle [this report], Bellowspipe limestone grades into rocks, both above and below, that are clearly Berkshire schist. Furthermore its eastern and western areas of outcrops differ lithologically and are at different stratigraphic horizons, so they cannot be traced into each other.

Named for occurrence at the "Bellows Pipe," in notch between Ragged Mountain and Greylock.

†Bellowspipe Quartzite[1]

Ordovician: Southwestern Massachusetts.

Original reference: T. N. Dale, 1894, U.S. Geol. Survey 14th Ann. Rept., pt. 2, p. 559, pl. 71.

In Monument Mountain, in southwest part of Berkshire County.

Bell Ranch Formation (in San Rafael Group)

Upper Jurassic: Northeastern New Mexico.

R. L. Griggs and C. B. Read, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 2006, fig. 2. Alternating sequence of light-gray sandstone and brownish-red siltstone beds. The alternating, parallel beds are 2 to 10 feet thick, in sharp contrast to massive Entrada sandstone below and poorly bedded Morrison formation above. Small nodules of gypsum present in uppermost bed of siltstone in northeastern part of area, and in vicinity of Colorado line, thin beds of gypsum found within beds of siltstone. Thickness 66 feet at type locality; ranges from 0 to about 65 feet in the area. Formerly called Wanakah formation in this area.

Type section: At Carpenter's Point, 18 miles southeast of Bell Ranch headquarters and 13 miles northwest of Tucumcari. Named from Bell Ranch and proposed that name be used in Tucumcari-Sabinoso area and in northeastern New Mexico.

Bells Landing Marl Member (of Tuscahoma Sand)[1]

Eocene, lower: Southwestern Alabama.

Original reference: E. A. Smith, 1883, Alabama Geol. Survey Prog. Rept. for 1881–82, p. 256, 321.

L. D. Toulmin, P. E. LaMoreaux, and C. R. Lanphere, 1951, Alabama Geol. Survey Spec. Rept. 21, p. 65, pl. 3. Described in Choctaw County where it lies about 25 feet above the Greggs Landing marl member and about 120 feet below Bashi marl member of Hatchetigbee formation.

Named for exposures at Bells Landing, on Alabama River, in Monroe County.

†Bells Landing Series[1]

Eocene, lower: Southwestern Alabama.

Original reference: E. A. Smith and L. C. Johnson, 1887, U.S. Geol. Survey Bull. 43, p. 46–51.

Named for exposures at Bells Landing, on Alabama River, in Monroe County.

Bellton coal group (in Greene and Washington Formations)[1]

Permian: Northern West Virginia and southwestern Pennsylvania.

Original reference: I. C. White, 1891, U.S. Geol. Survey Bull. 65, p. 32, 34.

Named for Bellton, Marshall County, W. Va.

Bell Top Formation

Miocene: Southwestern New Mexico.

F. E. Kottlowski, 1953, New Mexico Geol. Soc. Guidebook 4th Field Conf., p. 145, 148 (chart). Consists of pumice, soft pinkish rhyolite tuffs, vitrophyre flows and dikes, banded rhyolite flows and domes interbedded with light-colored pumiceous and tuffaceous sand and sandstone, and a few lenses of stream gravel. Thickness more than 800 feet. Underlies Uvas basalt (new); overlies unnamed rhyolite.

Exposed in Las Cruces region of Rio Grande Valley.

Bellvale Flags[1]

Bellvale Sandstone[1]

Bellvale Sandstone Member (of Marcellus Formation)

Middle Devonian: Southeastern New York and northern New Jersey.

Original reference: N. H. Darton, 1894, Geol. Soc. America Bull., v. 5, p. 367, 373.

Bradford Willard, 1937, Am. Jour. Sci., 5th ser., v. 33, no. 196, p. 271, 272. In proposed stratigraphic nomenclature for Green Pond Mountain area, New Jersey, Bellvale sandstone is considered member of Marcellus formation. Overlies Cornwall shale member of Onondaga formation; passes gradually upward into continental Skunnemunk conglomerate.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1794, chart 4. Bellvale sandstone shown on correlation chart below Skunnemunk conglomerate and separated from underlying Cornwall shale by a unit termed Bakoven(?)

Name derived from Bellvale Mountain, Orange County, N.Y.

Bell Valley Andesite (in Garren Group)

Tertiary: Western Texas.

Hugh Hay-Roe, 1957, Texas Univ. Bur. Econ. Geology Geol. Quad Map 21. Name proposed for a thick sequence of dark-gray olivine andesite flows. Maximum exposed thickness 610 feet on Chipsa Mountain. Youngest volcanic formation in area.

R. K. DeFord and others, 1958, Soc. Econ. Paleontologists and Mineralogists, Permian Basin Sec., Guidebook Apr. 10, 11, 12, p. 31 (fig. 14). Generalized columnar section shows Bell Valley andesite above Means trachyte.

Type section: North side of Chipsa Mountain, Wylie Mountains area, Jeff Davis County. Name derived from Bell Valley on north side of Chipsa Mountain.

Bellwood Dolomite

Silurian (Niagaran): Northeastern Illinois.

T. E. Savage *in* C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, p. 536, chart 3. Proposed for beds formerly called Waukesha dolomite in northeastern Illinois. Underlies Racine dolomite; overlies Joliet dolomite (restricted).

H. B. Willman, 1943, Illinois Geol. Survey Rept. Inv. 90, p. 29. Term Bellwood as used by Savage (1942) includes strata herein considered Waukesha and Racine.

Well exposed in vicinity of Bellwood, Cook County.

Belmont 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, 143–145.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 127–128, pl. 1. Facies nomenclature discussed. Correlation chart lists Belmont facies of Locust Point formation.

Name derived from village of Belmont situated on State Highway 46, 1 mile east of Monroe-Brown County line, SW¼SW¼ sec. 6, T. 8 N., R. 2 E.

Belmont Fanglomerate

Pliocene(?): Northeastern Nevada.

T. E. Eakin, 1960, Nevada Dept. Conserv. Nat. Resources Rept. 1, p. 26. Chiefly unbedded gravel and fanglomerate. Unconformable above Lake Newark formation (new); unconformable below alluvium. Name credited to F. L. Humphrey (in press).

F. L. Humphrey, 1960, Nevada Bur. Mines Bull. 57, p. 46, pl. 1. Formal proposal of name. Composed of unsorted and generally massive limestone, sand and pebbles, chert pebbles, and locally quartzite and granitic debris. Drill hole near Monte Cristo penetrated 1,200 feet of gravel without encountering bedrock. Upper formational contact arbitrarily placed because no clearly defined boundary between fanglomerate and recent alluvium and reworked gravels was recognized. Overlies Lake Newark formation (new) or bedded gravels which possibly correlate with Lampson formation (new).

Name derived from Belmont Canyon, White Pine mining district, White Pine County.

Belmont Porphyry[1]

Tertiary, upper(?): Central western Montana.

Original reference: J. Barrell, 1907, U.S. Geol. Survey Prof. Paper 57.

Mapped on and around Mount Belmont, 1 mile west of Marysville, Lewis and Clark County.

Beloit Dolomite[1]

Middle Ordovician: Eastern Wisconsin and northeastern Illinois.

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

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 113. Listed among upper Mississippi Valley formations not in general use.

A. F. Agnew and others, 1956, U.S. Geol. Survey Prof. Paper 274–K, p. 262–264. In eastern part of zinc-lead 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.

Named for exposures at Beloit, Wis.

Belridge Diatomite

Miocene, upper: Southern California.

S. S. Siegfus, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 1, p. 25. Name applied to diatomite facies that has not been clearly differentiated from typical Reef Ridge shale lithology into which it grades laterally.

Umberto Young, 1943, California Div. Mines Bull. 118, pt. 3, p. 523–524. Consists largely of both massive and bedded white punky diatomaceous shale which weathers to a yellowish gray and is interbedded with thin lenses of white quartz sand; also occasional interbeds of dark-grayish brown siltstone and some sandstone and conglomerate reefs. Thickness about 1,200 feet. Unconformably underlies Etchegoin formation; overlies McLure shale.

Occurs in Midway-Sunset area in San Joaquin Valley.

Belt Series[1]

Precambrian: Montana, Idaho, and Washington, and British Columbia, Canada.

Original reference: A. C. Peale, 1893, U.S. Geol. Survey Bull. 110, p. 15–20.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc. America Bull., v. 48, no. 12, p. 1873–1970. Belt series, within its northern basin, is divisible into facies that differ in lithology, stratigraphic sequence, thickness, recorded conditions of deposition, fauna, and flora. Of these facies, following are herein defined: Meagher, Blackfoot Canyon, Glacier Park, Galton, Purcell, and Coeur d'Alene. Comprises (ascending) Ravalli, Piegan (new), and Missoula groups. Following formations described: Altyn, Appekunny, Grinnell, Siyeh, Spokane, and Miller Peak.

Charles Deiss, 1943, Geol. Soc. American Bull., v. 54, no. 2 ,p. 211–218. In Saypo quadrangle, Montana, only upper Belt rocks are exposed. Series divided into (ascending) Miller Peak argillite, Cayuse formation (new), Hoadley formation (new), and Ahorn quartzite (new). Formations are equivalent in age to lower and middle part of Missoula group of Clapp and Deiss (1931).

C. P. Ross, 1947, Geol. Soc. America Bull., v. 58, no. 12, pt. 1, p. 1096–1099. In Borah Peak quadrangle, Idaho, Belt series subdivided into (ascending) Lemhi and Swauger quartzites (both new).

Russell Gibson, 1948, U.S. Geol. Survey Bull. 956, p. 8–19, pl. 1. Thickness 40,000 feet in Libby quadrangle, Montana. Comprises five formations (ascending): Prichard, Ravalli, Wallace, Striped Peak, and Libby (new). Prichard, Wallace, and Striped Peak correlated with formations of same name in Coeur d'Alene district; the Ravalli correlated with Burke formation, Revett quartzite, and St. Regis formation of that district.

C. P. Ross, 1949, (abs.) Washington Acad. Sci. Jour., v. 39, no. 3, p. 111–113. Proposed to include lower part of Belt series in Ravalli group with exception of Prichard formation and Neihart quartzite, the middle part in the Piegan group, and upper part in Missoula group. Name North Boulder group proposed for hitherto unnamed components of Belt series in isolated exposures near Jefferson River, southeast of Butte. Relations between North Boulder group and units farther north are not clear. The North Boulder may be equivalent in age to some part of Missoula group or to part of that group and part of Piegan group.

C. P. Ross, 1959, U.S. Geol. Survey Prof. Paper 296, p. 16–57, pls. 1, 2. Discussion of Belt series in Glacier National Park and Flathead region, Montana. Terms Ravalli, Piegan, and Missoula groups are used but their limits are redefined. Table compares present terminology with that used by Fenton and Fenton (1937).

W. H. Nelson and J. P. Dobell, 1959, U.S. Geol. Survey Misc. Geol. Inv. Map I–296. Belt series, in Bonner quadrangle, Montana, comprises (ascending) Piegan group with Newland limestone, and Missoula group consisting of (ascending) Miller Peak argillite, Bonner quartzite (new), McNamara argillite, Garnet Range quartzite, and Pilcher quartzite (new).

A. B. Campbell, 1960, U.S. Geol. Survey Bull. 1082–I, p. 551–569, pl. 28. St. Regis-Superior area, Mineral County, Mont., is underlain by about 50,000 feet of metasedimentary rocks of Belt series. Lower part of Belt series is divided into (ascending) Prichard, Burke, Revett, St. Regis, and Wallace formations; upper part, or Missoula group, is divided into (ascending) Spruce, Lupine, Sloway, and Bourchard formations (all new), and an unnamed feldspathic quartzite.

Name derived from extensive development in Big Belt and Little Belt Mountains of central Montana.

Belton Sand (in Chanute Formation)

Pennsylvanian (Missouri Series): Northwestern Missouri.

J. R. Clair, 1943, Missouri Geol. Survey and Water Resources, 2d ser., v. 27, p. 20–25, pl. 1. Consists of main lens, elongated in general northeast-southwest direction and three smaller disconnected lenses, at about same horizon, which have slightly different alignment. Total area about 8 square miles. Stratigraphically replaces Westerville limestone of Kansas City group and all or parts of shale above and below this horizon in area where it is present. Varies from 0 to 34 feet in thickness and occurs at depth of 59 to 152 feet below surface in wells.

Present under all or parts of secs. 1, 2, 3, 4, 7, 8, 9, 10, 11, 12, 13, 14, 16, 17, 19, 20, and 30, T. 46 N., R. 33 W., Cass County. Derivation of name not stated but town of Belton lies in this area.

Belva Shale[1]

Pennsylvanian: Western Arkansas.

Original reference: A. Winslow, 1896, New York Acad. Sci. Trans., v. 15, p. 51.

Probably named for Belva, Scott County.

†Belvidere Shale[1] (in Dakota Group)

Lower Cretaceous (Comanche Series): Central southern Kansas.

Original reference: R. T. Hill, 1859, Am. Jour. Sci., 3d, v. 50, p. 208–234.

R. C. Moore, 1935, Rock formations of Kansas *in* Kansas Geol. Soc.; Wichita [Am. Assoc. Petroleum Geologists 20th Ann. Mtg., Mar. 21-23]. Underlies Ellsworth formation (new); overlies Cheyenne sandstone. Comprises (ascending) Kiowa shale, Marquette sandstone, and Mentor sandstone member. Dakota group.

R. C. Moore and K. K. Landés, 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. 154. Kiowa shale as herein defined probably contains stratigraphic units formely called "Greenleaf sandstone," "Mentor beds," and others, and is in part equivalent to "Belvidere formation," "Medicine bed," "Elk River beds," and others.

Named for Belvidere, Kiowa County.

Belvidere Mountain Amphibolite[1] (in Camels Hump Group)

Cambrian: Northwestern Vermont.

Original reference: S. B. Keith and G. W. Bain, 1932, Econ. Geology, v. 27, no. 2, p. 173–174.

A. L. Albee, 1957, U.S. Geol. Survey Geol. Quad. Map GQ–102. Very coarse-grained amphibolite with large blades of dark-green hornblende, porphyroblasts of dark-red almandite garnet, and segregations of epidote. Assigned to Camels Hump group as upper formation. Maximum thickness about 1,000 feet. Underlies Ottauquechee formation; overlies undivided Camels Hump group. Type locality cited.

Named for exposures on Belvidere Mountain [in Jay Peak quadrangle], 3½ miles north-northwest of The Knob.

Bena Gravels

Miocene, lower and middle: Southern California.

T. W. Dibblee, Jr., and C. W. Chesterman, 1953, California Div. Mines Bull. 168, p. 12 (fig. 2), 38–40, pls. 1, 2, 3. Series of terrestrial gravels of lower and middle Miocene age conformably overlying Walker formation and Ilmon basalt (new) and unconformably underlying Kern River gravels in lower Caliente Canyon. In Cottonwood Canyon (outside mapped area), Bena gravels overlie Freeman-Jewett shale and grade laterally into marine Olcese sandstone and Round Mountain silt. Considered continental facies of lower and middle Miocene marine formations of eastern San Joaquin Valley. Thickness at type locality about 2,500 feet.

Type locality: Hills 3 miles southeast of Bena, Breckenridge Mountain quadrangle, Kern County. Also well exposed from Bena northwestward into Cottonwood Canyon.

Benbolt Limestone or 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. 833–836, 868–871. 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 Benbolt is applied to unit which includes second zone of coarse-grained limestone (zone 10), *Opikina* beds (zone 11), *Chasmatopora* beds (zone 12), and zone of crossbedded limestone (zone 13). Zones 10 and 11 are designated Shannondale limestone member; zones 12 and 13 Burkes Garden limestone member. Maximum thickness 325 feet. Overlies Cliffield formation (new); underlies Gratton limestone (new). Benbolt is probably the same as Butts' Lenoir of certain areas, and, in western Tazewell County and in Burkes Garden, comprises part of Butts' Ottosee.

B. N. Cooper, 1945, Virginia Geol. Survey Bull. 66, p. 138 (fig. 12), 139–140, 141 (fig. 13). In Russell County, overlies Rockdell limestone (new) and underlies Wardell formation.

C. E. Prouty, 1946, Am. Assoc. Petroleum Geologists, v. 30, no. 7, p. 1160–1165. Discussion of lower Middle Ordovician of southwest Virginia and northeast Tennessee. Detailed sections measured along seven belts were compared with revised classification of Tazewell County, Va. The Blackford, Five Oaks, Lincolnshire, Thompson Valley (new), upper Peery, Benbolt, Wardell, Bowen, Witten, and Moccasin formations extend into Tennessee. Benbolt is well developed in St. Paul belt from Narrows, Va., southwest to and beyond Heiskell, Tenn. At Heiskell, Ulrich (1911) assigned name Heiskell, though without definition, to beds which there presumably contain Benbolt and Wardell formations. In absence of Gratton calcilutite, Benbolt and Wardell formations are essentially inseparable lithologically. Where contact between Benbolt and Wardell cannot be accurately drawn, the two should be combined under Sevier formation as defined in this report.

Type section: About 1⅛ miles south of Benbolt, west of Tazewell County Farm. Named after historic homestead in east environs of Tazewell, Va.

Benbrook Limestone Member (of Goodland Formation)

Lower Cretaceous (Comanche Series): Northeastern Texas.

B. F. Perkins, 1957, Dissert. Abs., v. 17, no. 6, p. 1310; 1960, Geol. Soc. America Mem. 83, p. 9 (fig. 3), 12 (fig. 4), 17 (fig. 7), 18 (fig. 8), 19, 20–21. Proposed for upper section of thick limestones and marly limestones of Goodland formation. At type locality, consists of 70 feet of thick limestone and marly limestone units alternating with thinner marls. Overlies Marys Creek member (new); underlies Kiamichi formation.

Type locality: Along Marys Creek on Rowan Ranch, 2.7 miles northwest of town of Benbrook, Tarrant County.

†Bend Formation[1]

Lower and Middle Jurassic: Northern California.

Original reference: J. S. Diller, 1895, U.S. Geol. Survey Geol. Atlas, Folio 15.

R. W. Imlay, 1952, Geol. Soc. America Bull., v. 63, no. 9, p. 976. Abandoned in favor of Potem formation.

Crops out along western arm of Great Bend of Pit River, Gold Belt region.

Bend Group[1]

†Bend (Bendian) Series[1]

Lower and Middle Pennsylvanian: Central Texas.

Original reference: E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept., pl. 3, p. lxv.

N. H. Darton, L. W. Stephenson, and Julia Gardner, 1937, Geologic map of Texas (1:500,000): U.S. Geol. Survey. Group as mapped includes Marble Falls limestone and Smithwick shale.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). 82–83. Marble Falls and Smithwick deposits as seen at outcrop form natural unit structurally that has been referred to as Bend series or Bend group. When studied regionally, including areas where covered by later sediments, these beds are divisible into three lesser groups. In this report, these groups are termed Marble Falls, Big Saline (new), and Smithwick. Big Saline and Smithwick are groups in Lampasas series (new), and Marble Falls is group in Morrow series. Term group has broad meaning and wide application without regard to series boundaries; hence continued use, when needed, of term Bend group does not appear inconsistent with usage of these lesser group names proposed here.

R. C. Spivey and T. G. Roberts, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 2, p. 185–186. Report proposes that term Atoka formation be elevated to Atoka series and defined to include all beds from top of Morrow series to base of Des Moines series. This would include the Marble Falls and Smithwick. Term Atoka is preferred to redefinition of Lampasas series or of older term Bend group or series.

D. A. Zimmerman and G. D. Glover, 1956, Soc. Econ. Paleontologists and Mineralogists, Permian Basin Sec., Spring Mtg. and Field Symposium May 11, 12, p. 70. Bend series, as presently recognized, includes Smithwick formation and Marble Falls, exclusive of that part of Marble Falls which may be of Morrowan age.

R. C. Moore, 1958, Introduction to historical geology: New York, McGraw-Hill Book Co., p. 244 (fig. 10, 11). Diagrammatic section shows the Bendian occupying interval between Morrowan below and Desmoinesian above.

R. C. Moore, ed., 1960, Treatise on invertebrate paleontology, pt. 1, Mollusca 1: Lawrence, Kans., Univ. Kansas Press, p. xxi. List of divisions of geologic column shows Bendian stage in lower part of Oklan series, Middle Pennsylvanian.

Named for exposures at McAnnelly's Bend of Colorado River, San Saba County.

Ben Day Porphyry

Tertiary, lower: Southwestern Texas.

R. L. Ives, 1941, Am. Jour. Sci., v. 239, no. 5, p. 344, 347. Dense grayish porphyry with light-colored glassy-appearing phenocrysts, some of which iridesce like labradorite. Arrangement of phenocrysts in some of the darker porphyries is very regular.

Occurs as sheets, dikes, and necks in Mitre Peak area, which lies across Brewster-Jeff Davis County line, roughly 12 miles northwest of Alpine.

Bendian Period

Post-Chester-pre-Des Moines: Midcontinent.

Original reference (Bend Series): E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept., pl. 3, p. lxv.

B. H. Harlton, 1934, Am. Assoc. Petroleum Geologists Bull., v. 18, no. 8, p. 1018–1049. On basis of paleontological and diastrophic evidence, term Bendian is proposed for new period to include that part of section between Chester group of Mississippian age and Des Moines series of Pennsylvanian age. Bendian period in midcontinent is divided into Lower, Middle, and Upper Bendian. In Ardmore basin, Lower Bendian is represented by basal Springer formation, Middle Bendian by middle and upper Springer formation, and Upper Bendian by lower and middle Dornick Hills formation. These formations are correlated with Hot Springs sandstone, Stanley shale, Jackfork sandstone, and Johns Valley shale, the Bendian representatives in Ouachita Mountains. Carboniferous stratigraphy of Ouachita Mountains is made up of Mississippian part of Arkansas novaculite, Bendian Hot Springs sandstone, Stanley shale, Jackfork sandstone, Johns Valley shale, and Pennsylvanian Atoka formation.

B. H. Harlton, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 7, p. 852–914. Bendian period subdivided into two series, Pushmataha (new) below and Morrow above.

B. H. Harlton, 1959, *in* The geology of the Ouachita Mountains—a symposium: Dallas Tex., Dallas Geol. Soc. and Ardmore Geol. Soc., p. 130–139. Discussion of age classification of upper Pushmataha series in Ouachita Mountains. [Term Bendian period not used in this paper.]

Benevides Formation

Cretaceous (Comanche Series): Southwestern Texas.

D. L. Amsbury, 1957, Dissert. Abs., v. 17, no. 9, p. 1981; 1958, Texas Univ. Bur. Econ. Geology Geol. Quad. Map 22. Lower part dark-gray shales; overlain by yellow-brown skeletal calcarenite that forms prominent cap rock. Thickness 125 to 150 feet. Overlies Finlay limestone; underlies Loma Plata limestone (new).

P. C. Twiss, 1959, Texas Univ. Bur. Econ. Geology Geol. Quad. Map 23. Described in Van Horn Mountains where it is 160 feet thick. Concordantly overlies Finlay limestone and underlies Loma Plata limestone.

Type section: One and one-half miles southwest of Cleveland triangulation station, Pinto Canyon area, Presidio County. Named from Benevides Ranch.

Benezette Limestone Member (of Pocono Formation)[1]

Mississippian: Central northern Pennsylvania.

Original reference: C. A. Ashburner, 1885, Pennsylvania 2d Geol. Survey Rept. R_2, p. 104–105.

Crops out 1 mile west of village of Benezette, Elk County.

Ben Hur 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). Buff-weathering shaly limestone with a few interbeds of purer crystalline limestone. Thickness 127 to 153 feet. Underlies Hardy Creek limestone; overlies Woodway limestone (new). Same as lower unnamed member of Moccasin 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, 56–58. 117, pl. 1. Further described and type section given. Thickness at type locality 125 feet. Discussion of correlation problems and summary of nomenclature of Middle Ordovician formations in Lee and Tazewell Counties.

Type section: Along railroad cut of Louisville and Nashville Railroad 1,000 feet west of railroad station at Ben Hur, Lee County.

Benito Sandstone (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). Green micaceous sandstone 1,100 feet thick. Overlies Redil shale (new); underlies Ciervo shale (new). Name credited to D. W. Sutton (1960, unpub. thesis).

Type locality: Papanatas Canyon, Fresno County. Name derived from Benito Hill, near center south line sec. 32, T. 14 S., R. 11 E.

Benner Group or Formation

Benner Limestone (in Black River Group)

Benner Limestone (in Hunter Group)

Middle Ordovician (Bolarian): Central and south-central Pennsylvania.

G. M. Kay, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1969. Name applied to limestone in Black River group. Includes Stover and Snyder members. Thickness 189 feet in type section.

G. M. Kay, 1944, Jour. Geology. v. 52. no. 1, p. 15–19. Subdivided into Snyder member (lower) and Stover member (upper). Overlies Hostler member of Hatter formation. Underlies Valley View member of Curtin limestone in northwestern outcrops as at Bellefonte; disconformably underlies Nealmont limestone from Union Furnace southeastward as it thins by loss of upper beds. Derivation of name, distribution, and more exact location of type section stated.

Marshall Kay, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. [1402], 1409. Assigned to Hunter group and Hunterian subseries (Bolarian series). Comprises lower and greater part of group.

Marshall Kay, 1956, Geol. Soc. America Bull., v. 67, no. 1, p. 97, 102. Rank raised to a group; term replaces Hunter group for application to upper Bolarian series.

Carlyle Gray, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Mapped as Benner formation.

Type section: In Pennsylvania Railroad cut at Union Furnace, Huntingdon County. Named for Benner Township, Centre County, where recognized in section near Bellefonte. Present throughout central Pennsylvania southeastward to western belts of Cumberland Valley.

Bennerian Stage

Middle Ordovician (Bolarian): Virginia and West Virginia.

Marshall Kay, 1956, Geol. Soc. America Bull., v. 67, no. 1, p. 100. Name applied to later of two stages of Bolarian epoch in discussion of Middle Ordovician formations of eastern and southern West Virginia and western Virginia.

[Name probably derived from Brenner Township, Centre County, Pa., for which Benner limestone (and group) is named.]

Bennett Formation

Pliocene, lower: California.

O. P. Jenkins, 1938, Geologic map of California (1:500,000): California Div. Mines, sheet 4. Shown on map legend.

Bennett Shale[1] Member (of Red Eagle Limestone)

Permian: Southeastern Nebraska and northeastern Kansas.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 84, 86, 88, 185.

R. C. Moore, 1935, Rock formations of Kansas in Kansas Geol. Soc.: Wichita [Am. Assoc. Petroleum Geologists 20th Ann. Mtg., Mar. 21–23]; G. E. Condra, 1935, Nebraska Geol. Survey Paper 8, p. 8. Rank reduced to member status in Red Eagle formation. Overlies Glenrock limestone member; underlies Howe limestone member.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 48. As currently defined, consists of shale and, locally, some impure limestone; shale is characteristically dark gray to black in lower part and light gray in upper part; brachiopods abundant locally in black shale; grades into limestone southward from Elk County, Kans. Thickness 2½ to 15 feet. Underlies Howe limestone member; overlies Glenrock limestone member. Wolfcamp series.

Type locality: Along Little Nemaha and its branches south of Bennett, Lancaster County, Nebr.

Bennett Bridge Beds[1]

Upper Ordovician: Northern New York.

Original reference: R. Ruedemann, 1925, New York State Mus. Bull. 258, p. 87–89, 131, 141, 149, 154.

Exposed along upper Sandy Creek and at Bennett Bridge, below Salmon Falls, Oswego County.

Bennettsville facies[1] (of Carwood Formation)

Lower Mississippian: Southern Indiana.

Original reference: P. B. Stockdale, 1931, Indiana Dept. Conserv., Div. Geology Pub. 98, p. 77, 149–163.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 75; J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 127–128, pl. 1. Facies nomenclature discussed. Bennettsville is one of eight facies of Carwood formation.

Name derived from village of Bennettsville, 3¼ miles southeast of Carwood, east-center sec. 14, T. 1 S., R. 6 E., Clark County.

Bennington Limestone[1]

Lower Cretaceous: Southeastern and central southern Oklahoma.

Original reference: J. A. Taff, 1902, U.S. Geol. Survey Geol. Atlas, Folio 79.

L. W. Stephenson and others, 1942, Geol. Soc. America Bull., v. 53, no. 3, chart 9. Shown on correlation chart above Bokchito formation and below Woodbine sand.

Named for Bennington, Bryan County.

Bennington Quartzite[1]

Lower Cambrian: Southwestern Vermont.

Original reference: C. D. Walcott, 1896, U.S. Geol. Survey Bull. 134, p. 33.

In Bennington County.

Bens Creek 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. 204.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 77. Massive sandstone in Kanawha group between Eagle above and Bens Creek coals.

Named for Bens Creek, Mingo County.

Benson Dolomite Member (of Tribes Hill Formation)

Lower Ordovician: East-central New York.

R. R. Wheeler, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1938–1939. Named as member of Tribes Hill.

R. R. Wheeler, 1942, Am. Jour. Sci., v. 240. no. 7, p. 518, 522. Top unit in Tribes Hill in Champlain and Hudson Valleys. Overlies Fort Ann limestone member; disconformably underlies Cassin formation. Represents divisions C 4 and D 1 of Brainerd and Seely's "Calciferous." [See 1890 and 1891 references under Beekmantown group.]

D. W. Fisher, 1954, Geol. Soc. America Bull., v. 65, no. 1, p. 74. Name preoccupied; unit is middle Canadian in age, not Tribes Hill (lower Canadian). Subdivisions of Tribes Hill in Champlain Valley are poorly defined and can not be used in Mohawk Valley.

Occurs in Champlain and Hudson Valleys.

Benson facies (of Cow Bayou Member of Logansport Formation)

Paleocene (Midway): Northwestern Louisiana.

G. E. Murray, 1948, Louisiana Dept. Conserv. Geol. Bull. 25, p. 112–114. Named as lower facies of member. Consists of wedge(?) of chocolate-brown lignitic clays with interbedded gray silts; carries marine and brackish water microfauna and macrofauna. Transitional into underlying Lula facies.

Type locality: Exposures in roadcut on north side of State Highway 745, one-half to three-fifths mile west of Benson, in SW¼NE¼ sec. 9, T. 10 N., R. 13 W., De Soto Parish.

Benson Limestone[1]

Mississippian: Utah.

Original reference: F. F. Hintze, Jr., 1913, New York Acad. Sci. Annals, v. 23, p. 109, 113.

Named for occurrence in Reade [Reed] and Benson Ridge, just above old mine workings of same name, in Salt Lake County.

†Benson Limestone[1] (in Lexington Group)

Benson Limestone (in Lexington Limestone)

Middle Ordovician: Central Kentucky.

Original reference: A. F. Foerste, 1913, Kentucky Geol. Survey, 4th ser., v. 1, pt. 1, p. 380, 389, 429, 430.

D. K. Hamilton, 1948, Econ. Geology, v. 43, no. 1, p. 41, 42; 1950, Kentucky Geol. Survey, ser. 9, Bull. 5, p. 13–14. Considered uppermost formation in Lexington group.

A. C. McFarlan and W. H. White, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1635–1636. Occurs at top of lower Lexington limestone; overlies Jessamine limestone; underlies Brannon limestone in middle Lexington. Thickness 40 to 75 feet. South from central Bluegrass area includes Perryville facies (until recently regarded as post-Woodburn in age and referred to as Perryville formation).

Named for Benson, Franklin County.

Bent Beds (in Bluestone Formation or Group)

See Bent Mountain Member (of Bluestone Formation).

Bent Limestone (in Bluestone Formation)[1]

Bent Sandstone (in Bluestone Formation)[1]

Bent Shale (in Bluestone Formation)[1]

Mississippian (Chester Series): Southeastern West Virginia and southwestern Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 293, 316.

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 186. Reger's (1926) subdivisions of the Bluestone, Lower Bent shale, Bent limestone, Upper Bent shale, and Bent sandstone are herein defined as Bent Mountain member of Bluestone formation. Reger's Lower Bent shale and Bent limestone are the same as his Upper Bent shale; a double thickness of Upper Bent shale, produced by close folding, is exposed along Road 656 about 1½ miles north of Bailey; here, Reger apparently mistook the repeated Upper Bent shale for his Lower Bent shale and Bent limestone; the Bent sandstone of Reger, which overlies the Upper Bent shale on Bent Mountain, W. Va., is not present in area of this report [Burkes Garden quadrangle].

Type locality: Bent Mountain, Mercer County, W. Va., 1.2 miles southeast of Pride.

Bentley Formation

Bentley Member

Pleistocene: Central and southwestern Louisiana.

H. N. Fisk, 1938, Louisiana Dept. Conserv. Geol. Bull. 10, p. 78 (fig. 6), 157–160. 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. Bentley member consists of sequence which grades from coarse basal materials to silty clays in upper part of section; differs from Williana sediments in that they are thinner, and show greater variation in central and upper parts of sequence. Average thickness less than 60 feet. Unconformably overlies Miocene Catahoula formation; along eastern valley wall of Nantaches Lake is in unconformable contact with Jackson Eocene.

H. N. Fisk, 1940, Louisiana Dept. Conserv. Geol. Bull. 18, p. 177–180, pl. 1. Rank raised to formation. Described in Rapides and Avoyelles Parishes where along walls of Red River Valley it has an average thickness of 80 to 100 feet; locally overlies undifferentiated Fleming formation.

Well exposed along State Highway 19 between Bentley and Colfax, Grant Parish, and between Trout and White Sulphur Springs, La Salle Parish, and on U.S. Highway 71 between Grant-Rapides Parish line and Bayou Rigolette.

Bent Mountain Member (of Bluestone Formation)

Mississippian (Chester Series): Southeastern West Virginia and southwestern Virginia.

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 186, pl. 15. Bent Mountain member, as herein defined and used, consists of four of Reger's (1926) subdivisions of the Bluestone, Lower Bent shale, Bent limestone, Upper Bent shale, and Bent sandstone. In Burkes Garden quadrangle, member consists of only lower 60 feet of member as developed at type locality; most of the 60-foot section is red and green shale and mudrock. Overlies Hunt member (new). Reger's Lower Bent shale and Bent limestone are same as his Upper Bent shale. Double thickness of Upper Bent shale, produced by close folding, is exposed along Road 656 about 1½ miles north of Bailey; here, Reger, apparently mistook the repeated Upper Bent shale for his Lower Bent shale and Bent limestone.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (columns 97, 98). Shown on correlation chart as Bent Mountain beds (or Bent beds) in Bluestone formation or group.

Type locality (Reger, 1926): On Bent Mountain, Mercer County, W. Va., 1.2 miles southeast of Pride.

Benton Sand[1]

Tertiary: Southeastern Missouri.

Original reference: C. F. Marbut, 1902, Missouri Univ. Studies, v. 1, no. 3, p. 18, 23, 32.

Named for exposures at Benton Ridge, Scott County.

Benton Shale[1] or **Formation** (in Colorado Group)

Benton Group

Lower and Upper Cretaceous: Southeastern Montana, eastern Colorado, northwestern Iowa, southern Minnesota, northeastern New Mexico, South Dakota, and eastern Wyoming.

Original reference: F. B. Meek and F. V. Hayden, 1862, Philadelphia Acad. Nat. Sci. Proc., v. 13, p. 419, 421.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 14. Name Benton, given by Meek and Hayden to include section now classed as Carlile, Greenhorn, and Graneros, is no longer in use except at places where the Greenhorn is poorly developed or absent. This condition does not obtain in Nebraska, and name Benton is dropped.

B. C. Petsch, 1946, South Dakota Geol. Survey Rept. Inv. 53, p. 17 (fig. 5), 43–47. Discussion of geology of Missouri Valley in South Dakota. Text refers to Benton group as comprising Graneros shale, Greenhorn limestone, and Carlile shale. Group is exposed along Missouri River from St. Helena in Cedar County, Nebr., to Ponca State Park in Nebraska. Exposures are also present in Iowa along bluffs of Big Sioux River from Akron to Sioux City and along tributaries to the Bix Sioux in Union County, S. Dak. Table of formations (fig. 5) shows Benton formation, in Colorado group, comprises Graneros, Greenhorn, and Carlile as members.

J. T. Stark and others, 1949, Geol. Soc. America Mem. 33, p. 51–52, measured secs., pl. 1. In South Park, Colo., the Benton of Colorado group, consists mainly of black shale; some sandstone, limestone, and bentonite beds present. Thickness 410 to 460 feet. Conformably overlies Dakota formation, underlies Niobrara formation, probable unconformity.

M. S. Woyski, 1949, Geol. Soc. America Bull., v. 60, no. 6, p. 1001. Benton formation listed in geologic succession in central Minnesota.

K. M. Waagé, 1952, Colorado Sci. Soc. Proc., v. 15, no. 9, p. 373 (fig. 1). Benton shale shown on generalized stratigraphic section of rocks exposed in Denver-Golden area. Thickness 480 feet. Overlies Dakota sandstone; underlies Timpas limestone.

G. O. Bachman, 1953, U.S. Geol. Survey Oil and Gas Inv. Map OM–137. In northwestern part of Mora County, N. Mex., formation represented by equivalents of Graneros shale, Greenhorn limestone, and Carlile shale. Thickness 395 feet. Overlies Dakota sandstone; contact with Niobrara formation not observed in area.

K. M. Waagé, 1955, U.S. Geol. Survey Prof. Paper 274–B, p. 15, 28, 34, 37, 39, 46. In northern Front Range, Colo., overlies South Platte formation (new) of Dakota group.

A. B. Shaw, 1957, Rocky Mountain Assoc. Geologists Guidebook to the geology of North and Middle Park Basin, Colorado, p. 49 (fig. 1), 50. Name Benton has been used for many years in North Park, Colo., and is still useful in group sense to include all rocks from Thermopolis shale through Frontier sandstone, that is, from top of Dakota sandstone of Cloverly group to base of Niobrara formation. This definition does not coincide with Benton shale as used in northern Front Range for interval from top of South Platte formation of Dakota group to base of Timpas limestone member of Niobrara formation.

M. A. Jenkins, Jr., 1957, Rocky Mountain Assoc. Geologists Guidebook to the geology of North and Middle Parks Basin, Colorado, p. 52–53, pl. 1. Formation, in Red Dirt Creek area, Grand County, Colo., consists of 418 feet of black to dark-gray fissile shale containing bentonite seams. Contains Codell sandstone member. Graneros, Greenhorn, and Carlile members not recognized in this area. Conformably overlies Dakota formation; underlies Niobrara formation.

T. A. Steven, 1960, U.S. Geol. Survey Bull. 1082–F, p. 336 (table 1), 346–348, pl. 12. Discussion of Northgate district, Colorado. Benton shale of Early and Late Cretaceous age consists of 665 feet of dark-gray thin-bedded shale with interbedded bentonite layers. Overlies Dakota group with contact gradational; underlies Niobrara formation.

Named for Fort Benton, on Missouri River, about 40 miles below Great Falls, Mont.

Benwood cyclothem

Pennsylvanian (Monongahela Series) : Southeastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 158 (table 13), 176–178, 179 (map 23). Embraces interval between Sewickley cyclothem (new) below and Arnoldsburg cyclothem (new) above. Where complete, displays normal suite of members (ascending) : Sewickley shale and sandstone, Tyler redbed, Benwood limestone, Benwood underclay and coal, and Benwood roof shale. Average thickness 65 feet. Cyclothem is seldom found intact; commonly upper limit cannot be determined owing to absence of members above Benwood limestone and below Arnoldsburg redbed. In area of this report, Monongahela series is described on cyclothemic basis; 12 cyclothems are named. [For sequence see Pittsburgh cyclothem.]

Present in Bern, Canaan, Lodi, Rome, and Alexander Townships of Athens County.

Benwood Limestone Member (of Monongahela Formation)

Benwood Limestone and Shale (in Monongahela Group)

Benwood limestone and shale member

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

Original reference: M. R. Campbell, 1903, U.S. Geol. Survey Geol. Atlas, Folio 94, p. 10.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 100, 121–123, 124 (fig. 29). In Fayette County, Benwood limestone is divided into several parts by intervening sandstones, shales, and a coal and black shale horizon. Coal is present in only a few sections, but the black shale is persistent and is used to divide Benwood into an upper and lower part. Lower Benwood overlies Upper Sewickley coal and underlies Benwood coal; Upper Benwood underlies Arnoldsburg sandstone. Included in Monongahela group.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 10 (fig. 3), 76–80, geol. map. Ohio Geological Survey recognizes the Benwood member (Monongahela series) as that section of limestones and shales between Upper Sewickley sandstone and Fulton green shale member. Basal boundary indefinite in many areas as the limestone occurs just above Meigs Creek coal when Upper Sewickley sandstone is absent; upper boundary uncertain because of inconspicuous development or absence of Fulton green shale. Benwood consists of thick sequences of limestones in many areas and of alternations of limestone and calcareous shales in other localities; some exposures consist almost entirely of calcareous shales. Thickness in Morgan County 25 to 35 feet.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 158 (table 13), 177–178. Limestone member of Benwood cyclothem (new) in report on Athens County. Name is used for fresh-water limestone above Sewickley sandstone and below Fulton green shale. In Athens County, unit lacks division of upper and lower units as in Pennsylvania. A highly variable unit a few inches to 38 feet thick. Occurs as nodules or ledges and is interbedded with calcareous clay shale of redbed type (Tyler redbed member).

Named from town of Benwood, Marshall County, W. Va.

Benwood roof shale member

Benwood underclay member

See Benwood cyclothem.

Berdoo Granite

Precambrian: Southern California.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 473, 491. Name applied to granite occurring in Chuckwalla complex.

Named for its occurrence in Berdoo Canyon, Little San Bernardino Mountains, Riverside County.

Berea Sandstone[1] or Formation

Devonian or Mississippian: Ohio, northeastern Kentucky, southern Michigan, western Pennsylvania, and northern West Virginia.

Original reference: J. S. Newberry, 1870, Ohio Geol. Survey Rept. Prog. 1869, p. 21, 29.

Wallace de Witt, Jr., and D. F. Demarest, 1951, Geol. Soc. America Bull., v. 62, no. 11, p. 1357; J. F. Pepper, Wallace de Witt, Jr., and D. F. Demarest, 1955, U.S. Geol. Survey Prof. Paper 259, p. 28–40, pls. Three phases of Berea sandstone recognized. First and oldest is massive medium-grained sandstone which fills channels that were scoured into and at some places through Bedford shale. Similar appearance of Cussewago sandstone and coarse aggregates of grains found in channel sandstone phases of Berea has led some geologists to conclude that the Cussewago was part of the Berea. Second or fluviatile phase of Berea sandstone lies above channel phase in sheet 20 to 35 feet thick with thickest part in western Cuyahoga County, Ohio; feathers out in area of valley of Grand River in western Ashtabula County. Third is marine siltstone phase about 5 to 20 feet thick with thinnest part in western Cuyahoga County; thickens to east. Lenses of silty gray shale and very thin ripple-marked siltstone in many sections of the Berea have been cited by some geologists as evidence that the Berea is a tripartite formation composed of two sandstone members separated by a shale member. Irregular occurrence of lenses of silty shale in the Berea does not support this hypothesis. Siltstone facies thins eastward from 15 feet at Wick, Ohio, to 7 feet at Bartholomew quarry section near Littles Corner, Pa. In this section, the siltstone facies of Berea was identified as Corry sandstone by White (1881). Much of resulting confusion of correlations came from this identification. At Bartholomew quarry, the 7 feet of Berea is underlain by 22 feet of Bedford shale. The Berea thins rapidly across Hayfield Township and grades laterally into Shellhammer Hollow formation (new) in vicinity of Meadville. Throughout northern Ohio and northwestern Pennsylvania, upper contact of Berea sandstone is sharp, although it is overlain conformably by Orangeville shale. In northern Ohio, pyritic cap rock of the Berea grades upward in a distance of 2 inches into basal part of Sunbury member of Orangeville. In northwestern Pennsylvania, where pyritic cap rock is absent, Sunbury member of Orangeville is conformable on siltstone facies of Berea sandstone.

U.S. Geological Survey currently designates the age of the Berea as Devonian or Mississippian on the basis of a study now in progress.

Named for Berea, Cuyahoga County, Ohio.

Berenda limestone[1]

Paleozoic (Devonic) : New Mexico and Arizona.

Original reference: C. R. Keyes, 1906, Jour. Geology, v. 14, p. 147–154.

[C. R.] Keyes, 1942, Pan-Am. Geologist, v. 77, no. 3, p. 228 (table). Table shows Berenda included in Devonic of Arizona. Assigned to Linnian series. Older than Escacado limestone (new) ; younger than Bella shale.

Probably named for Berenda Valley, N. Mex.

Bergen Shale Member (of Lykins Formation)

Permian; North-central Colorado.

L. W. LeRoy, 1946, Colorado School Mines Quart., v. 41, no. 2, p. 31, 33, 35, fig. 7. Thin-bedded red arenaceous shales and mudstones containing numerous small irregular spots and streaks of bluish green. Thickness at type section 62 feet; at Ralston Creek 35 feet. Underlies Glennon limestone member (new) ; overlies Falcon limestone member (new).

Type locality: In roadcut on Highway 74 just west of business district of town of Morrison and in west fork of Glennon Canyon, Golden-Morrison area. Named from Bergen irrigation ditch, which cuts through Lyons sandstone in Turkey Creek, sec. 12, T. 5 S., R. 70 W., Morrison quadrangle.

Berger 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), 38–46, plates. Proposed to include all terrestrial rocks between unconformity at top of marine sediments of Midway group and unconformity at base of Saline formation (new). Comprises section of gray and greenish-gray silty clay and argillaceous sand and some interbedded lignite and sideritic layers; where formation abuts nepheline syenite masses, it includes many bauxite deposits of Arkansas region and associated kaolinitic fragmental underclay. Contains three distinct facies: deposits of bauxite, bauxitic clay, and kaolinitic clay; deposits of lignite, lignitic clay, and gray silty clay that overlies bauxite deposits in many open-pit mines; deposits of gray "salt and pepper" or grayish-green sand that occupy channels in lignitic beds in overburden sections at several bauxite pits, that underlie lignite beds locally in several of the drilled areas, and that form major part of formation downslope from bauxite area. Thickness 0 to 347 feet; surface outcrops reach maximum of 25 feet; drill-hole data show greater thicknesses. Rests upon eroded surface of Wills Point formation; along lower slopes of nepheline syenite hills, generally overlaps Wills Point and rests on residual clay or on rocks of Paleozoic age; in larger subsurface valleys where Wells Point has been removed, Berger rests upon the Kincaid or upon basement rocks.

Type section: South side of Chicago, Rock Island, and Pacific Railroad tracks on east side of viaduct and road crossing tracks at Brittain siding, Pulaski County, in SE¼SW¼ sec. 5, T. 1 S., R. 12 W., three-fourths mile southwest of Berger. Exposed in a narrow discontinuous band of outcrop as much as 1½ miles wide. Outcrop area extends northeastward from Hurricane Creek in Saline County to northeast end of Fourche Mountain in Pulaski County. West of Hurricane Creek, wedges out beneath Saline formation. At east end of outcrop area, truncated by Quaternary sediments of Arkansas River flood plain.

Bergman Group[1]

Lower and Upper Cretaceous: Northwestern Alaska.

Original reference: F. C. Schrader, 1902, Geol. Soc. America Bull., v. 13, p. 246.

R. W. Imlay and J. B. Reeside, Jr., 1954, Geol. Soc. America Bull., v. 65, no. 3, pl. 1 (facing p. 245). Age shown on correlation chart as Lower Cretaceous in both Koyukuk Valley and Kobuk Valley areas.

T. G. Payne, 1955, U.S. Geol. Survey Misc. Geol. Inv. Map I–84. Mostly marine. Age given on chart as Albian and Cenomanian.

U.S. Geological Survey currently designates the age of the Bergman Group as Lower and Upper Cretaceous on the basis of a study now in progress.

Named for Bergman trading post on Koyukuk River in Koyukuk-Kobuk region.

Berino Member (of Magdalena Formation)

Pennsylvanian (Strawn): Western Texas.

L. A. Nelson, 1937, Colorado Univ. Studies, v. 25, no. 1, p. 89. In Franklin Mountains, Texas, formation is divided into (ascending) La Tuna, Berino, and Bishops Cap members (all new).

L. A. Nelson, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 167, 168–169. Predominantly limestone; fossiliferous. Thickness about 555 feet. Derivation of name given.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 23. On basis of fusilinid studies, seems inadvisable to apply Nelson's terms to Pennsylvanian rocks of central New Mexico.

T. S. Jones, 1953, Stratigraphy of the Permian Basin of West Texas: West Texas Geol. Soc., p. 25. Berino is Strawn in age, but might include some Bend in lower parts.

Named from Berino, Dona Ana County, N. Mex., on Santa Fe Railroad about 4 miles north of Texas-New Mexico boundary.

Berkeley Group[1]

Pliocene: Western California.

Original reference: A. C. Lawson and C. Palache, 1902, California Univ. Pub., Dept. Geol. Bull., v. 2, p. 375, map.

Group includes Bald Peak Basalt, Moraga Formation, and Siesta Formation.

Named for occurrence east of Berkeley, Alameda County.

†Berkshire Limestone[1]

Lower Cambrian to Lower Ordovician: Western Connecticut, Massachusetts, and Vermont.

Original reference: E. Hitchcock, 1833, Rept. on Geol., Min., Bot., and Zool. of Massachusetts, p. 297–305.

Berkshire Schist[1]

Berkshire Formation

Middle Ordovician: Western Massachusetts, western Connecticut, eastern New York, and southwestern Vermont.

Original reference: T. N. Dale, 1891, Am. Geologist, v. 8, p. 1–7.

E. P. Kaiser, 1945, Geol. Soc. America Bull., v. 56, no. 12, pt. 1, p. 1089–1090. Abandoned in eastern part of Taconic Range, Vt. Mettawee and Schodack formations are extended to this area to replace the Berkshire.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, p. 38–40. Locally abandoned in Castleton quadrangle, Vermont, where name is replaced by Hortonville slate and phyllites of Mendon series. Remainder of Berkshire south of Castleton River mapped as Nassau formation.

E. N. Cameron, 1951, Connecticut Geol. Nat. History Bull. 76, p. 8–9. Included in Mount Prospect complex (new). Formation is complex series of mica gneisses, feldspathic quartz mica schists, and micaceous quartzites.

R. M. Gates, 1952, *in* R. M. Gates and W. C. Bradley, Connecticut Geol. Nat. History Survey Misc. Ser. 5, p. 7, 8. Formation abandoned in New Preston quadrangle, Connecticut. Replaced by Waramaug formation (new) because these rocks differ from Berkshire of past and present definitions.

Norman Herz, 1958, U.S. Geol. Survey Geol. Quad. Map GQ–108. Berkshire of 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 as Hoosac, Normanskill, and Rowe by Prindle and Knopf (1932). Consists of lower schistose marble, schistose quartzite, and graphic schist; black muscovite-quartz-albite-schist; and schistose marble. Transgresses older formations from west to east and from north to south. Most authors have drawn upper contact below Bellowspipe limestone, but validity of this limestone as a formation is questionable. In this report, color was used as primary distinction between Berkshire and overlying Greylock schist. Overlies Bascom formation. Middle Ordovician.

Named for occurrence in Berkshire County, Mass.

Berkshire County Series[1]

Precambrian: Western Massachusetts.

Original reference: W. O. Crosby, 1876, Rept. on geol. map of Massachusetts, p. 40.

Berkshire County.

Berlin Clay[1]

Pleistocene, upper: Connecticut.

Original reference: R. F. Flint, 1933, Geol. Soc. America Bull., v. 44, no. 5, p. 965–987.

Underlies parts of eastern Berlin Township.

†Berlin Gneiss[1]

Post-Lower Devonian: Northern New Hampshire.

Original reference: C. H. Hitchcock, 1873, Rept. Geol. Survey New Hampshire 1872, p. 7.

R. W. Chapman, 1935, Am. Jour. Sci., 5th ser., v. 30, no. 179, p. [404], 405–406. Described as a trondhjemite composed of quartz, oligoclase, biotite, and muscovite. Assigned to New Hampshire magma series.

R. W. Chapman, 1948, Geol. Soc. America Bull., v. 59, no. 11, p. 1075–1077. Named abandoned in Percy quadrangle; unit assigned to Oliverian magma series.

Named for Berlin Township in village of Berlin, Coos County.

Berlin Group (in Conemaugh Formation)[1]

Pennsylvanian: Southwestern Pennsylvania.

Original reference: I. C. White, 1878, Pennsylvania 2d Geol. Survey Rept. Q.

In Allegheny County.

†Berlin Limestone (in Conemaugh Formation)[1]

Pennsylvanian: Southwestern Pennsylvania.

Original reference: F. and W. G. Platt, 1877, Pennsylvania 2d Geol. Survey Rept. H_3, p. 223, 286, 292.

At Forwardstown, Somerset County.

Berlin Rhyolite Gneiss[1]

Precambrian (pre-Huronian?): Central southern Wisconsin.

Original reference: R. D. Irving, 1877, Geology Wisconsin, v. 2, p. 520.

Crops out at Berlin, Green Lake County.

Berlin Volcanics

Oligocene: Northwestern Oregon.

I. S. Allison and W. M. Felts, 1956, Geology of Lebanon quadrangle, Oregon (1:62,500): Oregon Dept. Geology and Mineral Industries. Tentative name Berlin volcanics used by Felts (1936, unpub. thesis) is abandoned in favor of Mehama volcanics.

Bermeja Complex

Upper Cretaceous or older: 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. 323–324, pl. 1. Serpentinite, silicified porphyritic volcanics, and fine-grained silicified sediments or volcanics, with minor spilite, amphibolitized spilite, and amphibolite. Diorite plug intrudes complex. Oldest rocks in area; exposed only in some anticlinical cores. Unconformably overlain by a sequence of shallow-water sediments and extrusive and pyroclastic volcanics, Cretaceous to Eocene in age; in most parts of area lava flows, the Río Loco formation, is at base of sequence. Where Río Loco is absent, underlies Mayagüez group (new). Age unknown. Age determinations in basal Mayagüez rocks resting unconformably on serpentinite show that Bermeja complex is older than Santonian-Campanian and possibly older than Cenomanian.

E. A. Pessagno, Jr., 1960, Geology of the Ponce-Coamo area, Puerto Rico: Puerto Rico Econ. Devel. Adm., and Princeton Univ. Dept. Geology, p. 20, 21. Mattson restricts word complex to basement rocks. He applied term Bermeja complex to these rocks which include amphibolites, serpentinites, and metamorphosed cherts. In present report, term deformed sequence is applied to the folded, faulted, intruded, but unmetamorphosed rocks that rest unconformably on Bermeja complex. Bermeja complex crops out only in southwestern Puerto Rico. Here it is overlain unconformably by Río Loco formation, oldest unit of deformed sequence. In Barranquitas quadrangle in south-central Puerto Rico, the Río Loco underlies a formation containing fossils of Cenomanian-Turonian age. Bermeja complex must be Cenomanian or older in age.

Complex is exposed in greatest variety in Sierra Bermeja.

Bern Limestone (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), 2276–2277. Defined to include persistent escarpment-forming limestone and associated strata which occur between Auburn shale above and Scranton shale below. Thickness ranges from about 7 feet to 35 feet; average 20 feet. Comprises (ascending) Burlingame limestone, Soldiers Creek shale, and Wakarusa limestone members.

Type section: In roadcut in SE¼SE¼ sec. 7, T. 1 S., R. 13 E., about one-half mile north and 1 mile west of Bern, Nemaha County. Name derived from town of Bern in northern part of county.

Bernadotte cyclothem[1]

Pennsylvanian: Central western Illinois.

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

Derivation of name not stated.

Bernadotte Sandstone Member (of Abbott Formation)

Bernadotte Sandstone (in Pottsville Formation)[1]

Bernadotte Sandstone (in Tradewater Group)

Pennsylvanian: Northern 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. 50 (fig. 22), 70–72, 203. In original description, Savage correlated this bed with massive sandstone that terminates outcrop of No. 1 coal and Seville limestone at type outcrop of Seville cyclothem. At south end of this cyclothem, sandstone thickens to abont 16 feet and rests directly on a coal. Savage believed this was No. 1 coal and considered Seville limestone cut out by sandstone. Outcrops now available show that No. 1 coal and Seville limestone thin out as they rise above sandstone and that coal that underlies sandstone in Pope Creek is Tarter coal. Bernadotte is older than No. 1 coal rather than younger. Occurs at base of Seville cyclothem. Type outcrop given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 31, 45 (table 1), 63. pl. 1. Allocated to member status in Abbott formation (new). Above Pope Creek coal member (new). Thickness about 16 inches. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type outcrop: Road and ravine just southwest of Bernadotte. SW¼ sec. 19, T. 5 N., R. 2 E., Vermont quadrangle, Fulton County.

Bernal Formation

Permian: Central northern New Mexico.

V. C. Kelley, 1949, New Mexico Univ. Pubs. in Geology 2, fig. 2. Name appears on composite stratigraphic chart of formations in Socorro and Santa Fe Counties.

J. E. Allen and S. M. Jones, 1952, (abs.) Geol. Soc. America Bull., v. 63, no. 12, pt. 2, p. 1320. Red quartz sandstone and shale 354 feet thick. Overlies upper Permian San Andres limestone. Triassic(?).

G. O. Bachman, 1953, U.S. Geol. Survey Oil and Gas Inv. Map OM–137. As defined herein, consists of brownish-red siltstone and fine-grained sandstone; in southern part of area, a single bed of gray to brown medium-grained sandstone about 1 foot thick is interbedded with the reddish-brown rocks. Average thickness 100 feet; 126 feet about 1 mile east of Ocate. Overlies Glorietta sandstone member of San Andres formation; disconformably underlies Santa Rosa sandstone. Has been considered a part of San Andres. Appears to be correlative with parts of Chalk Bluff formation of southeastern New Mexico and possibly Whitehorse sandstone of Oklahoma. Permian.

[Replaced by Artesia Group (D. B. Tait and others, 1962, Am. Assoc. Petroleum Geologists Bull., v. 46, no. 4).]

Type sequence: Near villages of Bernal and Chapelle, San Miguel County.

†Bernalillan series[1]

Permian: New Mexico.

Original reference: C. R. Keyes, 1936, Pan-Am. Geologist, v. 66, no. 1, p. 42.

Bernalillo shale[1]

Permian: Central northern New Mexico.

Original reference: C. R. Keyes, 1903, Ores and Metals, v. 12, p. 48.

In Sandia Mountains. Derivation of name not given.

Bernardston Formation[1]

Silurian and Devonian(?): Central and western Massachusetts, southwestern New Hampshire, and southeastern Vermont.

Original reference: J. D. Dana, 1873, Am. Jour. Sci., 3d ser., v. 6, p. 339–352.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, p. 1747, chart 4. Age of limestone shown as Lower or Middle Devonian.

Robert Balk, 1956, U.S. Geol. Survey Geol. Quad. Map GQ 90. Further described in Bernardston quadrangle, Massachusetts. Most common rock type is glossy sericitic minutely stratified light-gray phyllite locally merging into dark-gray and black slate. At the base is fine-grained dark-gray phyllite with thin quartz interbeds. Includes lenses of aphanitic laminated light-gray metatuff, well-foliated fine-grained amphibolite, massive greenish-gray diabase, light-gray fine-grained rhyolite, and white and yellow-brown quartz and quartz conglomerate. Latter are important horizon marker. Fossiliferous coarsely crystalline limestone at one locality. Thickness several thousand feet. Conformably overlies Leyden argillite. Silurian(?) or Devonian(?).

A. J. Boucot and others, 1958, Geol. Soc. America Bull., v. 69, no. 7, p. 855–870. Lower part of Bernardston formation in Massachusetts contains fossils of probable Silurian age. On lithologic basis, it is possible that lower part of Bernardston, including conglomerates, quartzites, and calcareous quartzite, is lateral equivalent of Clough formation and that limestone associated with Bernardston is lateral equivalent of Fitch formation.

Named for occurrence at Bernardston, Franklin County, Mass.

†Bernardston Limestone[1]

Lower and Middle Devonian: Western and central Massachusetts and New Hampshire.

Original reference: J. D. Dana, 1877, Am. Jour. Sci., 3d v. 14, p. 379–387.

G. A. Cooper, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Shown on correlation chart in Massachusetts and New Hampshire. Age given as Lower or Middle Devonian.

First described near Bernardston, Mass.

Berne Member[1] (of Cuyahoga Formation)

Berne Member (of Logan Formation)

Lower Mississippian: South-central Ohio.

Original reference: J. E. Hyde, 1915, Jour. Geology, v. 23, p. 656, 657, 660, 667, 669, 674–682.

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), 55–56. Berne conglomerate member included in Pretty Run sandstone facies (new) of Logan formation. Underlies Byer sandstone member; overlies adjoining Granville and Killbuck facies of Cuyahoga formation. Thickness a few inches to 16 feet; commonly 1 to 3 feet. Age given as Lower Mississippian.

J. E. Hyde, 1953, Ohio Geol. Survey Bull. 51, p. 3 (table 1), 98–101. Report refers to unit as Berne member, or pebble bed, of Cuyahoga formation. Overlies Black Hand member in Granville and Hocking Valley provinces. In a 1910 manuscript, Hyde referred to Berne as Hanover pebble bed.

Named for exposures in Berne Township, Fairfield County.

Berne Member (of Marcellus Shale)[1]

Middle Devonian: Eastern New York.

Original reference: G. A. Cooper, 1933, Am. Jour. Sci., 5th, v. 26, p. 544, 548.

Winifred Goldring, 1946, New York State Mus. Bull. 332, p. 238, 249. Cooper proposed name Berne member for shale interval between Onondaga limestone and Otsego member, an interval considered equivalent of Union Springs, Cherry Valley, and Chittenango members of Marcellus. Recent work has shown presence of Cherry Valley or Cherry Valley equivalent in the Helderbergs and southward. Cooper (p. 249) restricts Berne to the Chittenango sandy equivalent about 100 to 150 feet thick. As thus restricted, the Berne extends from its type locality around northeast end of Catskills at least as far south as Mt. Marion and Haliha Hill north of Kingston.

Type section: In hill south of Berne, Berne-Durham quadrangle, Albany County.

†Berners Formation[1]

Paleozoic(?), Triassic, and Jurassic: Southeastern Alaska.

Original reference: A. Knopf, 1911, U.S. Geol. Survey Bull. 446, p. 14–19, map.

Well exposed along west shore of Berners Bay and along Lynn Canal from Point St. Mary to mouth of Independence Creek; also on east shore of Berners Bay.

†Berry Formation

Eocene to Miocene, lower: West-central California.

R. R. Thorup, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1958. Listed as underlying Vaqueros formation (restricted) and overlying The Rocks sandstone (new). Thickness about 1,000 feet.

R. R. Thorup, 1943, California Div. Mines Bull. 118, pt. 3, p. 464 (fig. 190), 465. Usually white poorly sorted, poorly bedded, feldspathic, considerably crossbedded conglomeratic sandstone; red beds in upper part; probably of continental origin. Upper part of formation appears to grade into Vaqueros formation; contact of the two is placed at lowest occurrence of finer grained sandstone. Oligocene. Derivation of name given.

M. N. Bramlette and S. N. Daviess, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 24. Age may be Eocene to lower Miocene and may vary in different areas.

Type locality: SE¼ sec. 26, T. 20 S., R. 6 E., Junipero Serra quadrangle, Monterey County. Named for typical exposures near Berry Ranch.

Berryessa Formation

Cretaceous: Central California.

M. D. Crittenden, Jr., 1951, California Div. Mines Bull. 157, p. 22 (fig. 4), 31, 33–35, pl. 1. Introduced to designate sandstone, siltstone, and shale between Lower Cretaceous Oakland conglomerate and Tertiary Monterey formation. In western limb of Tularcitos syncline, thickness about 1,000 feet at Berryessa Creek; 1,600 feet at Alum Rock Canyon; 2,000 feet near Hendricks Ranch; may be thicker south of there, but base has not been mapped accurately, and top is clearly faulted; no complete section exposed in eastern limb of syncline. About 1 mile south of Alum Rock Canyon, Monterey formation overlaps Berryessa completely. Formation consists of rocks called Chico by Lawson (1914, U.S. Geol. Survey Geol. Atlas, Folio 193) and included in Knoxville by Templeton (1913, Geol. Soc. America Bull., v. 24, p. 96). Intruded by Alum Rock rhyolite (new). Name Berryessa does not imply that its exact age and stratigraphic position are known, but rather is an attempt to avoid the confusion associated with name Chico.

Type locality: On Berryessa Creek, San Jose-Mount Hamilton area, in central Coast Ranges, about 50 miles southeast of San Francisco; both top and base are exposed at type locality. Crops out on both sides of Tularcitos syncline; one band extends along Calaveras fault from vicinity of Calaveras Reservoir to Halls Valley a short distance east of San Felipe Valley; other band extends from Scott Creek across Alum Rock Canyon, then is faulted out for a distance of 3 miles and reappears west of Masters Hill and extends southeast to Panochita Hill, faulted segments reach edge of mapped area southeast of San Felipe Valley.

Bertha Limestone (in Bluefield Formation)[1]

Mississippian: Southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 299, 393.

Named for association with Bertha sandstone and Upper Bertha shale, but not exposed at type locality of Bertha shale. Observed, however, at other localities in Summers County, in Monroe and Mercer Counties, and also in Tazewell and Giles Counties, Va.

Bertha Sandstone (in Bluefield Formation)[1]

Mississippian: Southeastern West Virginia and southwestern Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Mercer, Monroe, and Summers Counties, p. 299, 391.

Type locality: Along mountain road which ascends from Bertha toward Low Gap School, Summers County. Also exposed in Monroe County and in Tazewell County, Va.

Bertha Shale (in Bluefield Formation)[1]

Mississippian: Southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 299, 392–394.

Occurs in Mercer, Monroe, and Summers Counties.

Berthelet Member[1] (of Milwaukee Formation)

Middle Devonian: Southeastern Wisconsin.

Original reference: G. O. Raasch, 1935, Kansas Geol. Soc. 9th Ann. Field Conf., p. 262, 265.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Shown on correlation chart above the Thiensville and below the Lindwurm. Middle Devonian.

Type locality: Milwaukee Cement quarry, Milwaukee County. Probably named for village of Berthelet.

Bertie Limestone (in Salina Group)

Bertie Formation

Bertie Group

Bertie Limestone Member (of Salina Formation)[1]

Upper Silurian: Western and east-central New York, and Ontario, Canada.

Original reference: E. J. Chapman, 1864, A popular and practical exposition of the minerals of Canada, p. 190.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Bertie waterlime listed as top formation in Salina group. Occurs above Camillus shale. Cayugan series.

D. W. Fisher and L. V. Rickard, 1953, New York State Mus. Circ. 36, p. 5–14, fig. 1. Bertie formation, in east-central New York, comprises (ascending) Fiddlers Green dolomite member, unnamed member, and Williamsville dolomite member. Overlies Camillus shale and merges eastward into Brayman shale (redefined). Underlies Cobleskill.

L. V. Rickard, 1955, New York State Geol. Assoc. Guidebook 27th Ann. Mtg., p. 7. Formation, in central New York, consists of three members (ascending) Fiddlers Green, Forge Hollow (new), and Williamsville. Fiddlers Green dolomite continues westward into Falkirk member of Bertie. Overlies Salina formation; underlies Cobleskill, Cayugan series.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. Rank raised to group. Includes rocks between base of Oatka and top of Williamsville. In western New York, comprises (ascending) Oatka shale, Falkirk dolomite, Scajaquada shale, and Williamsville waterlime. In central New York comprises (ascending) Fiddlers Green dolomite, Forge Hollow shale, and Oxbow dolomite (new). In Canastotan and Murderian stages (both new).

Named for exposures at Bertie (and in Bertie Township), Ontario, about 6 miles west of Buffalo, N.Y.

Bertram Dolomite[1]

Silurian (Niagaran): Eastern Iowa.

Original reference: W. H. Norton, 1895, Iowa Geol. Survey, v. 4, p. 135–138.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Correlation chart shows Bertram dolomite above Gower dolomite.

Named for Bertram, Linn County.

Berwick Formation (in Merrimack Group)

Berwick Gneiss[1]

Probably Ordovician and Silurian: Southwestern Maine and southeastern New Hampshire.

Original reference: F. J. Katz, 1917, Washington Acad. Sci. Jour., v. 7, p. 198.

Jacob Freedman, 1950, Geol. Soc. America Bull., v. 61, no. 5, p. 453 (fig. 2), 456–459, 475–476, pl. 1. Termed a formation. Consists of black, gray, and green phyllite, quartz-mica schist, quartzite, actinolite-quartz granulite, actinolite granulite, biotite-actinolite schist and actinolite amphibolite in the biotite metamorphic zone. Similar rocks in garnet zone. Well-bedded and lacking in gneissic structure. Maximum thickness in Mount Pawtuckaway quadrangle, New Hampshire, 7,000 feet. Silurian(?).

M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000): U.S. Geol. Survey. Includes Gove member which was reallocated from Littleton formation. Included in Merrimack group in New Hampshire. Probably Ordovician and Silurian.

M. P. Billings, 1956, Geology of New Hampshire, pt. 2, Bedrock geology: Concord, New Hampshire State Plan. Devel. Comm., p. 41–43. Age tentatively considered Silurian.

Named for development at Berwick, York County, Maine.

Berwick Quartz Diorite[1]

Devonian(?): Southwestern Maine.

Original reference: A. Wandke, 1922, Am. Jour. Sci., 5th, v. 4, p. 153.

About 2 miles east of Berwick, York County.

Berwyn Conglomerate[1]

Pennsylvanian: Central southern Oklahoma.

Original reference: J. T. Richards and R. A. Birk, 1925, Am. Assoc. Petroleum Geologists Bull., v. 9, no. 6, p. 983, 987-988.

Named for occurrence south of town of Berwyn, Carter County.

†Berwyn Member (of Skaneateles Shale)[1]

Middle Devonian: Central New York.

Original reference: G. A. Cooper, 1930, Am. Jour. Sci., 5th, v. 19, p. 219, 221.

G. A. Cooper, 1941, Washington Acad. Sci. Jour., v. 31, no. 5, p. 180–181. Name abandoned. Replaced by Butternut shale member (new).

Derivation of name not stated, but probably is village in Tully quadrangle.

Bessemer Clay

Pennsylvanian (Pottsville): Northeastern West Virginia.

W. A. Tallon, 1959, West Virginia Geol. and Econ. Survey Rept. Inv. 17, p. 17. Hammond clay grades downward into horizon here named Bessemer clay.

Type locality and derivation of name not given. Hammond clay occurs in vicinity of Hammond, Marion County.

Bessemer Granite[1]

Ordovician to Mississippian: Southern North Carolina and northwestern South Carolina.

Original reference: A. Keith and D. B. Sterrett, 1917, U.S. Geol. Survey Bull. 660-D, p. 129.

W. R. Griffitts and J. C. Olson, 1953, U.S. Geol. Survey Prof. 248–D, p. 204. Incidental mention in discussion of Shelby-Hickory district, North Carolina.

H. W. Jaffe and others, 1959, U.S. Geol. Survey Bull. 1097-B, p. 116. Lead-alpha age 491 millions of years.

U.S. Geological Survey currently designates the age of the Bessemer Granite as Ordovician to Mississippian on the basis of a study now in progress.

Named for fact that one of the minor bodies of granite underlies Bessemer City, Gaston County, N.C.

Bessemer Sandstone or Quartzite

Precambrian (Proterozoic): Northwestern Michigan.

W. A. Seaman *in* A. K. Snelgrove, W. A. Seaman, and V. L. Ayres, 1944, Michigan Dept. Conserv. Geol. Survey Div. Prog. Rept. 10, p. 16. Bessemer sandstone or quartzite and overlying lava flows which are cut by felsite and then by olivine diabase dikes, belong to lower part of Sibley series.

Occurs in Houghton, Ontonagon, and Gogebic Counties.

Bessie Member (of Quartermaster Formation)[1]

Permian: Western Oklahoma.

Original reference: H. L. Griley, 1933, Pan-Am. Geologist, v. 59, no. 3, p. 234.

Bethany Falls Limestone Member (of Swope Formation)

Bethany Falls Limestone (in Kansas City Group)[1]

Pennsylvanian (Missouri Series): Northwestern Missouri, southwestern Iowa, eastern Kansas, and southeastern Nebraska.

Original reference: G. C. Broadhead, 1868, St. Louis Acad. Sci. Trans., v. 2, p. 320.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2031 (fig. 4). Uppermost member of Swope limestone (or formation). Overlies Hushpuckney shale member; underlies Galesburg formation. This is classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma, May 1947.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 40. Thickness about 22 feet in south-central Iowa; 12 feet, Sarpy County, Nebr.; about 20 feet at Kansas City, Mo.; 12 to 27 feet in eastern Kansas, average 18 feet; pinches out near Oklahoma line.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 28, fig. 5. Uppermost member of Swope. Composed of thick limestone beds containing thin shale partings which are usually quite calcareous and fossiliferous. Uppermost beds generally algal and occasionally oolitic but have fine-grained texture in basal sections. Average thickness about 16 feet. Overlies Hushpuckney shale member; underlies Galesburg shale.

Named for exposures at falls of Big Creek, near Bethany, Harrison County, Mo.

†Betheden Formation

Paleocene or Eocene: East-central Mississippi.

F. F. Mellen, 1939, Mississippi Geol. Survey Bull. 38, p. 26–28. Includes all residual material at top of Midway and below Midway-Wilcox unconformity; includes deposits of bauxite, kaolin, bauxitix and kaolinitic clays and the overlying lignite. Thickness approximately 25 feet. Gradationally overlies Porters Creek formation; unconformably underlies Fearn Springs formation, or the Ackerman formation where Fearn Springs is absent.

F. S. MacNeil, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 5, p. 1070. Fearn Springs and Betheden appear to be intraformational. Recommended that name Betheden be abandoned and that Fearn Springs include both units.

Type locality: At Livingston Spring, 50 yards south of highway at Betheden, SW¼SE¼ sec. 23, T. 16 N., R. 13 E., Winston County.

Bethel 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 Bethel, which is in northwest part of Windsor County.

Bethel Group[1]

Upper Cambrian: Southeastern Vermont.

Original reference: C. H. Richardson, 1927, Vermont State Geologist 15th Rept., p. 127–158.

Probably named for Bethel, Windsor County.

Bethel Pyroxene Diorite[1]

Age(?): Eastern New York.

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

Dutchess County.

Bethel Sandstone[1]

Bethel Formation (in West Baden Group)

Bethel Sandstone (in New Design Group)

Upper Mississippian (Chester Series): Western Kentucky, northwestern Alabama, southeastern Illinois, southern Indiana, and northeastern Mississippi.

Original reference: C. Butts, 1917, Mississippian series in western Kentucky: Kentucky Geol. Survey, p. 63.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 766 (fig. 1), 826–827. Assigned to New Design group (new). In standard Mississippian section, underlies Paint Creek formation and overlies Renault formation. Sandstone is brownish moderately fine grained, in part massive and crossbedded and in part more thinly and evenly bedded; locally conglomeratic at base. Not more than 10 feet thick in Union County, Ill.; in southwestern part of county and in southeastern Perry County, Mo., cannot be recognized sufficiently to separate Renault and Paint Creek formations. Thickness in southern Johnson County, Ill., 12 feet; thickens to east to 50 feet in Ohio River bluff below Golconda; on both sides of river near Shetlerville at least 100 feet thick. Thins southward in Kentucky and not recognized beyond Elkton, Todd County.

D. J. McGregor, T. G. Perry, and W. J. Wayne, 1957, Indiana Geol. Survey Field Conf. Guidebook 9, p. 6, pl. 3. In this report [southwestern Indiana], Bethel formation is used in place of Mooretown sandstone. Stratigraphic position is below Beaver Bend limestone and above Paoli limestone.

S. W. Welch, 1958, U.S. Geol. Survey Oil and Gas Inv. Chart OC–58. In northwestern Alabama, beds described by Butts (1926, Alabama Geol. Survey Spec. Rept. 14) as Bethel sandstone are included in Tanyard Branch member of Pride Mountain formation (both new).

H. H. Gray, R. D. Jenkins, and R. M. Weidman, 1960, Indiana Geol. Survey Bull. 20, p. 36 (table 5), 47, pl. 1. Lowermost formation in West Baden group (redefined). Thickness 16 to 35 feet. Underlies Beaver Bend limestone; overlies Paoli limestone of Blue River group (new).

Named for exposures in vicinity of Bethel School, 3½ miles west of Marion, Crittenden County, Ky.

Bethel Schist[1]

Upper Cambrian: Southeastern Vermont.

Original reference: C. H. Richardson, 1924, Vermont State Geologist 14th Rept., p. 82–83.

W. F. Brace, 1953, Vermont Geol. Survey Bull. 6, p. 42 (table 2), 43 (table 3), 50-51. In Rutland area, "Bethel" formation resembles Pinney Hollow formation. There is possibility that the "Bethel," as mapped to the east, actually represents structural repetition of the Pinney Hollow. There is a question as to proper subdivision of unit mapped as "Bethel." About 6,000 feet of rock is exposed with no horizons detected. The ill-defined term "Bethel" is herein applied to the entire unit; however, it may include the Stowe and parts of Moretown formations in an unknown structural relationship. The "Bethel" overlies Ottauquechee formation. Cambro-Ordovician.

First described in Bethel Township.

Bethlehem Gneiss[1] (of New Hampshire Plutonic Series)

Upper Devonian(?): New Hampshire.

Original reference: C. H. Hitchcock, 1872, Rept. Geol. Survey New Hampshire, 1871.

M. P. Billings, 1937, Geol. Soc. America Bull., v. 48, no. 4, p. 504–506, 536–538. Unit should be called gneiss, not granodiorite gneiss, because it ranges in composition from granite to quartz diorite.

M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000): U.S. Geol. Survey. Belongs to New Hampshire plutonic series of Upper Devonian(?) age.

M. P. Billings, 1956, Geology of New Hampshire, pt. 2, Bedrock geology: Concord, New Hampshire State Plan. Devel. Comm., p. 55, 57. Summary discussion. Type locality for unit as currently defined.

Type locality: Exposures on Green Mountain, 2 miles southwest of Landaff, Moosilauke quadrangle. Named for town of Bethlehem, Grafton County.

Bethpage Gravel[1]

Miocene: Southeastern New York.

Original reference: C. P. Berkey and J. F. Sanborn, 1923, Am. Soc. Civil Engrs. Trans., v. 86, no. 1509, p. 75, pl. 3.

J. H. Sanford, 1938, New York State Water Power and Control Comm. Bull. GW-7, p. 11, 12, 18. Crosby's use of term Bethpage gravels mentioned in discussion of geologic history of Long Island.

First described in pits in central part of Long Island.

†Bettles Group[1] or Series[1]

Silurian: Northern Alaska.

Original reference: F. C. Schrader, 1900, U.S. Geol. Survey 21st Ann. Rept., pt. 2, p. 475.

Excellent exposures on lower part of Bettles River, where mountains which these rocks compose rise 2,000 feet or more above river. Principal capping rock over 2,000 square miles of upper waters of Chandlar and Koyukuk Rivers.

Beulah Limestone[1]

Mississippian: Eastern Colorado.

Original reference: A. E. Brainerd, H. L. Baldwin, Jr., and I. A. Keyte, 1930, Kansas Geol. Soc. Guidebook 4th Ann. Field Conf., p. 84, 86, 88, 90, 94.

J. C. Maher, 1950, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 39; 1951, World Oil, v. 133 (Oct.), p. 89–91. Upper finely sandy and finely oolitic limestone beds of sequence previously called Madison in vicinity of Beulah are considered as formation and here named Beulah limestone. Name Beulah was used by Brainerd, Baldwin, and Keyte (1930) to refer to beds now known as Williams Canyon limestone. Original authors abandoned name before it came into common use. Name Beulah is only one suitable for the limestone in this locality and is therefore used. Predominantly pink- to red-stained, white to buff, finely oolitic limestone; concentrations of reddish-yellow dense chert and pyrite present in uppermost layers, and traces of red sandy chert. Thickness at type section 53 feet. Overlies Hardscrabble limestone (new); underlies arkosic beds of Fountain formation; both contacts unconformable. Meramec(?).

Type section: In NW¼ sec. 4, T. 23 S., R. 68 W., Pueblo County. Restricted to isolated exposure on South Hardscrabble Creek in Custer County and to the almost continuous upper ledge in cliffs north and west of Beulah, Pueblo County.

†Beulah Shale[1] or Clays[1]

Upper Jurassic: Northeastern Wyoming and South Dakota.

Original reference: W. P. Jenney, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 2, p. 593, fig. 122, map.

In Hay Creek coal field; also 3 or 4 miles north of Beulah, in Red Water Valley, Crook County, Wyo.

Beulah Church Sand Lentil (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. Consists of 2 to 4 feet of glauconitic, sparingly fossiliferous sand about 30 feet below top of member.

Well developed at type locality of Slaughter Creek member on Slaughter Creek, Sabine Parish.

Beverly Syenite[1]

Late(?) Paleozoic: Northeastern Massachusetts.

Original references: C. H. Clapp, 1910, Igneous rocks of Essex County, Mass.; B. K. Emerson, 1917, U.S. Geol. Survey Bull. 597, map; C. H. Clapp, 1921, U.S. Geol. Survey Bull. 704, p. 85–89.

U.S. Geological Survey currently designates the age of the Beverly Syenite as Late(?) Paleozoic on the basis of a study now in progress.

Named for occurrence at Beverly, Essex County.

Bevier cyclothem

See Bevier Formation (in Cabaniss Group).

Bevier Formation (in Cabaniss Group)

Bevier Formation or cyclothem (in Cherokee Group)

Pennsylvanian (Des Moines Series): Western Missouri, southeastern Kansas, and northeastern Oklahoma.

G. E. Abernathy, 1937, Kansas Geol. Soc. Guidebook 11th Ann. Field Conf., p. 18, 19, 23; 1938, Kansas Acad. Sci. Trans., v. 41, p. 193, 195. Cherokee group divided into 15 cyclic formational units. The Bevier, fourteenth in sequence (ascending), overlies the Ardmore and underlies the Mulky. Average thickness 9 feet. [For complete sequence see Cherokee group.]

H. S. McQueen, 1943, Missouri Geol. Survey and Water Resources, 2d ser., v. 28, p. 89–90, 94. Formation comprises Bevier coal with underlying gray clay and overlying black slate. Thickness in Callaway County about 6 feet; 3 feet in Macon County. Overlies Ardmore formation; underlies Lagonda formation. Cherokee group.

W. B. Howe and W. V. Searight, 1953, Missouri Geol. Survey and Water Resources Rept. Inv. 14, pl. 1. Generalized section of strata exposed in Carroll and Livingston Counties shows Bevier formation above Wheeler formation (new) and below Lagonda formation. Cabaniss 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 column as Bevier formation in Cabaniss group. Overlies Verdigris formation; underlies Lagonda formation.

C. C. Branson, 1954, Oklahoma Geol. Survey Guide Book 2, p. 5. Listed as Bevier coal cycle in Senora formation in Oklahoma. Overlies Verdigris coal cycle and underlies Lagonda coal cycle. Cabaniss group.

W. B. Howe, 1956, Kansas Geol. Survey Bull. 123, p. 22 (fig. 5), 78–80. Formation consists of two members: Bevier coal and its underclay. Thickness 8 inches to 8 feet. Overlies Verdigris formation; underlies Lagonda formation. Cabaniss subgroup of Cherokee group. Note on derivation of name.

Name Bevier was originally applied by McGee (1888, St. Louis Acad. Sci. Trans., v. 5) to coal mined at Bevier, Macon County, Mo.

†Bexar[1]

Upper Cretaceous (Gulf Series): Southern Texas.

Original reference: R. T. Hill, 1901, U.S. Geol. Survey 21st Ann. Rept., pt. 7, p. 114.

Probably named for Bexar County.

Bexar Shale Member (of Pearsall Formation)

Cretaceous (Comanche Series); Subsurface in eastern and southern Texas and northern Louisiana.

J. M. Forgotson, Jr., 1956, Gulf Coast Assoc. Geol. Soc. Trans., v. 6, p. 91 (chart); 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 10, p. 2333 (fig. 2), 2337 (fig. 3), 2346–2350. Proposed for upper of three members of Pearsall formation; includes interval between either base of Rodessa formation, Hensell sand, or Glen Rose undifferentiated, and top Cow Creek or James limestone member. In type well, occupies interval from 3,320 to 3,340 feet and consists essentially of black calcareous shale and thin dense finely crystalline limestone beds. Bexar is a sedimentary wedge that thickens into basin with greatest thickening southward from Llano uplift. Depositional edge of Bexar on flanks of Llano uplift is missing owing to an unconformity at base of Hensell sand so that, on outcrop, Hensell sand rests directly on Cow Creek limestone member.

Type well: Ralph E. Fair, Jack Woodward, Inc., and F. B. Lafevre's Pauline Lyro Well 1 in the J. M. Bustillo Survey 29, Bexar County, Tex.

Bibb Dolomite[1]

Upper Cambrian: Northern central Alabama.

Original reference: E. O. Ulrich, 1915, U.S. Nat. Mus. Bull. 92, v. 1, p. vii; v. 2, pl. 2.

B. F. Howell and others, 1944, Geol. Soc. America Bull., v. 55, no. 8, chart 1. Shown on correlation chart as Upper Cambrian. Occurs above Ketona dolomite and below Copper Ridge dolomite.

T. N. McVay and L. D. Toulmin, 1945, Alabama Geol. Survey Bull. 55, p. 23. Listed with formations of Cambrian or Ordovician age.

Named for exposures at Bibb Furnace, about 2 miles west of Brierfield, Bibb County.

Bickett 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. 301, 430.

Type locality: On northwest angle of Bickett Knob, Monroe County. Also observed in Mercer and Summers Counties, W. Va., and in Giles County, Va.

Bickford Granite[1] (of New Hampshire Plutonic Series)

Upper Devonian(?): North-central New Hampshire.

Original reference: C. R. Williams, 1934, Appalachia, v. 20, no. 4, p. 69–78.

M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000): U.S. Geol. Survey. Mapped with same symbol as Concord granite under name of "binary granite." Belongs to New Hampshire plutonic series of Upper Devonian(?) age.

Typically exposed on Bickford Mountain, Franconia quadrangle.

Bicknell Sandstone[1]

Upper Jurassic: Northern California.

Original reference: J. S. Diller, 1892, Geol. Soc. America Bull., v. 3, p. 370–394.

E. D. McKee and others, 1956, U.S. Geol. Survey Misc. Geol. Inv. Map 1–175. Shown on paleotectonic map as underlying Hinchman sandstone and unconformably overlying unnamed volcanic rocks that overlie Mormon sandstone.

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

†Bicknell Tuff[1]

Upper Jurassic: Northern California.

Original reference: A. Hyatt, 1892, Geol. Soc. America Bull., v. 3, p. 407.
Taylorsville region.

Bidahochi Formation[1]

Pliocene: Northeastern Arizona and northwestern New Mexico.

Original reference: A. B. Reagan, 1924, Pan-Am. Geologist, v. 41, p. 357 (map), 366.

C. A. Repenning and J. H. Irwin, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 8, p. 1821–1826. Comprises three unnamed members: lower, 214 feet thick, banded gray, brown, and pink flat-bedded mudstone and argillaceous fine-grained sandstone and a few beds of white rhyolitic ash; middle volcanic member, 5 to 100 feet thick; upper, 274 feet thick, predominantly white to very pale brown crossbedded, poorly cemented medium- to fine-grained argillaceous sandstone and a few beds of white rhyolitie ash. Thickness of formation at reference section herein designated 488 feet; volcanic member not present as mappable unit. Overlies Wingate sandstone, angular unconformity. Pliocene.

E. M. Shoemaker, F. S. Hensley, Jr., and R. W. Hallogen, 1957, U.S. Atomic Energy Comm. TEI Rept. 690, p. 389–398. Formation divided into six members for mapping purposes. Four lower members constitute conformable sequence of claystone and siltstone or very fine grained sandstone that corresponds approximately to "lower member" of Repenning and Irwin (1954). Fifth member, informally referred to as White Cone member includes beds designated as "volcanic member" as well as beds included in "upper member" by Repenning and Irwin. Sixth member is mostly cross-stratified sandstone with minor interbedded claystone.

Type locality not stated; Reagan mapped formation 15 to 20 miles to north and east of settlement of Bidahochi, near Twin Buttes, Ariz. Reference section: Pueblo Colorado Wash 15 miles east of Bidahochi.

Bidarka Formation

Lower Jurassic: Southwestern Alaska.

L. B. Kellum, 1945, New York Acad. Sci. Trans., ser. 2, v. 7, no. 8, p. 203 (table 1), 205. Comprises 1,000 feet of massive to thin-bedded tuffaceous sandstone and interbedded calcareous shale and limestone in lower part and 1,300 feet of dark-gray-black shale with occasional thin beds of light-colored, coarse-grained, well-indurated sandstone in upper part. Underlies Kialagvik formation and overlies Kamishak formation.

In Cold Bay district.

Biddeford Granite[1]

Post-Carboniferous(?): Southwestern Maine.

Original references: C. H. Hitchcock, 1861, Maine Bd. Agr. 6th Ann. Rept., p. 193; F. J. Katz, 1917, U.S. Geol. Survey Prof. Paper 108, p. 177.

Jacob Freedman, 1950, Geol. Soc. America Bull., v. 61, no. 5, p. 476. Incidental mention in report on stratigraphy and structure of Mount Pawtuckaway quadrangle, New Hampshire.

Occurs in Biddeford, Kennebunkport, Kennebunk, and Dayton Townships, York County.

Biddie Knob Formation

[Lower Cambrian]: West-central Vermont.

E-an Zen, 1956, (abs.) Geol. Soc. America Bull., v. 67, no. 12, pt. 2, p. 1829–1830. Revised stratigraphic sequence proposed for north end of slate belt, Taconic Range. Consists of three major units: basal purple and green chloritoid slate (Biddie Knob formation); an intermediate Bull formation; and a black slate formation (the Hooker). Fossils in Bull and Hooker formations indicate that bulk of section is early Cambrian.

E-an Zen, 1959, New England Intercollegiate Geol. Conf. Guidebook 51st Ann. Mtg., p. 1. Underlies Mettawee member of Bull formation.

Type locality and derivation of name not stated.

Bidwell Coal Member (of Spoon Formation)

Pennsylvanian: Southeastern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 32, 45 (table), 65, pl. 1. Proposed for previously unnamed coal. Forms lowermost member of Spoon formation (new) in southeastern part of state. Underlies New Burnside coal member (new). Thickness about 6 feet. Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification is retained but is entirely independent of rock-stratigraphic classification.

Type locality: NE¼SE¼SW¼ sec. 5, T. 11 S., R. 4 E., Johnson County. Named for exposures about three-fourths mile northeast of Bidwell School.

Bienevides Formation

See Benevides Formation.

Big A Sandstone Member (of Supai Formation)

Big A standstone facies (of Supai Formation)

Permian: Central Arizona.

R. L. Jackson, 1951, Plateau, v. 24, no. 2, p. 84–91. Winters (unpub. thesis) recognized four members of Supai in Fort Apache area: Corduroy (new), Fort Apache, Big "A," and Amos Wash (new). In area of present report [Fossil Creek], Supai comprises (ascending) Packard Ranch (new), Oak Creek (new), Big A sand facies, and Corduroy sand facies.

First described near Fort Apache, Ariz.

Big Baldy Granite

Jurassic-Cretaceous: Central California.

D. C. Ross, 1958, California Div. Mines Spec, Rept. 53, p. 14, pl. 1. Medium grained, contains small amounts of dark mineral. Sparsely porphyritic with potash feldspar phenocrysts. May be in part correlative with Cactus Point granite (new).

Named for Big Baldy, highest point on prominent ridge in northwest part of area, Sequoia National Park. Exposed over an area of about 4 square miles and bounded on east and west by metamorphic rocks.

Big Basin Formation

Big Basin Sandstone (in Cimarron Group)[1]

Permian: Central southern Kansas and northwestern Oklahoma.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 3, 46–48.

G. H. Norton, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 12, p. 1760–1761 (fig. 1), 1764–1765 (fig. 3), 1813–1814. Overlying Day Creek dolomite are 65 feet of Permian red beds which Cragin named Hackberry shales and Big Basin sandstone. Name Hackberry being preoccupied, it has been dropped but Big Basin has been retained. Because these strata can be considered one formation of sand beds interstratified with beds of silty and sandy shale, they are herein considered to be one formation and all beds between Day Creek dolomite and top of Permian red beds of Kansas (here covered by Cretaceous) are termed Big Basin formation. Should further work establish correlation of lower shaly part of formation with Doxey shale member of Oklahoma Quartermaster formation, name Big Basin would be restricted to the sand beds alone, the possible equivalent of Elk City sandstone member of Quartermaster. At present, interrelations of type Quartermaster with Day Creek dolomite and so-called Cloud Chief member of Whitehorse have not been definitely established. Writer [Norton] believes that Evans (1931, Am. Assoc. Petroleum Geologists Bull., v. 15, no. 4) was not justified in attempting to drop Kansas nomenclature. Lowermost 25 feet is silty shale, and lower 7 feet of this shaly member is gray-green at some localities. Upper and more prominent part of formation consists of 40 feet of sandstones and sandy shales, both locally lithified to varying extent. Kiger division of Cimarron series.

Named for Big Basin, a depression in Clark County, Kans.

Big Bend facies[1]

Big Bend magnafacies[1]

Upper Devonian: Northwestern Pennsylvania and southwestern New York.

Original reference: K. E. Caster, 1934, Bull. Am. Paleontology, v. 21, no. 71.

W. L. Grossman, 1944, Geol. Soc. America Bull., v. 55, no. 1, p. 46. Complete succession of magnafacies as outlined by Caster for southern New York and northwestern Pennsylvania is not represented in Genesee group. At Cayuga, except for Genesco shale, group is presumably within the Big Bend magnafacies, for it is lithologically like Ithaca beds which Caster (1934) placed in that magnafacies. If facies are to be given names and more or less specific boundaries, Starkey tongue of the Sherburne, penetrating the shales to the west, might be treated as a tongue of the Big Bend magnafacies, though its extension away from main mass of magnafacies is far more limited than that of the black shales. With so many variations in ideal sequence of magnafacies and parvafacies, it is inadvisable to extend terms into western and central New York.

Named for exposures along Allegheny River from Kinzua through Big Bend, Warren County, Pa., and on to Warren, Pa.

Big Bend Gravel[1]

Pleistocene: Northwestern Pennsylvania.

Original references: E. H. Williams, Jr., 1917, Pennsylvania glaciation, First phase; 1917, Am. Philos. Soc. Proc., v. 59, p. 68–75.

Named for Big Bend, Warren County.

Big Blue Group[1]

Big Blue Series[1]

Permian: Eastern Kansas and southeastern Nebraska.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 3, 5.

J. E. Adams and others, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 11, p. 1677–1678. In Oklahoma and Kansas, Leonard series extends from the horizon near top of Herington limestone up to top of Dog Creek shale—that is, to base of Whitehorse group. Therefore, formations of Big Blue and Cimarron series of Kansas and Nebraska should be reclassified according to assignments in Wolfcamp, Leonard, and Guadalupe series.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 39, p. 40. Term Wolfcamp supplants term Big Blue, which has heretofore been used as name of lowermost series in Permian in northern midcontinent area. Big Blue series included some higher beds which are now assigned to the Leonard series. Boundary between Wolfcamp and Leonard in Kansas is drawn at top of Nolans formation.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 24, 30–31. Nebraska Geological Survey continues use of Big Blue series. As here considered, includes section between top of Herington limestone and the unconformity at horizon of Brownwille limestone; includes redefined Chase group, Council Grove group, and Admire group.

Named for Big Blue River, which, in northern Kansas, cuts deeply into these rocks.

Big Blue Serpentinous Member (of Temblor Formation)[1]

Miocene, middle: Southern California.

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

Named for exposures in Big Blue Hills.

Big Branch Formation[1] (in Dornick Hills Group)

Pennsylvanian (Desmoinesian): Southern Oklahoma.

Original reference: F. W. Floyd and D. C. Nufer, 1935, Tulsa Geol. Soc. Digest, 1934, p. 10–11.

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), 140–142. Description of type locality as taken from personal communication by Nufer: 800 feet of section, lower part gray shale with one thin sand bed near middle, upper 400 feet mainly shale with sandstones, chert conglomerate, and several limestones near top of section; placed in geologic column as that unit from top of Pumpkin Creek limestone down to top of Lester limestone; fauna is Des Moines in age and has no Morrow characteristics, and should be removed from the Dornick Hills. This definition is modified by raising base of Big Branch formation from top of Lester limestone to top of Frensley limestone member of Lake Murray formation. Underlies Deese formation.

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), 30. Maximum thickness about 450 feet. Includes Pumpkin Creek limestone member at top. Overlies Frensley limestone; underlies unnamed unit at base of Deese group. Desmoinesian.

Type locality: Exposures along Big Branch of Washita River in NW¼ sec. 11, T. 3 S., R. 2 E., Carter County.

Big Branch Gneiss

Precambrian: Central Texas.

V. E. Barnes, 1940, *in* Geol. Soc. America [Guidebook] 53d Ann. Mtg., p. 53 (geol. map). Shown on geological map of Cut Off Gap area.

V. E. Barnes, 1946, Texas Univ. Bur. Econ. Geology Pub. 4301, p. 56–57 [1945]. Predominantly medium- to dark-gray, medium- to fine-grained quartz diorite composition. Intrudes Valley Spring gneiss and Packsaddle schist. Granites of area and their pegmatites and aplites intrude Big Branch gneiss. Derivation of name given.

Frederick Romberg and V. E. Barnes, 1949, Geophysics, v. 14, no. 2, p. 152–153, fig. 1. Coal Creek serpentine mass is bordered along south and for half of its distance along north by Big Branch gneiss. On map legend Big Branch gneiss is placed above Red Mountain gneiss and below Coal Creek serpentine.

V. E. Barnes, [1952?], Geologic map of the Blowout quadrangle, Blanco, Gillespie, and Llano Counties, Texas (1:31,680): Texas Univ. Bur. Econ. Geology. Most abundant Precambrian rock in quadrangle. Intruded Packsaddle schist and Valley Spring gneiss. Age relation of Red Mountain gneiss and Big Branch gneiss not known. They may be nearly same age and derived from common source. Age relation to Coal Creek serpentine also in question.

Occurs in northeastern Gillespie and northwestern Blanco Counties. Name derived from Big Branch of Coal Creek.

Big Buffalo Series[1]

Lower Ordovician: Northern Arkansas.

E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, pl. 27.

Named for exposures on Buffalo River (formerly called Buffalo Fork of White River), in Newton County.

Big Butt Quartzite

Precambrian (Ocoee Series): Western North Carolina and eastern Tennessee.

G. W. Stose and A. J. Stose, 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1233. Big Butt quartzite caps Bald Mountains and also occurs in Murphy syncline where it is overlain by Valleytown formation.

G. W. Stose and A. J. Stose, 1949, Geol. Soc. America Bull., v. 60, no. 2, p. 272–273, 284–285. Thick-bedded white granular quartzite and interbedded argillite and fine-grained greenish arkose. On Big Butt, formation consists of two beds of massive quartzite, each about 30 feet thick, separated by approximately 100 feet of arkose and argillite. Northeast of the Big Butt, the quartzite caps Rich Mountain and in vicinity of Nolichucky River forms Jump Hill and caps Stony Point; at these places, the quartzite is enclosed in main syncline of Ocoee series and overlies Nantahala slate. One mile southeast of Murphy, Big Butt quartzite makes prominent ridge which is cut through by Hiwassee River; in exposures on north side of river, quartzite is 200 feet thick and consists of two layers of massive thick-bedded white quartzite with thinner beds of dark-banded white and blue, irregularly bedded quartzite in middle. In northern part of Ellijay quadrangle, quartzite is apparently 500 to 600 feet thick but thins southwestward and is not known south of Ellijay. In Murphy syncline, Keith, (1907, U.S. Geol. Survey Geol. Atlas, Folio 143) 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 quartzite are herein correlated with Big Butt quartzite, and 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. Keith (1905, U.S. Geol. Survey Geol. Atlas, Folio 118) termed the quartzite Nebo and the softer beds Murray shale, which are names that properly should be applied only to Lower Cambrian formations; hence, new name for the youngest formation of Ocoee series in Bald Mountains is proposed.

Named from the Big Butt, northeast culmination of Bald Mountains on Tennessee-North Carolina line.

Bigby Limestone[1]

Bigby facies (of Bigby-Cannon Limestone)

Middle Ordovician: Central Tennessee.

Original reference: C. W. Hayes and E. O. Ulrich, 1903, U.S. Geol. Survey Geol. Atlas, Folio 95, p. 2.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 2 (fig. 1), 80, 107–121. Bigby limestone grade laterally into Cannon limestone; the two are contemporary facies of unit here termed Bigby-Cannon limestone which overlies Hermitage formation and underlies Catheys formation. All included in Nashville group.

Named for exposures on Big Bigby Creek, Maury County.

Big Clifty Sandstone[1] **Member** (of Golconda Formation)

Big Clifty Formation (in Stephensport Group)

Upper Mississippian: Western Kentucky and southern Indiana.

Original reference: C. J. Norwood, 1876, Kentucky Geol. Survey, new ser., v. 1, pt. 6, p. 10, 13, 15, 16, 51, 73, 369.

D. H. Swann and Elwood Atherton, 1948, Jour. Geology. v. 56, no. 4, p. 277–278. Sandstone lenses occur sporadically in lower part of Golconda (Indian Springs) shale as far west as Marion County, Ill. Eastward these coalesce into a continuous sandstone unit which has its maximum thickness in a belt extending through eastern Gibson County, Ind., and Daviess County, Ky. There are places where the sandstone is more than 100 feet thick and lies on an unconformable surface which cuts into and even through Beech Creek limestone. This is most continuous and most prominent sandstone in lower and middle Chester of Indiana and Kentucky outcrop belt. Name "Big Clifty" was applied to this sandstone by Norwood (1876). Name has been little used since sandstone has generally been considered equivalent to Cypress sandstone, previously named in Illinois. Northeast of line extending from Shawneetown, Ill., through Dixon and Greenville, Ky., Big Clifty is separated from true Cypress by sheet of Beech Creek (Barlow) limestone; southwest of this line along outcrop belt through Christian and Caldwell Counties, Ky., Big Clifty may lie directly on true Cypress.

A. C. McFarlan and others, 1955, Kentucky Geol. Survey, ser. 9, Bull. 16, p. 18. Name Haney limestone is proposed for the "Golconda" as recognized east of Todd County, Ky., and north into Indiana. Abandoned name Big Clifty returns to use for sandstone that underlies the Haney and caps the Dripping Springs escarpment from Todd County eastward and northward to Ohio River. Because Big Clifty is represented by little or no sandstone in westernmost Kentucky outcrop and subsurface, in Illinois outcrop, and most of Illinois subsurface, name is unsuitable to these areas, and name Fraileys shale is proposed for interval between Haney and Beech Creek limestone wherever sandstone is insignificant or lacking.

D. J. McGregor, T. G. Perry and W. J. Wayne, 1957, Indiana Geol. Survey Field Conf. Guidebook 9, p. 6, pl. 2. Name Big Clifty formation is used here instead of Cypress as it now appears practically certain that name Cypress has been incorrectly used in Indiana. Formation consists of medium-bedded fine-grained sandstone with gray shale locally at base. Thickness 25 to 40 feet. Underlies Golconda formation; overlies Beech Creek limestone.

H. H. Gray, R. D. Jenkins, and R. M. Weidman, 1960, Indiana Geol. Survey Bull. 20, p. 36 (table 5), 40–41, pl. 1. Included in Stephensport group (redefined). Includes shale unit formerly considered to be lower part of Golconda formation. Thickness 42 to 56 feet. Underlies Golconda limestone; overlies Beech Creek limestone.

U. S. Geological Survey currently classifies the Big Clifty Sandstone as a member of Golconda Formation on the basis of a study now in progress.

Named for exposures on Big Clifty Creek, Grayson County, Ky.

Big Cottonwood Formation

Big Cottonwood Quartzite Series[1]

Big Cottonwood Series

Precambrian: Central northern Utah.

Original reference: S. F. Emmons, 1895, U.S. Geol. Survey 16th Ann, Rept., pt. 2, p. 362.

J. S. Williams, 1948, Geol. Soc. America Bull., v. 59, no. 11, p. 1130 (table). Table of summary of formations in Logan quadrangle, Utah, lists Precambrian Big Cottonwood Canyon series below Cambrian Brigham quartzite.

M. D. Crittenden, Jr., 1950, Utah Geol. and Mineralog. Survey [Utah Geol. Soc.] Guidebook 5, pl. 61–65. Formation consists of white or greenish quartzite and brown, green, or deep-blue-purple shale or slaty shale. Thickness 12,000 to 16,000 feet. Underlies unnamed tillite; overlies "the Metamorphic complex."

M. D. Crittenden, Jr., B. J. Sharp, and F. C. Calkins, 1952, Utah Geol. Soc. Guidebook 8, p. 3–4, pl. 1. Term Big Cottonwood series is here proposed as designation for 16,000-foot sequence of alternating rusty-weathering white or greenish quartzites and variegated red, greenish, and blue-purple shales that crop out in lower gorge of Big Cottonwood Canyon. Unconformably overlies Little Willow series (new); underlies Mineral Fork tillite (new). Precambrian.

R. E. Cohenour, 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 36, 37 (fig. 2). Big Cottonwood series discussed in Uinta-Wasatch Mountain junction and part of central Utah. Diagram shows Big Cottonwood above Little Willow series and below Mineral Fork tillite and Mutual quartzite in Wasatch Mountains and below Sheeprock series in Sheeprock Mountains. Correlates with Uinta Mountain group in eastern Uinta Mountains.

Name proposed for sequence which crops out in lower gorge of Big Cottonwood Canyon, in Wasatch Mountains.

Big Cottonwood Formation[1]

Upper Cretaceous: Southwestern Minnesota.

Original reference: F. W. Sardeson, 1908, Geol. Soc. America Bull., v. 19, p. 221–242.

Outcrops on Big Cottonwood River and in neighboring parts of Minnesota Valley.

Big Cottonwood Canyon Series

See **Big Cottonwood Formation.**

Big Creek Shale Member (of Carbondale Formation)[1]

Big Creek Shale (in Carbondale Group)

Pennsylvanian: Western and northern 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. 50 (fig. 22), 108–110, geol. sections 18, 19, 44. Included in Brereton cyclothem, Carbondale group. Thickness 10 to 30 feet; in Havana quadrangle 11 feet thick. Upper part of underlying Cuba sandstone is commonly shaly, and boundary between it and Big Creek shale is indefinite at many places. Stratigraphically below Herrin (No. 6) coal.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 35, 48 (table 1), pl. 1. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois. Carbondale is redefined as formation and includes Big Creek shale member which lies above Vermilionville sandstone member and below Herrin (No. 6) coal member.

Type locality: Along Big Creek in T. 7 N., R. 4 E., Canton quadrangle, Fulton County. Named from outcrops along Big Creek in T. 7 N., R. 4 E., Fulton County.

†Big Deciper Calcareous Sands[1]

Upper Cretaceous (Gulf Series): Southern Arkansas.

Original reference: R. T. Hill, 1888, Arkansas Geol. Survey Ann. Rept. 1888, v. 2, p. 72, 77, 79, 188.

Named for exposures in bluffs of Big Deciper Creek, 6 miles south of Arkadelphia, Clark County.

†Big De Gray horizon[1]

Upper Cretaceous (Gulf Series): Southwestern Arkansas.

Original reference: R. T. Hill, 1888, Arkansas Geol. Survey Ann, Rept. 1888, v. 2, p. 79, 81, 188.

Named for occurrence in bed of Big De Gray Creek, near McCaulley's, Clark County.

Big Elk Sandstone Member (of Colorado Shale)[1]

Upper Cretaceous: Central southern Montana.

Original reference: C. F. Bowen, 1918, U.S. Geol. Survey Bull. 691–F, p. 189, 195–198.

H. D. Hadley, P. J. Lewis, and R. B. Larsen, 1952, Billings Geol. Soc. Guidebook 3d Ann. Field Conf., p. 135. Big Elk sandstone and Mosby sandstone of central Montana probably equivalent to part of Frontier formation.

Named for exposures in Big Elk Dome, in west part of Musselshell Valley.

Bigelow Formation (in Council Grove Group)[1]

Permian: Northeastern Kansas and southeastern Nebraska.

Original references: R. C. Moore, M. K. Elias, and N. D. Newell, 1934, Stratigraphic sections of Pennsylvanian and "Permian" rocks of Kansas River valley: Kansas Geol. Survey, issued Dec.; R. C. Moore, 1935, Rock formations of Kansas *in* Kansas Geol. Soc.: Wichita, Kans. [Am. Assoc. Petroleum Geologists 20th Ann. Mtg., Mar. 21-23]; G. E. Condra, 1935, Nebraska Geol. Survey Paper 8.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 39, p. 65. Proposed that Bigelow be dropped as stratigraphic term and that Crouse limestone, Blue Rapids shale, and Funston limestone be recognized as formations. Gives derivation of name.

Named from Bigelow, Marshall County, Kans.

Big Falls Picritic Basalt (in Hana Volcanic Series)

Pleistocene(?): Maui Island, Hawaii.

G. A. Macdonald *in* H. T. Stearns and G. A. Macdonald, 1942, Hawaii Div. Hydrography Bull. 7, p. 231 (table), 238–241, pl. 1. Characterized by prominent phenocrysts of augite and olivine. Commonly very vesicular pahoehoe, locally aa. Typically consists of many thin flow units ranging in thickness from 1 or 2 feet to 20 feet. Maximum thickness about 134 feet. Basal unit of series; lies on eroded surface of Kula lavas; in sea cliff east of Hanawi Stream fills gorge cut completely through

Kula lavas into Honomanu basalts. Stratigraphically below Makapipi basalts (new).

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 77–78. Exposed along narrow band with outcrop area of about 0.1 square mile along east side of Hanawi Gulch, in Nahiku area along northeast side of island. Pleistocene(?).

Named for occurrence at Big Falls on Hanawi Stream, Haleakala (East Maui) volcano.

Bigford Member (of Mount Selman Formation)[1]

Eocene, middle: Southern Texas.

Original reference: A. C. Trowbridge, 1923, Geol. Soc. America Bull., v. 34, p. 75; 1923, U.S. Geol. Survey Prof. Paper 131–B, p. 92.

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 the Mount Selman have been regarded as contemporaneous. Geographic and stratigraphic positions of the fossiliferous ferruginous sandstones north of Leming, Atascosa County, suggest that they represent eastward extension of Bigford from Frio County. If Leming and Scruggs Creek localities should prove to represent same zone, then on the assumption that the conglomerate is basal part of 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.

Named for Bigford Ranch, Webb County.

Bigfork Chert[1]

Middle Ordovician: Southwestern Arkansas and southeastern Oklahoma.

Original reference: A. H. Purdue, 1909, Geol. Soc. America Bull., v. 19, p. 557; 1909, Slates of Arkansas; Arkansas Geol. Survey, p. 30, 35.

B. H. Harlton, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 4, p. 781 (fig. 2), 782, 783–787. Geographically extended into Ouachita Mountains, southeastern Oklahoma, where it is well exposed at Black Knob Ridge and in the Potato Hills. At Black Knob Ridge, light- to dark-gray hard cryptocrystalline well-bedded cherty highly siliceous limestone with thin layers of coarsely crystalline limestone; upper part consists of alternating chert and marly shale or shale beds ranging from 1 inch to 2 feet in thickness. About 600 feet thick. Conformably underlies Polk Creek shale; overlies Womble shale. Upper Ordovician.

Named for exposures over large area around Bigfork post office, Montgomery County, Ark.

Big Glass Mountain Complex[1]

Recent: Northern California.

Original reference: H. A. Powers, 1932, Am. Mineralogist, v. 17, no. 7, p. 280–282.

In Modoc Lava Bed quadrangle.

Bigheart Sandstone Member (of Tallant Formation)

Bigheart Sandstone Member (of Nelagoney Formation)[1]

Pennsylvanian (Missouri Series): Central northern Oklahoma.

Original reference: L. C. Snider, 1911, Oklahoma Geol. Survey Bull. 7, p. 221.

M. C. Oakes, 1951, Tulsa Geol. Soc. Digest, v. 19, p. 119–120, 121–122. Reallocated to member status in Tallant formation (new).

W. F. Tanner, 1956, Oklahoma Geol. Survey Circ. 40, p. 32–39, pl. 1. Basal member of Tallant. Revard sandstone member lies near top of formation. Average thickness between 10 and 35 feet.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 21–22, pls. In Pawnee County, Bigheart is thick resistant bed of fine- to coarse-grained sandstone. Massive to well bedded to crossbedded; contains silty or shaly streaks. Thickness 50 to 72 feet. Basal member of Tallant. Separated from overlying Revard sandstone member by unnamed shale member approximately 100 feet thick.

Named for exposures west of Barnsdall (formerly called Bigheart), Osage County.

Big Hill Basalt or Flow (in Clayton Basalt)

Late Cenozoic: Northeastern New Mexico.

Brewster Baldwin and W. R. Muehlberger, 1959, New Mexico Bur. Mines Mineral Resources Bull. 63, p. 117 (fig. 17), 119, 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. Big Hill is second in known sequence; younger than Emery Peak and older than Mud Hill.

Big Hill is deeply eroded cone composed of tuff, spatters, and minor amounts of lava, Union County.

Big Hill Beds[1] or Member (of Richmond Formation)

Big Hill Limestone

Upper Ordovician: Northern Michigan.

Original reference: R. C. Hussey, 1926, Michigan Univ. Mus. Geol. Contr., v. 2, no. 8, p. 115–150.

R. C. Hussey, 1952, Michigan Dept. Conserv., Geol. Survey Div. Pub. 46, Geol. Ser. 39, p. 14 (table). Table shows Big Hill [member] of Richmond formation; occurs above Stonington [member].

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2 (column 46). Chart shows Big Hill limestone overlying Ogontz limestone.

Beds exposed from crest of Hinkins Hill (also known as Big Hill) north to east end of Maywood road, Delta County.

Bighorn Dolomite,[1] Limestone, or Group

Upper Ordovician: Wyoming and southern Montana.

Original reference: N. H. Darton, 1904, Geol. Soc. America Bull., v. 15, p. 394–401.

C. W. Tomlinson, 1917, Jour. Geology, v. 25, no. 2, p. 113, 118 (fig. 2); no. 3, p. 253–257. Bighorn dolomite divisible into nine members. Members 5 to 7 constitute a distinct and widely developed unit. In Goose Creek Ridge section, there is little ground for differentiating these three from each other but lowest Richmond fauna occurs in beds there marked as member 6. In Crandall Creek and Dead Indian Creek sections, there is conspicuous surface of disconformity with a basal breccia, at base of member 6. It probably represents the hiatus which was inferred by Darton between Trenton and Richmond members of the Bighorn. In Teton Range, there is an unconformity at base of member 6. Blackwelder proposes recognition of members 6 and 7 in that region, and of corresponding strata in Gros Ventre Range, as a distinct formation, to be called the Leigh.

Eliot Blackwelder, 1918, Washington Acad. Sci. Jour., v. 8, no. 13, p. 419–420. From Teton Range eastward at least to middle of Wind River Mountains and north into Absaroka Range, the massive member, the Bighorn dolomite, is overlain by a thin persistent layer, the Leigh dolomite member. The Leigh is commonly 30 to 40 feet thick, and, in most if not in all localities, is limited both above and below by disconformities.

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1092. In Wind River Canyon area, Wyoming, Big Horn [Bighorn] dolomite overlies Boysen formation (new).

J. D. Love, 1939, Geol. Soc. America Spec. Paper 20, p. 17-20, pl. 17. Formation in southern Absaroka Range, Wyo., comprises three members: Lander sandstone, about 7 feet high; massive middle dolomite member, 180 feet thick; and Leigh dolomite member, 25½ feet thick. Overlies Gallatin formation; underlies Darby formation.

Erling Dorf and Christina Lochman, 1940, Geol. Soc. America Bull., v. 51, no. 4, p. 543, 554 (fig. 2). In southern Montana, overlies Grove Creek formation (new).

E. B. Branson and C. C. Branson, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 124 (table 1), 129. Bighorn dolomite in this report [Wind River Mountains] is 200 to 300 feet thick. Overlies Lander sandstone; and underlies Darby formation. No lithologic or faunal unit comparable with Leigh dolomite member of Gros Ventre Range recognized in area of report.

H. R. Wanless, R. I. Belknap, and Helen Foster, 1955, Geol. Soc. America Mem. 63, p. 14–15, pls. Bighorn dolomite is prominent in eastern Teton and southwest Gros Ventre Ranges where it overlies Boysen limestone (formation). Also exposed in Snake River Canyon, on either side of St. John thrust, and in the sheets west of Ferry Peak and Needle Peak thrusts. It is oldest exposed stratum both in northern Grayback Ridge, resting on Darby thrust where it overlies overturned Cretaceous Bear River shales, and in Shepherd Creek on western side of Hoback Range, where it is partially exposed in faulted anticline about one-half mile east of Hoback fault. Also exposed in southwestern and West Jackson Hole Buttes. Thickness 60 to 620 feet. Upper part of Bighorn was designated Leigh member by Tomlinson (1917), but, since its Ordovician age is doubted, it is herein considered separate formation and its thickness is not included in above-mentioned thicknesses. Leigh formation is overlain by Darby formation.

R. K. Hose, 1955, U.S. Geol. Survey Bull. 1027–B, p. 45–48, pl. 6. Described in Crazy Woman Creek area, Johnson County, Wyo., where it overlies Gallatin limestone and Gros Ventre formation, undivided, and unconformably underlies Madison limestone. Consists of three major units: basal 65 feet, light-gray to brick-red, very fine-grained to coarse-grained almost pure quartz sandstone; middle, about 250 feet of dense massive dolomite; upper, about 40 feet of white-weathering slabby argillaceous dolomite.

M. M. Knechtel, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 8, p. 1994–1995. In Little Rocky Mountains, Mont., overlies Emerson formation (new). Upper Ordovician.

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 Willston basin, eastern Montana. Term Bighorn group used to include (ascending) Red River and Stony Mountain formations in subsurface. Overlies Winnipeg formation.

P. W. Richards and C. L. Nieschmidt, 1957, Billings Geol. Soc. Guidebook 8th Ann. Field Conf., p. 54–62. Bighorn dolomite crops out in south-central Montana and northern Wyoming throughout Absaroka Range, Beartooth and Pryor Mountains, and all but southern part of Bighorn Mountains. Missing from Big Snowy and Little Belt Mountains and Bridger Range in Montana; occurrence west of Yellowstone National Park spotty. Maximum thickness about 500 feet in Bighorn Mountains near Montana-Wyoming border east of map area. Thinner southward, westward, and northward from that area. Merges eastward into Red River and Stony Mountain formations. Bighorn is restricted for this report to area north of Wind River basin, Wyoming—that is, north of approximately the 43°30′ parallel of latitude—to the predominantly carbonate rocks. As thus restricted, divided into two main units which are distinguished in map area except in Pryor Mountains and on north flank of Beartooth Mountains. Lower three-fourths of lower unit is massive cliff-forming dolomite, and upper one-fourth is thin-bedded dolomite; unit is 210 to 260 feet thick. Massive lower part of lower unit is evidently Tomlinson's units 3 and 4, and white blocky dolomite at top of lower member is Tomlinson's unit 5. Upper unit is a 1- to 3-fold sequence of lower unit, but the massive- and thin-bedded parts are neither as thick nor as continuous in upper unit as in the lower. Upper unit, as here described, includes Tomlinson's units 6 to 9 inclusive. Tomlinson said his units 6 and 7 are Leigh dolomite member. However, the writers [Richards and Nieschmidt] do not believe that these two units are necessarily the stratigraphic equivalent of Leigh dolomite member as defined in Teton Range by Blackwelder, and name Leigh is not applied in area of this report. Overlies Cambrian Grove Creek formation throughout Beartooth Mountains and adjacent areas; underlies Devonian strata throughout all but far southeast corner of area; in that area and to the south, underlies Madison limestone. Unconformably underlies Devonian strata. Unconformity marked in some places by channel deposits which, in Park County, Wyo., were named Beartooth Butte formation by Dorf (1934). Jefferson formation overlies Beartooth Butte formation and the Bighorn beyond edges of Beartooth Butte formation.

W. J. Mapel, 1959, U.S. Geol. Survey Bull. 1078, p. 13–17, pls. Thickness 370 to 395 feet in Buffalo-Lake De Smet area, Wyoming. Includes sandstone member at base, massive cliff-forming dolomite member in middle, and thin-bedded dolomite and dolomitic limestone member at top. Overlies Gallatin and Gros Ventre formations, undifferentiated; underlies Madison limestone.

Named for exposures in Bighorn Mountains, Wyo.

†Bighorn glacial epoch[1]

Pleistocene (pre-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.

Biglow Glacial Substage

Pleistocene (Tazewell): West-central Colorado.

R. L. Nelson, 1954, Jour. Geology, v. 62, no. 4, p. 329–331, fig. 2, table 4. Time of Wisconsin glaciation in Frying Pan Valley during which outwash deposits and Biglow moraines were deposited. Older than Ivanhoe glacial substage (new); younger than Thomasville glacial substage (new).

Deposits mapped in vicinity of Biglow. In Frying Pan River drainage just west of Continental Divide in Sawatch Range.

Big Mountain Shale Member (of Keyser Limestone)[1]

Lower Devonian: Northern West Virginia and western Virginia.

Original reference: F. M. Swartz, 1929, U.S. Geol. Survey Prof. Paper 158–C, p. 29.

H. P. Woodward, 1943, West Virginia Geol. Survey, v. 15, p. 38, 42–44, 226. Dark thin-bedded calcareous shale with thin limestone bands and locally partly knobby or irregular bedding. Relatively unfossiliferous limestones; contacts with adjacent units are sharp. Passes laterally into lower part of Clifton Forge sandstone of Alleghany County, Va., and adjacent areas in West Virginia.

Named from Big Mountain about 1½ miles west of village of Upper Tract, Pendleton County, W. Va.

Bignell Loess

Bignell Formation (in Sanborn Group)

Bignell Silt Member (of Sanborn Formation)

Pleistocene and Recent: Southwestern Nebraska and northwestern Kansas.

C. B. Schultz and T. M. Stout, 1945, Am. Jour. Sci., v. 243, no. 5, p. 241–244. Formation consists of gray loess. Separated from "Peorian" loess by prominent soil and overlain by complex top soil.

J. C. Frye and O. S. Fent, 1947, Kansas Geol. Survey Bull. 70, p. 50–51. Geographically extended into Kansas where it is considered silt member of Sanborn formation. Occurs above Brady soil at top of Peoria silt member. Thickness in Rice County, 1½ feet.

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 138–140. Member forms thin discontinuous widely distributed deposits over northwestern part of Kansas. Commonly less than 10 feet thick; resembles underlying Peoria loess in lithology; contains distinctive, though sparse, molluscan fauna. Rests on Brady soil. Caryan-Mankatoan.

C. W. Hibbard, 1958, Am. Jour. Sci., v. 256, no. 1, p. 55 (fig. 1). Formation at top of Sanborn group.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. Shown on correlation chart as Bignell Formation. [Kansas does not use term Sanborn group].

Type locality: About 1.7 miles due south of Bignell, southeast of North Platte, in E½E½ sec. 3, T. 12 N., R. 29 W., Lincoln County, Nebr.

Big Oak Flat 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. 200, 203–204, 226 (fig. 5), pl. 3. Lower part, 300 to 350 feet thick, is interbedded brownish sandstone and clay-shale, with limestone concretions; upper part is foraminiferal clay-shale, 200 to 300 feet thick. Unconformably overlies Call sandstone member (new) on southwest limb of Butts Ranch syncline; underlies Lodo formation. Considered younger than Butts Ranch shale (new); may be younger than Moreno shale which does not appear on southwest side of syncline.

Type locality: Small northeast-trending canyon 1 mile northwest of Big Oak Flat, San Benito County. Named for Big Oak Flat. Exposed only on southwest side of Butts Ranch syncline.

Big Rock Conglomerate Member (of Kiawa Mountain Formation)

Precambrian: Central northern New Mexico.

Fred Barker, 1958, New Mexico Bur. Mines Mineral Resources Bull. 45, p. 1, 10, 24–25, pl. 1. Consists of dark- to medium-gray quartz-pebble conglomerate with intercalated slightly feldspathic quartzite. Most pebbles are light-gray quartz; a few are red and black quartz. Crossbedding common, and current bedding commonly well defined by laminae of iron oxide as well as by layers of differing grain size. Pebbles mostly in the 1- to 5-inch range are well to poorly sorted and highly rounded. Thickness 50 to 200 feet. Underlies lower quartzite member; overlies Ortega quartzite; appears to pinch out east of Poso Spring.

Extends along its strike from NE¼ sec. 20, T. 27 N., R. 8 E., to Big Rock syncline (0.2 mile northwest of Big Rock) and north to Poso anticline; also in SE¼SW¼ sec. 23, T. 27 N., R. 8 E., Las Tablas quadrangle.

Big Run Sandstone

Pennsylvanian (Monongahela Series): Eastern Ohio.

A. T. Cross, W. H. Smith, and Thomas Arkle, Jr., 1950, Field guide for special conference on the stratigraphy, sedimentation, and nomenclature of the Upper Pennsylvanian and Lower Permian strata (Monongahela, Washington, and Greene series) in the northern portion of the Dunkard Basin of Ohio, West Virginia, and Pennsylvania: West Virginia Geol. and Econ. Survey, Sec. 12–A, 12–B, Stop 15 [pl. 1]. Big Run sandstone shown on profile of Uniontown to middle Benwood strata on Ohio Route 7, north of Powhatan. Description reads Lower Uniontown (Big Run sandstone). Columnar section [pl. 1] shows Big Run sandstone above Lower Uniontown coal and below Uniontown coal (No. 10).

Big Saline Formation (in Bend or Marble Falls Group)

Big Saline Group

Big Saline Member (of Marble Falls Formation)

Pennsylvanian: North-central Texas.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 83–85. In much of north-central Texas, type Marble

Falls beds are unconformably overlain by group of shales, sandstone, and limestone, which is herein named Big Saline group. Underlies Smithwick group. Big Saline beds have commonly been included with the Marble Falls. Group is represented by some 50 feet of fusulinid-bearing limestones and shales in east-central McCulloch County; beds become more shaly eastward and identity at outcrop becomes less certain. Northward in subsurface, beds attain thickness of at least 400 feet in Ranger area and are divisible into two formations De Leon and Sipe Springs (both new). Lampasas series.

F. B. Plummer, 1944, Texas Univ. Bur. Econ. Geology Mineral Resources Circ. 33, p. 6, 7; 1945, Texas Univ. Bur. Econ. Geology Pub. 4401, p. 65, 67, 68, 73. Member of Marble Falls formation. Overlies Sloan member (new); underlies Lemons Bluff member (new).

F. B. Plummer, 1947, Jour. Paleontology, v. 21, no. 2, p. 142, 143–145. Formation, east of Cavern Ridge, includes (ascending) Gibbons conglomerate, Aylor oolite, Lemons Bluff spiculite, and Brister limestone members; west of Cavern Ridge includes (ascending) Gibbons, Brook Ranch, Lemons Bluff, and Soldiers members. Overlies Sloan formation; underlies Smithwick formation. Bend (Atoka) group.

F. B. Plummer, 1950, Texas Univ. Bur. Econ. Geology Pub. 4329, p. 56 (fig. 13), 57–77. Here assigned to Marble Falls group, Bend series.

Type locality: Near mouth of Big Saline Creek in eastern Kimble County.

Big Snowy Group[1] or Formation

Mississippian and Pennsylvanian: Central Montana.

Original reference: H. W. Scott, 1935, Geol. Soc. America Proc. 1934, p. 367.

O. A. Seager, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 5, p. 863. In subsurface in Cedar Creek anticline, southeastern Montana, Big Snowy group includes (ascending) Charles (new), Kibbey, and Otter formations. Underlies Amsden formation; overlies Madison (Pahasapa of Black Hills).

L. L. Sloss, 1952, Billings Geol. Soc. Guidebook 3d Ann. Field Conf., p. 65 (chart), 67, 68 (cross section). Restricted at base to exclude Charles formation (subsurface and surface?) which is here assigned to Madison group. As restricted, includes (ascending) Kibbey, Otter, and Heath formations. Underlies unit referred to as lower Amsden.

L. S. Gardner, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 2, p. 329–349. Big Snowy group of Scott is expanded and redefined to include, in ascending order, not only Kibbey sandstone, Otter formation, and Heath formation of his original report, but also three overlying formations—Cameron Creek, Alaska Bench limestone, and Devils Pocket formation. Scott's (1935) Amsden consisted of a lower red shale, siltstone, and sandstone member (Cameron Creek of this report) and an upper gray limestone member (Freeman's Alaska Bench limestone). Underlies Triassic(?) or Permian(?) and Pennsylvanian undifferentiated, or locally Ellis group; overlies units of Madison group. Thickness 1,509 feet at standard section herein suggested. Mississippian and Pennsylvanian.

O. D. Blake, 1959, Billings, Geol. Soc. Guidebook 10th Ann. Field Conf., p. 64 (fig. 1), 65–68. Includes unit termed Lombard facies.

Standard section: Composite of Stonehouse Ranch and State Road No. 25 sections. Upper part of section was measured in secs. 31 and 32,

T. 11 N., R. 21 E., and lower part was measured in sec. 30, T. 11 N., R. 21 E., and sec. 25, T. 11 N., R. 20 E., Big Snowy Mountains. Named for extensive distribution and exposures in Big Snowy Mountains. Also exposed in Little Belt Mountains, Castle Mountains, and Lombard Hills.

Big Spring Member (of Conococheague Formation)

See Big Spring Station Member (of Conococheague Formation)

Big Springs 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), 153. Big Springs limestone member of Lecompton formation; underlies Queen Hill shale member; overlies Doniphan 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. 20, fig. 5. Thickness about 1 foot in Iowa, Missouri, and Nebraska; average about 2 feet in Kansas. Type locality stated. G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 24.

Commonly one massive light- to dark-gray argillaceous bed. Very fossiliferous in some outcrops. Thickness 1 to 1½ feet. Underlies Queen Hill shale member; overlies Doniphan shale member.

Type locality: North of Big Springs, Douglas County, Kans.

Big Spring Station Member (of Conococheague Formation)

Upper Cambrian: Northwestern Maryland and southwestern Pennsylvania.

Ernst Cloos, 1951, Maryland Dept. Geology, Mines and Water Resources, Washington County [Rept. 14], p. 45, 55–56. Name Big Spring member applied to basal unit of the Conococheague as described in section measured at Big Spring, Md. Consists mainly of dolomite, shale, sandstone beds, oolite and cryptozoon limestone. Thickness 312 feet. Underlies dolomite beds in middle part of formation; overlies Elbrook formation. Name credited to J. L. Wilson.

J. L. Wilson, 1952, Geol. Soc. America Bull., v. 63, no. 3, p. 307–308, pl. 3. Formally proposed as Big Spring Station member. Member is best defined by abundant beds of platy yellow-weathering dolomitic siltstone or silty dolomite and coarsely arenaceous dolomite or siliceous orthoquartzite; some of the latter beds are 4 to 5 feet thick, although generally the rock type occurs in thinner layers interbedded with typical laminated limestone of the higher Conococheague. Upper boundary arbitrarily drawn at top of uppermost orthoquartzite or very arenaceous limestone within lower group of Conococheague sandstones; lower limit of member (and formation) arbitrarily drawn at lowest of these sandstone beds; the buff-yellow weathering silty dolomite in the Big Spring Station is the same type as that in underlying Elbrook formation, and boundary between the two units is gradational if sandy layers are not considered.

Carlyle Gray and A. A. Socolow, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 148–150. Snitz Creek member of Conococheague has same stratigraphic position of, and is lithologically similar to, Big Spring Station member (Wilson, 1952) of Conococheague formation.

Type section: At railroad cuts north of and in fields west of Big Spring Station on Western Maryland Railroad about 3 miles south of Clear Spring, Washington County, Md.

Big Spruce Knob Sandstone[1]

Mississippian: Southern West Virginia.

Original reference: D. B. Reger, 1920, West Virginia Geol. Survey Rept. Webster County, p. 214, 221–223.

Named for exposure at base of Big Spruce Knob, Pocahontas County.

Big Spruce Knob Shale[1]

Mississippian: Southern West Virginia.

Original reference: D. B. Reger, 1920, West Virginia Geol. Survey Rept. Webster County, p. 214, 223–224.

Exposed on Big Spruce Knob, Pocahontas County.

Big Stone Gap Member (of Chattanooga Shale)[1]

Mississippian (Kinderhookian): Southern Tennessee and southwestern Virginia.

Original reference: J. H. Swartz, 1927, Am. Jour. Sci., 5th, v. 14, p. 485–499.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (columns 93, 94, 96, 97). Shown on correlation chart as overlying Olinger shale and locally the Chemung. Mississippian (Kinderhookian).

W. H. Hass, 1956, U.S. Geol. Survey Prof. Paper 286, p. 26. At locality 228 (near Apison, Hamilton County, Tenn.), black shale identified as Big Stone Gap member of Chattanooga by Swartz is placed in Maury formation as herein defined. This stratigraphic assignment made because beds in question either contain conodonts like those of Maury formation of Tennessee or have lithology similar to that formation.

Extends continuously from Chattanooga area to Big Stone Gap, Va., and beyond.

Big Stone Gap Shale[1] or Siltstone

Upper Devonian and Lower Mississippian: Southwestern Virginia.

Original reference: G. W. Stose, 1923, Virginia Geol. Survey Bull. 24.

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 143–144, pl. 15. Stose (1923) named Big Stone Gap shale from Big Stone Gap, Va. Swartz (1926 [1927]) proposed that Big Stone Gap be used as name for upper member of Chattanooga formation. Present writer [Cooper] agrees with Swartz's restriction of name but doubts advisability of designating the shale as a member. Geographic distribution of unit is sufficiently extensive for shale to be regarded as formation. In Burkes Garden quadrangle [this report], Big Stone Gap shale is present only in belt immediately north of St. Clair fault. Where well exposed near south edge of Bluefield, formation consists of about 10 feet of black fissile shale. This shale was identified as Sunbury shale by Reger (1926, West Virginia Geol. Survey Rept. Mercer, Monroe and Summers Counties), but this correlation has scant supporting evidence. Writer traced black shale zone at base of the Price from Bluefield, Va., southwestward to Duffield, Scott County and is satisfied that the black shale at Bluefield is upper part of Big Stone Gap shale of Stose and the Big Stone Gap member of Chattanooga formation of Swartz. Underlies Price formation; overlies "Chemung." Mississippian (Kinderhook).

L. D. Harris and R. L. Miller, 1958, U.S. Geol. Survey Geol. Quad. Map GQ–111. Described in Duffield quadrangle as Big Stone Gap siltstone. This formation was defined as shale by Stose. Consists of about 200 feet of dark-gray to grayish-black carbonaceous siltstone with some interbeds of dark-gray carbonaceous shale. Overlies a 400-foot sequence of siltstone (Portage shale as used by Stose, 1923); underlies Price siltstone. On basis of conodonts collected in Duffield quadrangle and near Big Stone Gap, Hass believed formation to be Late Devonian and Early Mississippian in age.

Named for Big Stone Gap, southwestern Virginia.

Big Thompson Metasediments

Big Thompson Schist[1]

Precambrian: Central northern Colorado.

Original reference: M. B. Fuller, 1924, Jour. Geology, v. 32, p. 51–63.

M. F. Boos, 1954, (abs.) Geol. Soc. America Bull., v. 65, no. 12, pt. 2, p. 1372. Estes Park beds (new) of Big Thompson series of metasedimentary formations and Longs Peak (Silver Plume) and Mount Olympus granitic rocks constitute bedrock of Estes Park Valley.

B. D. Hudson, 1959, Dissert, Abs., v. 19, no. 10, p. 2578. Metasediments are oldest rocks in area near mouth of Big Thompson Canyon. Quartzite, micaceous quartzite, feldspathic quartzite, quartz schist, and mica schist interbedded in a relatively undeformed sequence at least 13,000 feet thick.

Named for Big Thompson River, which, in traversing eastern slope of Front Range, has exposed a complete section of the schist.

Big Valley Bed (in Strawn Group)[1]

Pennsylvanian: Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 374, 380.

D. A. Zimmerman and G. D. Glover, 1956, Soc. Econ. Paleontologists and Mineralogists Permian Basin Sec. [Guidebook] Spring Mtg. and Field Symposium, May 11, 12, no. 70. Underlies Brown Creek bed; overlies Bull Creek sandstone. Strawn series.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 58, pl. 27. Drake (1893) separated rocks of Strawn group [division] into 20 units of alternating sandstone and shale beds. He gave local names to these units, or "beds" as he termed them, and numbered them from 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 Big Valley, Mills County.

Big Wash Andesite

Tertiary: Northwestern Arizona.

B. E. Thomas, 1949, Econ. Geology, v. 44, no. 8, p. 667, fig. 2. Andesite flow which lies unconformably on rhyolite tuff and breccia of Kingman series (new).

B. E. Thomas, 1953, Geol. Soc. America Bull. v. 64, no. 4, p. 408. Thickness of flow 50 to 60 feet. Platy jointing well developed in the bed.

Only occurrence is west of Chloride, on north side of mouth of Big Wash, on west flank of Cerbat Mountains, Mohave County.

Bijiki Iron-Formation Member (of Michigamme Slate)[1]

Precambrian (Animikie Series): Northwestern Michigan.

Original reference: C. R. Van Hise and W. S. Bayley, 1895, U.S. Geol. Survey 15th Ann. Rept., p. 596.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 36. Lower part of Michigamme slate in Marquette district includes Bijiki iron-formation, Clarksburg volcanics, and Greenwood iron-formation members. Animikie series.

Named for exposures near mouth of Bijiki River.

Bijou Formation

Miocene-Pliocene: South Dakota.

R. E. Stevenson and L. A. Carlson, 1950, Areal geology of Bonesteel quadrangle (1:62,500): South Dakota Geol. Survey. Interbedded bentonitic clay, sandy siltstone, sandstone, and pebble conglomerate. Stratigraphically above Elk Butte member of Pierre formation and below Herrick gravels (new).

R. E. Stevenson, 1953, South Dakota Acad. Sci. Proc., v. 32, p. 86–89. Characterized by green siliceous coarse quartzose sandstone which makes up about 21 percent of formation. This siliceous sandstone occurs as discontinuous lenses. Bulk of formation consists of greenish to gray bentonitic clay. Thickness, determined from exposures and drill holes, 38 to 54 feet. Barstovian-Clarendonian.

R. E. Stevenson, 1957, South Dakota Acad. Sci. Proc., v. 36, p. 134–138. As herein revised, consists of lenses and thin beds of greenish siliceous sandstone which may be found interbedded with strata of Pliocene or Miocene age (unnamed upper Miocene, Valentine, or Ash Hollow). That is, the Bijou represents a discontinuous facies of greenish silica-cemented sandstone in Miocene and Pliocene rocks of south-central South Dakota.

Typical section: SW¼NE¼ sec. 30, T. 96 N., R. 67 W., Gregory County. Named from exposures in Bijou Hills.

Bilk Creek Sandstone Member (of Wanakah Formation)

Bilk Creek Sandstone Member (of Morrison Formation)

Upper Jurassic: Southwestern Colorado.

M. I. Goldman and A. C. Spencer, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 9, p. 1748 (fig. 2), 1750, 1752 (fig. 3), 1753 (table 1). Proposed as member of Morrison formation. About 20 feet of sandstone or sandy beds capped by carnelian sandstone. Underlies Wanakah marl member; overlies Pony Express limestone member. [See La Plata sandstone.]

E. B. Eckel, 1949, U.S. Geol. Survey Prof. Paper 219, p. 27 (table), 28–29, pl. 2. Reallocated to member status in Wanakah formation. Overlies Pony Express member and underlies unnamed marl member.

Named for exposures along highway about 6 miles west of Telluride, along San Miguel Valley, opposite mouth of Bilk Creek, Ouray County.

Billings Member (of Wellington Formation)

Permian: North-central Oklahoma.

G. O. Raasch, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1928. Thickness 52 feet. Underlies Antelope Flats member (new); overlies Midco (lacustrine) member (new).

W. F. Tanner, 1959, Jour. Sed. Petrology, v. 29, no. 3, p. 327 (table 1). Table shows Billings Pool member above Midco member and below Antelope Flats member.

Type locality and derivation of name not stated.

Billings Pool Member (of Wellington Formation)

See Billings Member (of Wellington Formation).

Bills Creek Beds[1] or Member (of Richmond Formation)

Bills Creek Shale

Upper Ordovician: Northern Michigan.

Original reference: R. C. Hussey, 1926, Michigan Univ. Mus. Geology Contr., v. 2, no. 8, p. 113–150.

R. C. Hussey, 1952, Michigan Dept. Conserv. Geol. Survey Div. Pub. 46, Geol. Ser. 39, p. 13, 14 (table), 40–45. Overlie Haymeadow Creek member (new) of Trenton formation. Unit termed Haymeadow Creek was formerly included in basal Bills Creek beds. Maximum thickness of beds 80 feet; lower 20 feet are now correlated with Collingwood which some workers consider late Trenton. Thickness at type locality about 62 feet. Underlie Stonington beds [or member] of Richmond. Contact with overlying Stonington beds is disconformable.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2 (column 46). Chart shows Bills Cheek shale below Bay de Noc limestone.

Type locality: Along Bills Creek, sec. 7, T. 41 N., R. 20 W., sec. 12, T. 41 N., R. 21 W., 5 miles northeast of Rapid River, Delta County.

Biloxi Sand[1]

Pleistocene: Southern Mississippi, and southeastern Louisiana.

Original reference: L. C. Johnson, 1891, Geol. Soc. America Bull., v. 2, p. 24-25.

Named for Biloxi, Harrison County, Miss.

Bimber Run Conglomerate Member[1] (of Venango Formation)

Upper Devonian: Northwestern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 86, table opposite p. 61.

Bradford Willard, 1939, Pennsylvania Geol. Survey, ser. 4, Bull. G–19, p. 14, 243. Listed as member of Venango formation. Underlies North Warren shale member. Upper Devonian. Bimber Run and North Warren are part of Caster's (1934) Salamanca formational suite.

Named for occurrence on Bimber Run and south of its mouth in Watson Township, Warren County.

†Bingen Formation[1] or Sand[1]

Upper Cretaceous (Gulf Series): Southwestern Arkansas, northwestern Louisiana, and southeastern Oklahoma.

Original reference: R. T. Hill, 1888, Arkansas Geol. Survey Ann. Rept. 1888, v. 2, p. 56–58.

Named for exposures near Bingen, Hempstead County, Ark.

Bingham Quartzite[1]

Pennsylvanian: Central northern Utah.

Original reference: A. Keith, 1905, U.S. Geol. Survey Prof. Paper 38, p. 33–37, map sections.

Includes following units: Phoenix Limestone Lentil, Tilden Limestone Lentil, Yampa Limestone Lentil, Highland Boy Limestone Member, Commercial Limestone Member, Jordan Limestone Member, Lenox Limestone Member, and Butterfield Limestone Member.

In Bingham district.

Binghamton Drift

Binghamton Substage

Pleistocene (Wisconsin): New York and Pennsylvania.

Paul MacClintock and E. T. Apfel, 1944, Geol. Soc. America Bull., v. 55, no. 10, p. 1145 (fig. 1), 1155–1159, pl. 1. Based primarily on lithologic differences, three Wisconsin drift sheets are recognized (ascending) Olean, Binghamton, and Valley Heads. Binghamton drift differs from Olean drift in having abundance of both igneous erratics and limestone. These two constituents, being more conspicuous than the drab gray and browns of the local plateau, give Binghamton drift a brighter look.

L. C. Peltier, 1949, Pennsylvania Geol. Survey, 4th ser., Bull. G 23, p. 4 (table 1), 16 (fig. 5), 19–20, table 5. Referred to as Binghamton substage in discussion of glacial geology of Susquehanna River terraces. Discussion also of Binghamton till, sand, and loess. Overlies Olean and constitutes youngest glacial deposits in this part of Pennsylvania.

Named for exposures near Binghamton, Broome County, N.Y. Drift border passes from Ohio into Pennsylvania 16 miles southwest of Newcastle and enters New York from Pennsylvania on east side of Conewango Valley, 3½ miles east of Fentonville and 9 miles southeast of Jamestown.

Binnewater Sandstone (in Salina Formation)[1]

Silurian: Southeastern New York.

Original reference: C. A. Hartnagel, 1905, New York State Mus. Bull. 80, p. 342–357.

G. H. Chadwick, 1944, New York State Mus. Bull. 336, p. 46–51. Not present in Catskill and Kaaterskill quadrangles. Rock called Binnewater by field parties is of later age and is here called Fuyk sandstone a facies of the Rondout.

Named for occurrence at Binnewater, 7 miles southwest of Kingston, Ulster County.

Birch Creek Limestone Member (of Barnsdall Formation)

†Birch Creek Limestone Bed (in Ochelata Formation)[1]

Pennsylvanian (Missouri Series): Northeastern Oklahoma.

Original reference: C. F. Bowen, 1918, U.S. Geol. Survey Bull. 686–D, p. 17–19.

M. C. Oakes, 1951, Tulsa Geol. Soc. Digest, v. 19, p. 120. Reallocated to member status in Barnsdall formation (new). At state line, Barnsdall consists of Birch Creek limestone at base and two unnamed shale members that are separated by unnamed sandy limestone less than 2 feet thick.

W. F. Tanner, 1956, Oklahoma Geol. Survey Circ. 40, p. 29–30. Varies laterally from lens to lens; occurs at more than one horizon and represents more than one environment.

Named for exposure in bluffs on north side of Birch Creek, near eastern edge of SE¼ sec. 25, T. 24 N., R. 10 E., Osage County.

Birch Creek Schist[1]

Precambrian: Eastern and south-central Alaska.

Original reference: J. E. Spurr, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 3, p. 140–145, 224.

F. F. Barnes and others, 1951, U.S. Geol. Survey Bull. 963–E, p. 146–147, pl. 18. Oldest formation exposed in Healy-Lignite area, south-central Alaska. Unconformably underlies unnamed coal-bearing formation.

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 Lower Precambrian rocks and Paleozoic rocks.

Clyde Wahrhaftig, 1958, U.S. Geol. Survey Prof. Paper 293–A, p. 8, pls. 1, 2, 3. Predominantly quartz-serite schist; locally contains layers of quartzite and black carbonaceous schist. In fault contact with Cantwell formation. Occupies east-trending belt from 3 to 12 miles wide in north part of Alaska Range.

Named for exposures in Birch Creek district, central eastern Alaska.

Bird Iron-Bearing Member (of Hemlock Formation)

Precambrian (Animikie Series): Northern Michigan.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 30 (table 1), 36. Consists of oolitic hematite-chert, highly ferruginous quartzite and schist, and breccia made up of angular chert and jasper fragments in a matrix of hard blue hematite. Member attains a maximum thickness of 300 feet and lies about 1,300 feet below the top of formation. Overlain and underlain by greenstone.

Named for the Bird Exploration in sec. 13, T. 43 N., R. 32 W., Iron County.

Birdbear Formation (in Jefferson Group)

Upper Devonian: Subsurface in North Dakota and Montana.

C. A. Sandberg and C. R. Hammond, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 10, p. 2292 (fig. 2), 2302–2303 (fig. 4), 2318–2322. Proposed for widespread beds of light-colored finely crystalline dolomite and limestone that overlie the Duperow and underlie the Three Forks in Williston basin and central Montana. Thickness ranges from fraction of a foot to 125 feet; in type well 90 feet. Replaces term Nisku formation now restricted to type area in central Alberta.

Type section: Interval between depths of 10,310 and 10,400 feet in Mobil Producing Company's Birdwell No. 1, in sec. 22, T. 149 N., R. 91 W., Dunn County, N. Dak.

Bird Creek Limestone (in Wabaunsee Group)

Bird Creek Limestone Member (of Buck Creek Formation)[1]

Bird Creek Limestone Member (of Vamoosa Formation)

Pennsylvanian (Virgil Series): Northeastern Oklahoma.

Original reference: C. F. Bowen, 1918, U.S. Geol. Survey Bull. 686–L, p. 137, pl. 21.

K. E. Masters, 1957, Shale Shaker, v. 7, no. 5, p. 8–10. Reallocated to member status in upper part of Vamoosa formation. Report covers Prague area in Lincoln and Pottawatomie Counties.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 25 (table 2), 48–50, pl. 1. In Pawnee County, consists of single bed of limestone resting on Severy shale. Extends into Creek County on south, where its southern extent is not known. Thickness about 2 feet in type area; less than 1 foot to 1½ feet in Pawnee County. Underlies Hallett shale. In Wabaunsee group.

Named for exposures on valley sides of Bird Creek and tributaries in T. 27 N., R. 8 E., Osage County.

Birdhead Sandstone Member (of Cloverly Formation)

Birdhead Sandstone Member (of Thermopolis Shale)[1]

Upper Cretaceous: Central southern Montana and northern Wyoming.

Original reference: W. T. Thom, Jr., and others, 1935, U.S. Geol. Survey Bull. 856.

P. W. Richards, 1955, U.S. Geol. Survey Bull. 1026, p. 43. Birdhead sandstone, which was tentatively correlated with Newcastle sandstone of Black Hills and Powder River Basin areas and Muddy sandstone of Bighorn Basin and included in Thermopolis shale by Thom and others (1935), is top of Cloverly formation as herein described. Member is mostly fine-grained sandstone, in part silty and argillaceous. Commonly 10 to 15 feet thick. Not sharply set off from underlying beds; overlain by zone of black shale with hard ironstone concretions, this shale is basal unit of Thermopolis shale.

Birdhead Coulee cuts across the sandstone in T. 3 S., R. 27 E., Yellowstone County, Mont.

Bird Mountain Grit[1]

Cambrian or Ordovician: West-central Vermont.

Original reference: T. N. Dale, 1893, U.S. Geol. Survey 13th Ann. Rept., pt. 2, p. 337–340.

E. P. Kaiser, 1945, Geol. Soc. America Bull., v. 56, no. 12, pt. 1, p. 1084, 1090. Considered a thick facies of Zion Hill formation of Lower Cambrian age.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, p. 40, 41-42. Represented as several lenses of coarse clastics interbedded with rocks of Nassau formation. Name used only in lithologic sense to designate a facies of Nassau formation. Some exposures mentioned.

Exposed on top of Bird Mountain, Rutland County, on large hill 2 miles southwest, and in scattered patches and lenses nearby.

Birdsong Shale[1] **(in Linden Group)**

Birdsong Shale Member (of Ross Formation)

Lower Devonian: Western and central Tennessee.

Original reference: C. O. Dunbar, 1918, Am. Jour. Sci., 4th, v. 46, p. 741.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 280, 282 (fig. 83), 292–296. Rank reduced to member status in Ross formation (new). Conformably overlies Rockhouse limestone member; unconformably underlies Flat Gap limestone, Harriman formation, or Camden formation; grades southward into Ross limestone member of Ross formation. Basal 8 to 10 feet of Birdsong as described by Dunbar (1919, Tennessee Div. Geology Bull. 21) is Rockhouse limestone member of this report. Thickness 25 to 40 feet; locally 60 feet. Includes interbeds referred to as Decaturville chert zone.

Typically developed along valley of Birdsong Creek, Benton County.

Bird Spring Formation[1]

Upper Mississippian, Pennsylvanian, and Lower Permian: Nevada, California, and Utah.

Original reference: D. F. Hewett, 1931, U.S. Geol. Survey Prof. Paper 162, p. 9, 21.

N. D. Newell, 1948, Geol. Soc. America Bull., v. 59, no. 10, p. 1056 (fig. 2). Geographically extended into Confusion Range, Utah, where it is about 2,600 feet thick and underlies Supai(?). Pennsylvanian.

R. B. Kraetsch and R. L. Jones, 1951, Utah Geol. Soc. Guidebook 6, p. 60–62. Fusulinids from Bird Spring indicate that formation transcends Pennsylvanian-Permian boundary in Confusion Range area.

J. C. Hazzard, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 5, p. 881–885. Extended into northern part of Nopah Range, Calif., where it is about 1,110 feet thick and overlies Yellowpine limestone member of Monte Cristo limestone. Lower and Middle Pennsylvanian.

D. F. Hewett, 1956, U.S. Geol. Survey Prof. Paper 275, p. 42–45, pl. 1. Mapped in Ivanpah quadrangle, California. Pennsylvanian.

C. W. Merriam and W. E. Hall, 1957, U.S. Geol. Survey Bull. 1061–A, p. 4–5, 7. Keeler Canyon formation (new) of Pennsylvanian to early Permian age includes rocks that have been referred to provisionally as Bird Spring(?) formation (McAllister, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–95). Bird Spring formation is not wholly Pennsylvanian but embraces Upper Mississippian and Permian.

R. K. Hose and C. A. Repenning, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 9, p. 2170. Name Ely limestone extended into Confusion Range where it replaces term Bird Spring formation.

H. J. Bissell, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 8, p. 1427 (fig. 3), 1433 (fig. 9), 1434–1435 (fig. 10). In Spring Mountain area, Nevada, underlies Spring Mountain formation (new) and overlies Illipah formation.

Mark Rich, 1960, (abs.) Geol. Soc. America Bull., v. 71, no. 12, pt. 2, p. 2039. Bird Spring formation near Lee Canyon, Clark County, Nev., consists of more than 7,000 feet of predominantly carbonate beds that show no apparent major lithologic breaks. Megafossils from basal 500 feet indicate that lower 100 feet is Chesterian in age and that Mississippian-Pennsylvanian boundary occurs within a transitional interval. Fusulinids collected from remaining 6,500 feet of formation indicate that following divisions of Pennsylvanian and Permian are represented: Morrowan, Atokan, Desmoinesian, Missourian, Virgilian, Wolfcampian, and Leonardian. Pennsylvanian-Permian boundary is also gradational. A total of 2,600 feet of Chesterian and Pennsylvanian beds and 4,500 feet of Permian is present. Upper limit of formation could not be determined because of truncation by faulting.

Underlies large area in Bird Spring Range, Nev.

†Birdsville Formation[1] or Group[1]

Mississippian: Western Kentucky and southeastern Illinois.

Original reference: E. O. Ulrich, 1904, Missouri Bur. Geology and Mines, v. 2, ser. 2, p. 109.

Named for Birdsville, Livingston County, Ky.

Birkmose Member (of Franconia Formation)

Upper Cambrian: Central Wisconsin and eastern Minnesota.

R. R. Berg, 1951, Minnesota Geologist, v. 8, no. 4, p. [1]; 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), 862–863, measured sections. Consists of two rock types: greensand, a fine-grained crossbedded glauconitic sandstone; and wormstone, a massive buff to orange glauconitic sandstone that contains linear masses of gray silt; top of member contains a 2-foot bed of glauconitic, dolomitic, flat-pebble conglomerate. Thickness at type locality 27 feet; in Houston County, Minn., 10 to 18 feet. Overlies Woodhill member (new); underlies Tomah sandstone and shale member (new).

Type section: Along State Highway 35, center sec. 25, T. 29 N., R. 20 W., St. Croix County, Wis. Named from exposures north of Birkmose Park in Hudson, Wis.

†Birmingham Breccia[1]

Lower Ordovician: Northern central Alabama.

Original reference: E. A. Smith, 1890, Alabama Geol. Survey Rept. Cahaba coal field, p. 152.

Named for exposures at Birmingham, Jefferson County.

Birmingham Red Bed (in Conemaugh Formation)[1]

Pennsylvanian: Western Maryland and Pennsylvania.

Original reference: C. K. Swartz, 1922, Maryland Geol. Survey, v. 11, p. 63, pl. 6.

Birmingham Shale Member (of Conemaugh Formation)[1]

Birmingham redbed member

Birmingham shale member

Pennsylvanian: Western Pennsylvania, eastern Ohio, and northern West Virginia.

Original reference: J. J. Stevenson, 1876, Pennsylvania 2d Geol. Survey Rept. K, p. 79.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 10 (fig. 3), 57–58, geol. map. Birmingham shale member (of Conemaugh series) shown on geologic column of Ohio as interval between Skelly limestone member below and Elk Lick shale and limestone member above. Inasmuch as latter members are not represented over much of Ohio, the Birmingham usually includes all strata between Skelly limestone and Morgantown sandstone; in many areas, a development of thick sandstones occurs throughout interval from Gaysport limestone, or Ames limestone, to top of Morgantown or even stratigraphically higher. In Morgan County [this report], where Skelly limestone is present, the Birmingham consists of 10 to 18 feet of variegated gray to chocolate-brown clay shale which is partly sandy and locally contains siderite nodules.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 94 (table 11), 147–148. Member of Elk Lick cyclothem in report on Athens County. Stephenson (1876) named Birmingham member from Birmingham Station near Pittsburgh, Pa. Its stratigraphic position, broadly limited, is between Duquesne and Elk Lick coals, and it may coalesce with redbeds above and below to fill much of interval between Ames limestone and Pittsburgh coal. Johnson (1929, Pennsylvania Geol. Survey, 4th ser., Topog. and Geol. Atlas 27) has shown that in type area there is facies relationship between redbed and (or) shale and sandstone and that in places sandstone largely or entirely replaces redbed lithology. Condit (1912, Ohio Geol. Survey, 4th ser., Bull. 17) reported that the Morgantown (Upper Grafton of present report) locally replaces Birmingham redbed in eastern Ohio. Thickness as much as 22½ feet.

Named for exposures at Birmingham Station, west of Pittsburgh, Allegheny County, Pa.

Bisbee Group[1] **or Formation**

Lower Cretaceous (Comanche Series): Southeastern Arizona and southwestern New Mexico.

Original reference: E. T. Dumble, 1902, Am. Inst. Mining Engrs. Trans., v. 31, p. 696–715.

A. A. Stoyanow, 1937, Geol. Soc. America Proc. 1936, p. 296, 297 (table). Group includes (ascending) Morita, Mural, and Hay Flat (new) formations.

B. S. Butler, E. D. Wilson, and C. A. Rasor, 1938, Arizona Bur. Mines Bull. 143, Geol. Ser. 10, p. 24-26. Sandstone and shale of Bisbee group intruded by Uncle Sam porphyry and Schieffelin granodiorite (both new).

S. G. Lasky, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 5, p. 527–540; 1947, U.S. Geol. Survey Prof. Paper 208, p. 13 (table), 16–26, pl. 1. In Little Hatchet Mountains, N. Mex., group includes (ascending) Broken Jug limestone, Ringbone shale, Hidalgo volcanics, Howells Ridge formation, Corbett sandstone, Playas Peak formation, and Skunk Ranch formation (all new).

James Gilluly, 1945, Am. Jour. Sci., v. 243, no. 12, p. 645–646. Formation, in Tombstone area, consists of series of gray, brown, and red-brown sandstones interfingering with shale and a minor amount of limestone; locally a basal conglomerate. Thickness about 3,000 feet. Unconformably underlies Bronco volcanics (new); unconformably overlies Pennsylvanian Naco limestone.

A. A. Stoyanow, 1949, Geol. Soc. America Mem. 38, p. 8–12. Sequence in group is (ascending) Glance conglomerate, Morita formation, Lowell formation (new), Mural limestone, and Cintura formation.

James Gilluly, 1956, U.S. Geol. Survey Prof. Paper 281, p. 70–79. In central Cochise County, Ariz., group includes (ascending) Glance conglomerate, Morita formation, Mural limestone, and Cintura formation. Where units are not differentiated, Bisbee is mapped as formation, about 3,600 feet thick; unconformably overlies Naco group.

F. F. Sabins, Jr., 1957, Geol. Soc. America Bull., v. 68, no. 10, p. 1323, 1324 (table 1), 1325, pl. 1. In Cochise Head and western part of Vanar quadrangle, Arizona, group is about 2,600 feet thick and includes Glance conglomerate at base and undifferentiated rocks above. Unconformably overlies older rocks; underlies Nipper formation (new). Where Nipper formation is absent underlies Faraway Ranch formation.

Elliot Gillerman, 1958, New Mexico Bur. Mines Mineral Resources Bull. 57, p. 11 (table 2), 43–53, pl. 1. In Peloncillo Mountains, N. Mex., and Ariz., group is divided into (ascending) McGhee Peak formation, Carbonate Hill limestone, Still Ridge formation, and Johnny Bull sandstone (all new). Formations have not been correlated with Ransome's or Stoyanow's formations in southeastern Arizona, nor with Lasky's formations in Little Hatchet Mountains. Overlies Naco group which here includes Chiricahua limestone at top; underlies Upper Cretaceous volcanic sequence.

Named for exposures at Bisbee, Ariz.

Biscara intrusive andesite

Miocene(?) or Pliocene(?) : North-central New Mexico.

Fred Barker, 1958, New Mexico Bur. Mines Mineral Resources Bull. 45, p. 64, pl. 1. Eastward forked dike of andesine-hornblende-biotite andesite porphyry. Dike consists of breccia in which fragments of tuff, conglomerate, and dark felsite are cemented by andesite porphyry. Thickness about 350 feet at western end, where the two forks join; north fork about 150 feet and south fork about 100 feet. Intrudes Biscara member (new) of Los Pinos formation.

In Canon del Agua, 2 miles northeast of Las Tablas, Las Tablas quadrangle, Rio Arriba County.

Biscara Member (of Los Pinos Formation)

Miocene(?) or Pliocene(?) : North-central New Mexico.

Fred Barker, 1958, New Mexico Bur. Mines Mineral Resources Bull. 45, p. 3, 38, 44, pl. 1. Interlayered tuffaceous sandstone, tuff, conglomerate, and volcanic flow breccia. Conglomerate, with fragments of gray, brown, and dark-red andesite and quartz latite, graywacke, and tuff forms most of the unit. Maximum observed thickness 650 to 700 feet on west side of Canon del Agua. Successively overlapped from south to north by Jarita basalt member (new), an associated gray tuff, and Cordito member (new). Name credited to Butler (unpub. dissert.).

Named after exposure in Biscara Canyon about 1 to 5 miles from its mouth (Butler). These strata of the type locality, however, are here included in Biscara-Esquibel member (new). Mapped in lower Tusas Valley east of Tusas Canyon, from 1.3 miles north of Petaca to a point about 3.5 miles north-northwest of Las Tablas, Las Tablas quadrangle, Rio Arriba County.

Biscara-Esquibel member (of Los Pinos Formation)

Miocene(?) or Pliocene(?) : North-central New Mexico.

Fred Barker, 1958, New Mexico Bur. Mines Mineral Resources Bull. 45, p. 3, 38, 45–46, pl. 1. Consists of interbedded conglomerate, tuff, and graywacke. Conglomerate with fragments of andesite, latite, tuff, sandstone. and flow breccia. Thickness about 300 feet near head of the Rio Tusas and about 1,100 feet in northeastern part of T. 28 N., R. 8 E. Laps onto Precambrian rocks in vicinity of Hopewell. A composite of two members that were named by Butler (unpub. dissert.) after type areas in Biscara and Esquibel Canyons.

Exposed from SW. cor. T. 28 N., R. 9 E., to northern boundary and part of the western boundary of the Las Tablas quadrangle, Rio Arriba County.

Bisher Limestone

Bisher Formation[1]

Middle Silurian: Southwestern Ohio and northern Kentucky.

Original reference: A. F. Foerste, 1917, Ohio Jour. Sci., v. 17, p. 189, 190.

A. C. McFarlan and W. H. White, 1952, Kentucky Geol. Survey, ser. 9, Bull. 10, p. 12, 13. Bisher formation or dolomite discussed in report dealing with Boyle-Duffin-Ohio shale relationships.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Formation shown on correlation chart above Ribolt shale and below Lilley formation. Niagaran series.

Typically exposed northeast of Bisher Dam, about 1 mile south of Hillsboro, Highland County, Ohio.

Bishop Conglomerate[1]

Oligocene or Miocene: Southwestern Wyoming, northwestern Colorado, and northeastern Utah.

Original reference: J. W. Powell, 1876, Geology of eastern portion of Uinta Mountains, p. 40, 44, 62, 169.

H. J. Bissell, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 4, p. 578 (fig. 2), 616–617. Crops out in Strawberry Valley quadrangle, Utah. Where best exposed about 100 feet thick. Rests unconformably on older formations, and in mapped area commonly has gentle north dip; this dip, together with slight lithologic difference, is main basis for separating unit from Uinta formation.

M. D. Picard, 1957, Jour. Sed. Petrology, v. 27, no. 4, p. 373. Oligocene-Miocene(?).

Caps Bishop Mountain, now known as Pine Mountain, Sweetwater County, Wyo.

Bishop sandstone[1]

Upper Jurassic: Northeastern Utah.

Original reference: C. R. Keyes, 1924, Pan-Am. Geologist, v. 41, p. 36, 301.

Flamingo Gorge area. Derivation of name not stated.

Bishop Tuff

Pleistocene: East-central California.

C. M. Gilbert, 1938, Geol. Soc. America Bull., v. 49, no. 12, p. 1833–1860. Name applied to welded rhyolite tuff having areal extent of 400 square miles and average thickness of 500 feet. In upper parts, pumice lapilli are imbedded in porous vitric-crystal matrix. Thick sections show structural and textural gradation from top to bottom, wherein, at base vitric constituents are compressed, distorted, and aligned in the horizontal plane, and structure becomes very compact; sorting poor; bedding conspicuously absent; well-developed columnar jointing is distinctive feature.

W. C. Putnam, 1940, (abs.) Geol. Soc. America Bull., v. 51, no. 12, pt. 2, p. 1939. In sequence of events, Bishop tuff is shown occurring above Sherwin till.

W. C. Putnam, 1949, Geol. Soc. America Bull., v. 60, no. 8, p. 1281, 1286 (fig. 4), 1289–1290. Sequence shows Bishop tuff as erupted between Aeolian Buttes (new) and Sherwin glacial stage.

W. C. Putnam, 1960, California Univ. Pubs., Geol. Sci., v. 34, no. 5, p. 235–237, map 1. Bishop tuff was erupted a short time after Sherwin glacial stage, being emplaced as a succession of nueés ardentes with maximum thickness of more than 750 feet in Owens Gorge, where base is unexposed. Followed by Tahoe glacial stage.

Occurs in area between Bishop and Mono Lake.

Bishop Brook Limestone[1] (in Manlius Group)

Bishop Brook Limestone Member (of Manlius Limestone)

Lower Devonian: Central New York.

Original reference: Burnett Smith, 1929, New York State Mus. Bull. 281, p. 27, 32.

G. H. Davis 3d, 1953, New York State Mus. Circ. 35, p. 8, 10. Discussion of contact between Manlius limestone and Coeymans limestone in upper New York State. In section measured in quarry at Manlius, units exposed are Bishop Brook limestone, Pools Brook limestone, and Jamesville limestone. Pools Brook and Jamesville represent upper two members of the Manlius while Bishop Brook limestone is considered Coeymans in age. Boundary between Manlius limestone and Helderbergian limestone exposed in this area is marked by conspicuous disconformity which occurs between Pools Brook and Bishop Brook limestones. Although Bishop Brook is definitely Helderbergian in age, no conclusive evidence that unit is western extension of Coeymans was found.

L. V. Rickard, 1955, New York State Geol. Assoc. Guidebook 27th Ann. Mtg., p. 7; 1956, Dissert. Abs., v. 16, no. 1, p. 102. Coeymans limestone of central New York, overlying Jamesville member of Manlius, is entirely younger than Coeymans of eastern New York. Name Deansboro is proposed for this part of Coeymans. "Bishop Brook" is merely reappearance of the Deansboro at Manlius beneath pre-Onondaga unconformity.

Exposed on hillside east of Manlius village, Onondaga County. Named for Bishop Brook northeast of Manlius.

Bishop Creek Granite

Upper Jurassic or Lower Cretaceous(?): Eastern California.

G. A. Schroter, 1938, Eng. Mining Jour., v. 139, no. 4, p. 43. Even granular to porphyritic quartz monzonite; locally as acidic as granite or as basic as diorite.

Occurs on east flank of Sierra Nevada Mountains, southwest of Bishop, in Inyo County.

Bishop Mountain Conglomerate[1]

Miocene(?): Southwestern Wyoming, northwestern Colorado, and northeastern Utah.

Original reference: J. W. Powell, 1876, Geology of eastern portion of Uinta Mountains, p. 40, 44, 62, 109.

Caps Bishop Mountain now known as Pine Mountain, Sweetwater County, southwestern Wyoming.

Bishops Cap Member (of Magdalena Formation)

Pennsylvanian (Strawn) : Western Texas.

L. A. Nelson. 1937, Colorado Univ. Studies, v. 25, no. 1, p. 89. In Franklin Mountains, Texas, formation divided into (ascending) La Tuna, Berino, and Bishops Cap members.

L. A. Nelson, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 166–168, 170 (fig. 5). Predominantly limestone with minor amounts of sandstone and conglomerate; fossiliferous. Thickness about 625 feet. Between exposed top of formation and base of exposed Permian Hueco, thickness of approximately 1,800 feet of sediments, probably Pennsylvanian, is covered by alluvium. Derivation of name given.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 23. On basis of fusulinid studies, it seems inadvisable to apply Nelson's terms to Pennsylvanian rocks of central New Mexico.

T. S. Jones, 1953, Stratigraphy of the Permian Basin of West Texas: West Texas Geol. Soc., p. 25. Lower part of Bishops Cap is middle Strawn (Upper Pennsylvanian), but no diagnostic fossils have been reported from upper 392 feet.

Named for Bishops Cap Peak about opposite Filmore, Dona Ana County, N. Mex.

Bishops Lodge Member (of Tesuque Formation)

Miocene, middle(?) : Central New Mexico.

F. E. Kottlowski, 1953, New Mexico Geol. Soc. Guidebook 4th Field Conf., p. 148 (chart). On chart only. Near base of formation. Age shown as Miocene.

Brewster Baldwin, 1956, New Mexico Geol. Soc. Guidebook 7th Field Conf., p. 118. Just north of Santa Fe, 50 to 530 feet of light-gray volcanic-derived sandstone and silt, with minor tuff beds, were measured by Kottlowski (Spiegel and Baldwin, unpub. ms.). This tuffaceous unit in places rests conformably on as much as 100 feet of pinkish-tan Precambrian-derived sandstone typical of the Tesuque formation, although Cabot (1938) extended Picuris tuff southward to include exposures just north of Santa Fe, Kottlowski is proposing name Bishops Lodge member for following reasons: (1) Bishops Lodge member is interbedded with lower part of Tesuque; (2) Cabot's treatment of Picuris tuff is generalized, whereas study of Santa Fe area is detailed; and (3) exact correlation with type Picuris tuff is not possible at present.

W. W. Boyer, 1959, Jour. Sed. Petrology, v. 29, no. 1, p. 64–72. Discussion of playa deposit in Bishops Lodge member of Tesuque. Discovery of marked disconformity at top of playa beds separating them from overlying Tesuque formation, coupled with changes in lithology, mode of sedimentation, and nature of terrain supplying the sediments suggests that Bishops Lodge member and beds underlying it should be separated from Tesuque formation.

In Santa Fe region.

Bison Banded Member[1] (of Hennessey Shale)

Permian: Central northern Oklahoma.

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

Named for fact that it is exposed on all sides of Bison, Garfield County.

Bissell Formation (in Tropico Group)

Miocene or Pliocene: Southern California.

T. W. Dibblee, Jr., 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 1, p. 137 (fig. 1), 138, 141–142. Arkosic sandstone, granitic conglomerate, green-gray siltstone, interbedded limestone, dolomite, chert, and siliceous shale; nonfossiliferous, may be in part a lacustrine facies of Fiss fanglomerate (new). Thickness about 845 feet. Conformably overlies Gem Hill formation (new); unconformably underlies fanglomerate of probable Pleistocene age.

Type locality: An east-trending ridge in N½ sec. 11, T. 10 N., R. 11 W., in Bissell Hills, Rosamond quadrangle, Kern County.

Bissett Conglomerate[1]

Triassic: Western Texas.

Original reference: P. B. King, 1927, Am. Jour. Sci., 5th ser., v. 14, p. 212–221.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 663. Bissett conglomerate, when first described, was considered to be of Permian age, but was shown to be separated from Permian limestones below and from the Cretaceous above by unconformities. Subsequent study of vertebrates and plants from one locality in formation demonstrates that they are Triassic in age, and Bissett is now so classified. Some exposures to the northwest that have been mapped as Bissett may be much younger and belong to basal Cretaceous (Trinity).

Named for exposures on northwest and northeast flanks of Bissett Mountain, southwestern part of Glass Mountains.

Bistineau Member (of Hall Summit Formation)

Paleocene (Midway): Northwestern Louisiana and northeastern Texas.

P. D. Meager and L. C. Aycock, 1942, Louisiana Dept. Conserv. Geol. Pamph. 3, p. 13. Named in stratigraphic summary of Louisiana lignite district. Name credited to G. Murray, Jr.

G. E. Murray, Jr., and E. P. Thomas, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 1, p. 48 (fig. 2), 59. Typically calcareous silt and shale. Attains maximum thickness of 100 feet in type area. Overlies Grand Bayou member; contact gradational. Largely covered by Quaternary deposits over northern half of Sabine uplift. Paleocene. Type locality designated. Mapped in Texas.

G. E. Murray, 1948, Louisiana Dept. Conserv. Geol. Bull. 25, p. 132–134, pl. 10. Includes all sediments stratigraphically between Grand Bayou member and overlying basal sand of Marthaville formation; beds are conformable with and transitional into overlying and underlying sediments.

Type locality: Exposures in T. 15 N., R. 10 W., in southwestern Bienville Parish, La., and particularly those in secs. 9 and 10 along Louisiana Highways 5650, 933, and 1154, from Ringold to Lake Bistineau. Outcrop belt extends into Shelby County, Tex.

Bitter Creek Formation[1]

Triassic or Jurassic: Northwestern British Columbia, Canada, and southeastern Alaska.

Original references: R. G. McConnell, 1911, Canada Geol. Survey Summ. Rept. 1910, p. 63; 1912, Canada Geol. Survey Summ. Rept. 1911, p. 57; 1913, Canada Geol. Survey Mem. 32, p. 12.

Portland Canal region, British Columbia.

†Bitter Creek Group[1]

Eocene: Southwestern Wyoming, northwestern Colorado, and northeastern Utah.

Original references: E. D. Cope, 1872, Philadelphia Acad. Nat. Sci. Proc., v. 24, p. 279; 1872, Am. Philos. Soc. Proc., p. 481.

Exposed along Bitter Creek, a small tributary of Green River in Wyoming, from Black Butte northwest to Salt Wells Station on Union Pacific Railroad and at some other points west of Salt Wells, Sweetwater County, Wyo.

Bitter Creek Sandstone, Formation, Beds, or Sand

Miocene, middle: Southern California.

T. W. Dibblee, Jr., 1951, Soc. Econ. Paleontologists and Mineralogists, Pacific Sec. [Guidebook], Stop 2, p. 1–2. Consists of light-buff medium-grained semifriable arkosic sandstone containing reefs of *Ostrea bourgoisii*, *Pecten ostrellanus*, and several species of *Astrodapsis*. Formation is sandy facies of Monterey shale in Cuyama Valley. Thickness about 1,400 feet. Underlies Santa Margarita sandstone; overlies Monterey shale. [Road log accompanying report refers to Bitter Creek sands.]

I. T. Schwade, 1954, California Div. Mines Bull. 170, map sheet 1. Middle Miocene sediments in Cuyama Valley exhibit considerable lateral variation both in outcrop and subsurface. Westernmost exposures shown on map are entirely Monterey shale, chiefly siliceous; in subsurface, a short distance to east, the first fingers of sandstone, locally called Bitter Creek, have been noticed. Largely at expense of the shale, but in addition with each unit exhibiting considerable thickening, the sandstones become dominant sedimentary feature of Middle Miocene section in central part of Cuyama Valley and hills to south. On north side of Caliente Mountain, the Bitter Creek forms prominent part of section, but less dominantly so than in area to south. This unit, made up chiefly of fine silty locally crossbedded fossiliferous sandstone, is considered to represent a large middle Miocene delta. To east, Bitter Creek beds interfinger with, and progressively grade into terrestrial conglomerates and red beds locally called Caliente formation.

D. E. Savage, 1957, (abs.) Geol. Soc. America Bull., v. 68, no. 12, pt. 2, p. 1845. Shown on chart as marine formation unconformably underlying Caliente formation. Thickness about 1,000 feet.

M. L. Hill, S. A. Carlson, and T. W. Dibblee, Jr., 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 12, p. 2991. Preoccupied term Bitter Creek replaced by Branch Canyon formation (new).

Type locality: At Bitter Creek, Cuyama Valley. Crops out prominently on both sides of Salisbury Canyon.

Bitterroot period[1]

Precambrian: Montana.

Original reference: C. R. Keyes, 1926, Pan-Am. Geologist, v. 46, p. 203.

Bitterwater Formation

Pliocene, upper, and Quaternary: California.

O. P. Jenkins, 1938, Geologic map of California (1:500,000): California Div. Mines, sheet 4. Shown on map legend.

Bivouac Formation

Pliocene, upper, or Pleistocene: Northwestern Wyoming.

J. D. Love, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 8, p. 1899, 1907–1911, fig. 1. Slightly lithified conglomerate with minor amounts of very soft sandstone, siltstone, claystone, and pumicite, and one welded tuff. Conglomerate is brownish gray, soft, porous, and poorly stratified. Welded rhyolite tuff is most conspicuous feature of formation, and crops out in cliffs on north and east sides of Signal Mountain where it is about 60 feet thick. Tuff is about 700 feet above lowest exposures of formation. Minimum thickness for formation on Signal Mountain is about 1,000 feet. Unconformably overlain and surrounded by several sequences of Pleistocene glacial and interglacial deposits. Unconformably overlies Teewinot formation (new).

Type section: On Signal Mountain, secs. 19 and 20, T. 45 N., R. 114 W., Teton County, south of town of Moran and east of Jackson Lake. Name derived from Bivouac Peak, a prominent peak in Teton Range, directly west of type section.

Biwabik Iron-Formation[1] (in Animikie Group)

Precambrian: Northeastern Minnesota.

Original reference: C. R. Van Hise and C. K. Leith, 1901, U.S. Geol. Survey Ann. Rept., pt. 3, p. 353, 358–370.

F. F. Grout and others, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 1021 (table 3), 1044–1050. Animikie group comprises (ascending) Pokegama quartzite, Biwabik iron-formation series, and Virginia slate. Detailed discussion of nature of contact of Biwabik iron-bearing formation with Virginia slate. Later Precambrian.

Named for Biwabik mine, one of earliest and largest mines located on formation, Mesabi district. Biwabik is Chippewa word for piece or fragment of iron.

Blach Ranch Limestone Member (of Thrifty Formation)[1]

Blach Ranch Limestone (in Graham Group)

Upper Pennsylvanian: Central northern Texas.

Original references: F. B. Plummer and R. C. Moore, 1921, Texas Univ. Bull. 2132; 1922, Jour Geology, v. 30, p. 23, 31.

Wallace Lee, 1938, Texas Univ. Bur. Econ. Geology Pub. 3801, p. 58–61. Blach Ranch limestone member is first reliable datum above Avis sandstone member. In southern part of Young County, consists of two limestones separated by 2 to 3 feet of bluish clay. Separated from overlying Breckenridge limestone member by unnamed interval of shale and sandstone.

John Kay, 1956, North Texas Geol. Soc. Field Guidebook, May 25–26, fig. 4. Shown on generalized columnar section of Brazos River area as Blach Ranch limestone in Graham group. Occurs below Breckenridge limestone and above Ivan limestone.

L. F. Brown, Jr., 1960, Texas Univ. Bur. Econ. Geology Rept. Inv. 41, p. 14–17, pl. 1. Plummer and Moore (1921) proposed term Blach Ranch for "a limestone which occurs about 30 feet in most sections above the Ivan member." They described the limestone from "typical exposures in vicinity of Blach Brothers Ranch east of Breckenridge." However, type locality that is given for section (id., p. 156) measured on "Blach Brothers Ranch four miles east of Crystal Falls." Plummer and Moore described the limestone as light gray, massive, weathering to large buff or brown slabs or rounded boulders, and rather fossiliferous. They reported average thickness to be 3 or 4 to as much as 8 feet. Type Blach Ranch limestone redescribed and locality noted. Blach Ranch limestone is uniform persistent unit throughout area. Lower limestone is about 1.4 feet thick and separated by about 1 foot of shale from upper 0.8- to 1-foot limestone bed. About 1 foot of platy, argillaceous, fossiliferous limestone commonly occurs at top of upper bed. Separated from overlying Breckenridge limestone member by unnamed shale member 30 to 50 feet thick.

Type section (redescribed): On original Black Brothers Ranch, now two ranches owned by heirs Jack and Bill Black and B. H. Trammell of Breckenridge. Type section is 3¾ miles east of Crystal Falls, northeast of Breckenridge in north-central Stephens County. Ranch name was misspelled in original description. Limestone crops out in north-south belt across Black and Trammell Ranches. New type section is in and near railroad cut on Chicago, Rock Island, and Pacific Railroad.

Black Flint Member (of Pottsville Formation)[1]

Pennsylvanian: Southeastern Ohio.

Original reference: H. Morningstar, 1922, Ohio Geol. Survey, 4th ser., Bull. 25, p. 130.

Crops out in Jackson County and southwestern part of Vinton County.

Black Bay Gabbro (in Beaver Bay Complex)

Precambrian: Northeastern Minnesota.

H. M. Gehman, 1958, Minnesota Univ., Center for Continuation Study, Apr. 21–22, p. 1. Generally coarse-grained with numerous coarser pegmatitic zones. Youngest intrusion of the complex. Forms dikes and small sills surrounding and intruding Beaver Bay ferrogabbro (new).

In southeastern Lake County.

Black Bear Quartz Gabbro

Lower Cretaceous(?): Northeastern Oregon.

W. H. Taubeneck, 1957, Geol. Soc. America Bull., v. 68, no. 2, p. 195–196, 235. Moderately dark-colored rock with average grain size between 1 and 2 millimeters. Contains scattered crystals of dark-green amphibole with maximum length about 7 millimeters. Cuts Elkhorn Ridge argillite; brecciated contacts sharp. Assumed to be older than Bald Mountain tonalite (new).

Characteristically exposed near Black Bear mine, on southeast slopes of Hunt Mountain, in Elkhorn Mountains [Grant County]. Forms part of Bald Mountain batholith.

†Black Bluff Group, Clay, or Series (in Midway Group)[1]

Eocene, lower: Southern Alabama.

Original reference: E. A. Smith and L. C. Johnson, 1887, U.S. Geol. Survey Bull. 43, p. 61–62.

Named for exposures at Black Bluff, on Sucarnoochee Creek, at its junction with Tombigbee River, in Sumter County.

Black Butte Flow

Age not stated: Northern California.

Howel Williams, 1932, California Univ. Pub., Bull. Dept. Geol. Sci., v. 21, no. 8, p. 310. Hornblende-mica dacite. Discussed under general heading of pre-Lassen dacite flows which include Manzanita dacites, Crescent Cliffs flow, Loomis Peak flow, etc.

Exposure of pre-Lassen dacite is mapped in vicinity Black Butte, Tehama County, Lassen Volcanic National Park.

Black Butte Gravel

Black Butte Till

Eocene: Southwestern Montana.

H. W. Scott, 1938, Jour. Geology, v. 46, no. 4, p. 628–635. Unconsolidated glacial deposits composed of rocks ranging in size from clay particles to boulders 5 feet in diameter. Underlies mid-Tertiary volcanics and rests upon upturned truncated Lower Cretaceous sediments. Tentatively correlated with Ridgway and Gunnison tillites of Colorado.

J. A. Mann, 1954, Yellowstone-Bighorn Research Proj. Contr. 190, p. 37–41. Proposed that name be changed to Black Butte gravel because theory of glacial origin calls for conditions of topography and climate which are not only difficult to explain but which are seemingly in opposition to available evidence.

Type locality: West side of Black Buttes, a prominent physiographic feature that rises 1,000 feet above surrounding area, in Gravelly Range of Tobacco Root Mountains.

†Black Butte Quartzite[1]

Upper Cretaceous: Southwestern Wyoming.

Original reference: J. W. Powell, 1876, Geology of eastern portion of Uinta Mountains, p. 160.

Caps Black Butte, southwest of Black Butte Station, on Union Pacific Railroad, Sweetwater County.

Black Butte Tongue (of Mancos Shale)

Black Butte Tongue (of Rock Springs Formation)

Upper Cretaceous: Southwestern Wyoming.

L. A. Hale, 1950, Wyoming Geol. Soc. Guidebook 5th Ann. Field Conf., p. 52–53, fig. 1. Tongue of Rock Springs formation. Sediments are characteristic of deposition in shallow-water near-shore environment. Shale is commonly sandy and contains much carbonaceous material. Thickness 860 feet. Overlies Chimney Rock tongue (new).

L. A. Hale, 1955, Wyoming Geol. Soc. Guidebook 10th Ann. Field Conf., p. 90 (fig. 1), 92, 93 (fig. 3). Lithologically similar to Blair formation, both being zones of lateral and vertical transition between typical marine and continental lithology. Equivalent to Rangely tongue (new) of Mancos. Figure 3 shows Black Butte tongue of Mancos.

Named for exposures along Black Butte Creek, sec. 36, T. 18 N., R. 102 W., Sweetwater County. Occupies strike valley between Chimney Rock escarpment and cliffs of overlying Ericson formation.

Black Canyon Group

Tertiary(?) (pre-Pliocene): Northwestern Arizona and southeastern Nevada.

C. R. Longwell, 1936, Geol. Soc. America Bull., v. 47, no. 9, p. 1417–1419. Complex assemblage of andesitic lava flows, volcanic breccias (both flow breccias and tuff-breccias), and tuffaceous sandstone layers, with numerous intrusive masses. Underlies Muddy Creek formation with angular unconformity.

F. A. Nickell, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 12, p. 1804 (fig. 2). Includes monzonite, andesite, latite, basalt, and breccia.

Exposed in upper Black Canyon, Mohave County, Ariz., and Clark County, Nev.

Black Canyon Schist[1]

Precambrian (Gunnison River Series): Central western Colorado.

Original reference: J. F. Hunter, 1925, U.S. Geol. Survey Bull. 777.

Occurs throughout area, with many interruptions, from Cochetopa Creek down Gunnison nearly to mouth of Smiths Fork.

Black Crater Formation[1]

Tertiary, upper: Central northern Oregon.

Original reference: E. T. Hodge, 1927, Geol. Soc. America Bull., v. 38, p. 163.

The basalts of Black Crater cover large area on east slope of Cascade Mountains.

Black Creek Formation[1]

Upper Cretaceous: Eastern South Carolina and western North 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, 13, 14.

C. W. Cooke, 1936, U.S. Geol. Survey Bull. 867, p. 25–39. Consists principally of very dark gray laminated clay and micaceous sand. Clay predominates at typical exposures, which represent lower part of formation, but sand is more abundant in Snow Hill member at top. No reliable estimates of thickness in South Carolina [this report]. Unconformably overlies Tuscaloosa formation; unconformably underlies Peedee formation or younger deposits.

Erling Dorf, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 11, p. 2178–2184. In South Carolina, Middendorf member of Black Creek formation (herein revived as equivalent of upper part of Cooke's (1936) Tuscaloosa formation) is shown to contain plant remains essentially equivalent to those of lower Black Creek formation of North Carolina; lower part of Cooke's Tuscaloosa is herein referred to as Lower Cretaceous(?) (undifferentiated). Includes Snow Hill member at top. Underlies Peedee formation.

C. W. Cooke and F. S. MacNeil, 1952, U.S. Geol. Survey Prof. Paper 243-B, p. 21. Beds mapped as Black Creek by Cooke (1936) in western Sumter County, S.C., are now regarded as Black Mingo as herein restricted.

P. M. Brown, 1959, North Carolina Div. Mineral Resources Bull. 73, p. 9 (table 1), 10–11. Described in Greenville area where it is exposed along streams in northern part of Greene and Pitt Counties. North and east of Pitt County, formation has been recognized only in subsurface. Thickness 75 to 150 feet. Comprises an unnamed lower member and Snow Hill marl member at top. Unconformably overlies Tuscaloosa formation, exhibiting transgressive offlap relationship; underlies Peedee formation.

C. E. Brett, 1959, Elisha Mitchell Sci. Soc. Jour., v. 75, no. 2, p. 69–70. Upper Cretaceous formations of North Carolina Coastal Plain are (ascending) Middendorf, Black Creek shale, and Peedee. 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. Division of either Black Creek or Peedee formations into members is not warranted. Term Black Creek formation should connote dark-gray to black laminated shales with intercalations of clean sand lying conformably beneath Peedee formation.

Named for exposures along Black Creek in Darlington and Florence Counties, S.C.

†Black Earth Dolomite Member (of St. Lawrence Formation)[1]

Upper Cambrian (Croixan): Southern Wisconsin and northern Illinois.

Original reference: E. O. Ulrich, 1916, Geol. Soc. America Bull., v. 27, p. 477–478.

C. A. Nelson, 1956, Geol. Soc. America Bull., v. 67, no. 2, p. 169 (fig. 2), 173, 180, 181, 182. Basal member of formation. Commonly sandy dolomite and interbedded dolomitic siltstone and fine-grained sandstone; in vicinity of Black Earth and Madison and at localities along Mississippi Valley, generally massive, brown to buff, slightly glauconitic, with algal structures locally. Distinctly glauconitic facies occur along Minnesota River valley, especially at St. Lawrence where beds described as St. Lawrence limestone by Winchell resemble upper strata of Franconia formation (Reno member of Berg, 1954). In basinward facies, where it rests directly on Franconia greensand, the Black Earth contains only small amounts of interbedded dolomitic siltstone and sandstone; elsewhere, in shoreward direction member is higher in the stratigraphic column and rests on strata of Lodi member. Thickness ranges from 8 to 13 feet in basinward facies, as at St. Lawrence, Lake City, Gotham, Spring Green, and Madison; shoreward to north thins to one-half to 3 feet at Goodenough Hill, Wilton, and Menomonie.

Well developed west of Madison in hills bordering valley of Black Earth Creek, between Black Earth and Mazomanie, Dane County, Wis.

Blackfoot Formation[1]

Blackfoot Limestone Member (of Siyeh Limestone)

Precambrian (Belt Series): Northwestern Montana.

Original reference: C. D. Walcott, 1906, Geol. Soc. America Bull., v. 17. p. 5, 9, 11.

C. E. Erdmann, 1944, U.S. Geol. Survey Water Supply Paper 866–B, p. 48. One of several names used for upper limestone member of Siyeh limestone. In Belt series.

Named for exposures in canyon of North Fork of Blackfoot River, where entire section is exposed. In Mission Range.

Blackfoot Canyon facies (of Belt Series)

Precambrian: Western Montana.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc. American 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. Blackfoot Canyon facies characterized by development of Grinnell and Appekunny silt-clay argillites in place of the calcareous Chamberlain, and by great thickness of Siyeh, Spokane, and Sheppard, or Helena.

In Glacier National Park.

Blackfootian series[1]

Precambrian (Belt Series): Montana, and Alberta, Canada.

Original reference: C. R. Keyes, 1925, Pan-Am. Geologist, v. 44, p. 217, 218.

Blackford Formation

Blackford Member (of Cliffield Formation or Lurich Formation)

Blackford facies (of Murfreesboro Formation)

Middle Ordovician: Southwestern Virginia, northwestern Georgia, and northeastern Tennessee.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 126, 127, 132–133. Blackford facies of Murfreesboro is commonly composed, in lower 70 feet or less, of a heterogenous sequence of red shale, red mottled argillaceous dolomite, gray shale, gray clay, and gray magnesian crumbly limestone; basal bed is, in places, a massive layer or two, as much as 5 feet thick, of dull gray dolomitic rock containing many angular fragments of residual chert. Above variegated lower part of facies is 100 to 300 feet of layers of chert which is derived from thin-bedded limestone. Occurs, in general, southeast of belt in which St. Clair facies (new) is found. Well exposed in Scott, Russell and Tazewell Counties.

B. N. Cooper and C. E. Prouty, 1943, Geol. Soc. America Bull., v. 54, no. 6, p. 823–826, 862–863, 864, 884 (fig. 3). Butts (1940) included in the Blackford the basal clastics, ash-gray shale, and blocky chert beds as recognized in Tazewell County. Assignment to the Murfreesboro is incorrect, and reference to the Murfreesboro age of Blackford facies should be discontinued. It is herein proposed to use the name Blackford for the same succession but to drop the facies designation in favor of term member of Cliffield formation (new). As defined, member includes zones 1 to 3 of the Cliffield. Thickness as much as 165 feet. Overlies Five Oaks limestone member (new); disconformable on Beekmantown.

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 55–57, pl. 8. Blackford is used herein as name of formation occurring between Clinch and Walker Mountains, where it includes beds of same age as included in Blackford member of Cliffield formation as recognized northwest of Clinch Mountain. Underlies Five Oaks herein given formational rank. Thickness in Burkes Garden quadrangle not more than 60 feet; probably averages less than 25 feet.

B. N. Cooper, 1945, Virginia Geol. Survey Bull. 66, p. 42. Restricted to the succession of ash-gray shales and underlying basal clastics; zone of blocky chert formerly classed with the Blackford is here named Elway limestone.

C. E. Prouty, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 7, p. 1145–1148. Geographically extended into northeastern Tennessee.

A. C. Munyan, 1951, Georgia Geol. Survey Bull. 57, p. 54–59. Formation geographically extended into Georgia where it overlies Newala formation and in some areas Knox dolomite.

A. T. Allen, 1953, Georgia Geol. Survey Bull. 60, p. 179. In Graysville area, Blackford is thin red argillaceous limestone with few scattered grains of sand. Overlies Knox dolomite.

Marshall Kay, 1956, Geol. Soc. America Bull., v. 67, no. 1, p. 69, 95 (fig. 8). Basal member of Lurich formation (new).

L. D. Harris and R. L. Miller, 1958, U.S. Geol. Survey Geol. Quad. Map GQ–111. Blackford formation as mapped in Duffield quadrangle includes Tumbez limestone.

Well exposed along U.S. Route 19 at several places between Pounding Mill Branch and Pisgah Chapel, Tazewell County, Va., and near Blackford, Russell County.

Blackford Stage

Ordovician (Chazyan): Virginia.

Marshall Kay, 1958, Am. Jour. Sci., v. 256, no. 2, p. 93, 94, 95. Name given to provincial stage in Virginia which includes rocks between the Canadian [series] and Elway and Lincolnshire formations of the type Ashby [stage]. Name used in place of Marmor stage, which is based on formations in Tennessee, and has type section isolated from other post-Canadian stages of Appalachian region. Older than Ashby stage; these two believed to be Chazyan but not to constitute the whole of that series. Approximately equivalent to lower part of St. Paul group (Neuman, 1951).

Name probably derived from Blackford, 2 miles southeast of Honaker, Russell County, for which Blackford formation is named.

Black Hand Formation[1] or Sandstone

Mississippian: Central Ohio.

Original reference: L. E. Hicks, 1878, Am. Jour. Sci., 3d, v. 16, p. 216, 217.

Gordon Rittenhouse, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 58. Incidental mention of Black Hand sandstone in discussion of distribution of types of Berea sand in West Virginia, eastern Ohio, and western Pennsylvania.

Probably named for Black Hand, Licking County.

Black Hand Member[1] (of Cuyahoga Formation)

Mississippian: Central and southern Ohio.

Original reference: J. E. Hyde, 1915, Jour. Geology, v. 23, p. 657, 667–682, 757–779.

F. T. Holden, 1941, Illinois Acad. Sci. Trans., v. 34, no. 2, p. 172; 1942, Jour. Geology, v. 50, no. 1, p. 49–50. Seven lithologic facies, each subdivided into a varying number of members and submembers are recognized in Cuyahoga formation. Black Hand shale is member of Killbuck shale facies (new); Black Hand conglomerate is member of River Styx (new), Toboso, and Hocking Valley conglomerate facies. Overlies Armstrong sandstone member. Thickness 75 to 80 feet.

E. J. Szmuc, 1958, Dissert. Abs., v. 18, no. 6, p. 2109. Crossbedded pebbly sandstone. Uppermost member of Cuyahoga. In Cuyahoga, Summit, Medina, and Lorain Counties, term Wooster shale member (new) is used in place of Black Hand, because term Black Hand is restricted to the pebbly sandstone. Intertongues with Wooster shale and, in parts of Wayne, Medina, and Ashland Counties, the sandstone is completely replaced by shale.

Named for exposures at Black Hand, Licking County.

Blackhawk Breccia[1]

Pleistocene: Southern California.

Original reference: A. O. Woodford and T. F. Harriss, 1928, California Univ. Pub., Dept. Geol. Sci. Bull., v. 17, p. 267, 279–283.

Typically developed at mouth of Blackhawk Canyon, San Bernardino County.

Blackhawk Formation (in Mesaverde Group)[1]

Upper Cretaceous: Central eastern Utah.

Original reference: E. M. Spieker and J. B. Reeside, Jr., 1925, Geol. Soc. America Bull., v. 36, p. 443.

D. J. Fisher, 1936, U.S. Geol. Survey Bull. 852, p. 10 (table), 12–14. In Book Cliffs coal field, formation includes all but lower part of unit as exposed a few miles to west where first defined. Consists of three sandstone-bearing members; both lower and middle members overlain by tongues of shale that locally contain coal. In eastern Utah, sandstones give way to Mancos shale.

R. G. Young, 1955, Geol. Soc. America Bull., v. 66, no. 2, p. 183, figs. 2, 3, pl. 3. Base of formation, as redefined in Book Cliffs, is at base of Spring Canyon sandstone of Clark (1928, U.S. Geol. Survey Bull. 793). In most outcrops, formation overlain disconformably by Castlegate member of Price River formation. Consists of six prominent littoral marine sandstone tongues and many lesser ones, all of which project eastward into Mancos, where they lose their identity by grading into shale. Above each of them and below next succeeding littoral marine sandstone, lagoonal deposits of sandstone, shale, and coal are developed. Six principal members are (descending) Desert (new), Grassy (new), Sunnyside (new), Kenilworth (new), Aberdeen, and Spring Canyon (new). This division possible only where basal littoral marine sandstones are developed. Not included in Mesaverde group—a term no longer used in Book Cliffs. Of Montana age.

Named for prominent exposures near Blackhawk, a mining community on east front of Wasatch Plateau. Also exposed in Book Cliffs.

Blackhawkian[1]

Pleistocene: Iowa.

Original reference: C. R. Keyes, 1930, Pan-Am. Geologist, v. 54, p. 377.

Black Hill Rhyolite[1]

Tertiary: Colorado.

Original reference: W. Cross, 1886, U.S. Geol. Survey Mon. 12, p. 349.

Forms Black Hill, about 18 miles southeast of Leadville, Lake County.

Black Hill Shale[1]

Lower Cretaceous (Comanche Series): Central southern Kansas.

Original reference: F. W. Cragin, 1885, Washburn Coll. Lab. Nat. History, v. 1, no. 3, p. 90.

Named for Black Hill, Comanche County.

Blackhorse shales[1]

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

Original reference: C. R. Keyes, 1922, Pan-Am. Geologist, v. 37, no. 1, p. 63–64.

Blackhorse Butte is conspicuous landmark in Schanasse County, S. Dak.

Blackiston Formation (in New Albany Shale)

Blackiston Member (of New Albany Shale)

Upper Devonian: Southeastern Indiana, northern Kentucky, and southern Ohio.

Guy Campbell, 1946, Geol. Soc. America Bull., v. 57, no. 9, p. 835, 837, 840 (fig. 3), 842–847, 860 (fig. 4), 868, 877. Contains two unnamed members with different facies of black shale. Layers of gray shale are interbedded with black shale of both members in middle third of formation. There are 40 or more layers of gray shale from one-half to 8 inches thick, separated by black shale 1 inch to 5 feet thick; total thickness of this zone is 27 feet. Thickness of formation 75 feet. Disconformably overlies Blocher formation (new); underlies Sanderson formation (new). In parts of Kentucky, overlies Trousdale formation; thickness in Bullitt County 35 feet.

H. H. Murray and others, 1955, Indiana Geol. Survey Field Conf. Guidebook, 8, p. 43, pl. 1. Indiana Geological Survey uses term Blackiston with member rank.

Well exposed in vicinity of Blackiston Mill, old land-mark and recreation center, on Silver Creek, Clark County, Ind. Section from base of Blackiston to top of New Albany is exposed from Armstrong's bend along Silver Creek to Blackiston Mill and west along Mount Tabor Creek to a point near Mount Tabor Church. Middle zone of gray shale is persistent throughout Indiana, Kentucky, Ohio, and Tennessee.

Blackjack Basalt[1]

Miocene: Southeastern Oregon.

Original references: K. Bryan, 1929, U.S. Geol. Survey Water-Supply Paper 597, p. 55; 1930, Jour. Geology, v. 39, p. 504.

Named for fact it caps Blackjack Butte, Malheur County.

Blackjack Creek cyclothem

See Blackjack Creek Limestone Member (of Fort Scott Limestone)

Blackjack Creek Limestone Member (of Fort Scott Limestone)

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

L. M. Cline, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 26–27 (fig. 2), 36–37, 67. Proposed for lowermost limestone in Fort Scott. Occurs below Houx limestone member (new). Base of Marmaton group in Kansas and Henrietta group in Missouri. Traced into Appanoose County, Iowa.

J. M. Jewett, 1951, Kansas Geol. Survey Bull. 38, p. 304–305. Underlies Little Osage shale member (new). Overlies Cherokee shale. Thickness about 5 feet in Bourbon County; 16 feet or more in Labette County.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 99. Blackjack Creek cyclothem consists of sandy shale, underclay, coal (Mulky bed), black shale, and limestone (Blackjack Creek limestone) belonging in lower part of Fort Scott limestone. Average thickness about 15 feet.

F. C. Greene and W. B. Howe, 1952, Missouri Geol. Survey and Water Resources Inf. Circ. 8, p. 2, 19. Thickness in Missouri about 7 feet. Forms base of Marmaton group.

W. B. Howe and W. V. Searight, 1953, Missouri Geol. Survey and Water Resources Rept. Inv. 14, pl. 1. Generalized section of strata in Carroll and Livingston Counties, Mo., shows Blackjack Creek limestone member overlying Excello formation.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 33, fig. 5. One of thickest and most persistent limestones in Des Moines series in Iowa. Light gray to light blue gray; weathers brown to buff; varies from massive to slabby. Thickness 1 to 4 feet. Base of formation; separated from Houx limestone member shale interval 2 to 10 feet thick.

Type locality: Outcrops in Johnson County, Mo., 4 miles southeast of Fayetteville, along Blackjack Creek.

Blackjack Knob Member (of Theodosia Formation)

Lower Ordovician: Southern Missouri and northern Arkansas.

J. S. Cullison, 1944, Missouri Univ. School Mines and Metallurgy Bull., Tech. Ser., v. 15, no. 2, p. 25, 31, pl. 2. Upper member of formation. Overlies Lutie member (new); unconformably underlies Cotter formation. Thickness as much as 180 feet. Includes Gainesville sandstone (new) near base; upper part is a monotonous sequence of alternating gray, slightly cherty, finely crystalline dolomite and argillaceous dolomite.

Type section: On north side of Blackjack Knob, Protem quadrangle, in eastern Taney County, Mo.

Blackjack School Sandstone Member (of Atoka Formation)[1]

Middle Pennsylvanian: Eastern Oklahoma.

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

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 56. Thin massively bedded sandstone. Thickness 25 to 40 feet in type area. Overlies unnamed shale above Webber[s] Falls member; underlies unnamed shale at top of formation.

Named for exposures at and around Blackjack School, sec. 9, T. 11 N., R. 19 E., Muskogee County.

Black Knob Dolomite (in Pacheta Member of Lowell Formation)

Lower Cretaceous: Southeastern Arizona.

A. A. Stoyanow, 1949, Geol. Soc. America Mem. 38, p. 12, 27. Yellow dolomite, pinkish when fresh, in places silicified. Thickness in Ninety One Hills area 30 feet; on Black Knob Ridge 56 feet. Overlies Cienda limestone (new); underlies Black Knob quartzite (new).

In standard section of Lowell formation in the Ninety One Hills and exposed on Black Knob Ridge, Cochise County. 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.

Black Knob Quartzite (in Pacheta Member of Lowell Formation)

Lower Cretaceous: Southeastern Arizona.

A. A. Stoyanow, 1949, Geol. Soc. America Mem. 38, p. 12, 27. Greenish quartzite in places overlain with buff and white speckled sandstone. Contains large silicified tree trunks. Whitish-gray limestone at base. Thickness in Ninety One Hills area 30 feet; on Black Knob Ridge, where it consists of buff and white quartzite beds, 412 feet. Underlies Joserita member (new) and overlies Black Knob dolomite (new).

In standard section of Lowell formation in Ninety One Hills and exposed on Black Knob Ridge. 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.

Black Lake lagunal facies.

Middle Devonian: Northeastern Michigan.

[G. M. Ehlers], 1938, Michigan Acad. Sci. Arts and Letters Sec. Geology and Mineralogy [Guidebook] 8th Ann. Field Excursion, [fig. 2] after p. 8. Shown on columnar section between the Rockport below and the Ferron Point above.

W. A. Kelly, 1940, Michigan Acad. Sci. Arts and Letters Sec. Geology and Mineralogy [Guidebook] 10th Ann. Field Excursion, [fig. 1]. Probaby a lagunal facies of the Rockport.

Occurs in Black Lake Quarry, Black Lake-Afton area.

Blacklead Limestone[1]

Mississippian and Pennsylvanian: Northern Idaho.

Original reference: A. L. Anderson, 1930, Idaho Bur. Mines and Geology Pamph. 34.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, p. 701, chart. Age shown on chart as Mississippian and Pennsylvanian.

Lies far back in Clearwater Mountains at head of Cayuse Creek, a tributary of North Fork of Clearwater River. Also present in a high valley between Blacklead Peak and Rhodes Creek, Orofino region.

Blackleaf Formation (in Colorado Group)

Blackleaf Sandy Member (of Colorado Shale)[1]

Lower Cretaceous: Northwestern and central Montana.

Original reference: E. Stebinger, 1918, U.S. Geol. Survey Bull. 691-E, p. 154, 158-164.

W. A. Cobban and others, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2787-2793; 1959, Billings Geol. Soc. [Guidebook] 10th Ann. Field Conf., p. 89-90. Rank raised to formation and subdivided into (ascending) Flood, Taft Hill glauconitic, Vaughn bentonitic, and Bootlegger members (all new). Overlies Kootenai formation with obscure disconformity having hiatus that may be as much as 100 feet; underlier Marias River shale (new). Ranges in thickness on Sweetgrass arch from 600 feet north of Cut Bank to more than 800 feet south and east of Conrad.

Named for exposures along Blackleaf Creek in sec. 18, T. 26 N., R. 8 W., and vicinity, Teton County. Formation occurs in country between Missouri River and international boundary and between Rocky Mountain front and about Range 8 East.

Black Mesa Basalt[1]

Quaternary: Western Oklahoma and northern New Mexico.

Original reference: A. C. Shead, 1923, Oklahoma Univ. Bull. 271, new ser., p. 108–113.

H. T. U. Smith, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 103. In Abiquiu quadrangle, New Mexico, Quaternary formations overlie pre-Quaternary rock with angular unconformity, and comprise Canjilon till (new); Canones andesite (new), Vallecito basalt (new), and Black Mesa basalt, which were poured out high-level erosion surfaces; Puye gravel (new), which overlies erosion surface at an intermediate level, and is overlain, locally, by Bandelier rhyolite tuff (new), and Santa Clara basalt (new).

Named for exposures on Black Mesa, extreme northwestern part of Oklahoma Panhandle.

Black Mingo Formation[1]

Eocene, lower: Eastern South Carolina.

Original references: E. Sloan, 1905, Geognostic map of South Carolina: South Carolina Geol. Survey; 1907, Summ. Mineral Resources of South Carolina, p. 12, 16; 1908, Catalogue of mineral localities of South Carolina: South Carolina Geol. Survey, ser. 4, Bull. 2, p. 449.

C. A. Cooke and F. S. MacNeil, 1952, U.S. Geol. Survey Prof. Paper 243–B, p. 20–21. Black Mingo was referred to as being of Wilcox age (Cooke, 1936, U.S. Geol. Survey Bull. 867) because of presence of *Ostrea arrosis* Aldrich. Although this oyster was stated by Aldrich to be from the Nanafalia, and has since been found to be restricted to it, in the correlation table Black Mingo was placed opposite Tuscahoma sand of Alabama because of occurrence in both of *Turritella mortoni* Conrad, a species now known to be abundant in both the Tuscahoma and Nanafalia. Mapped with this oyster-bearing bed were underlying siliceous clay shales and an overlying massive red sand now known to be of early Claiborne age. A revised map would show the Black Mingo to be confined to a much smaller area, chiefly along valley floors. Beds mapped by Cooke (1936) as Black Creek (Cretaceous) in western Sumter County are now regarded by MacNeil as Black Mingo as here restricted to the siliceous clay-shale and oyster-bearing bed, whereas the overlying more widely distributed sands in Richland, Lee, Sumter, Clarendon, and Williamsburg Counties that were mapped as Black Mingo are now placed by MacNeil in the Congaree formation of early Claiborne age. Some beds in Warley Hill section, considered by Cooke (1936) to be McBean, are now recognized as belonging to Black Mingo. Black Mingo formation, as mapped by Cooke (1936), is now known to have included some beds of early Claiborne age, and (even as here restricted) may include beds of both early Eocene and Paleocene ages. Further subdivision of formation is deferred until more definite evidence of Paleocene age is produced. If lower shales of Black Mingo should prove to be of Paleocene age, one of Sloan's names (1907, 1908) Rhems shale or Lang Syne shale may be available. Included in Wilcox.

Exposed along Black River from Brewington Lake, Clarendon County, to mouth of Black Mingo Creek, up which it is exposed to a point between Rhems and General Marion Bridge.

Black Mountain Andesite

Pliocene(?): Southwestern Arizona.

James Gilluly, 1937, Arizona Bur. Mines Bull. 141, Geol. Ser. 9, p. 49. Black Mountain andesite appears to underlie Childs latite (new) at north end of Childs Mountain. Elsewhere, rests on the latite, and, though the latite may be merely an intercalation in the Black Mountain, it is equally possible that apparent occurrence of the Black Mountain beneath the latite is due to faulting.

At north end of Childs Mountain, Ajo quadrangle, Pima County.

Black Mountain Basalt Flow[1]

Pleistocene: Southern California.

Original reference: C. L. Baker, 1912, California Univ. Pub., Dept. Geol. Bull., v. 7, p. 121–142.

C. D. Hulin, 1925, California State Mining Bur. Bull. 95, p. 20–61. Derivation of name given. Very late Pliocene or early Pleistocene.

T. W. Dibblee, Jr., 1952, California Div. Mines Bull. 160, p. 30, pls. 1, 2, 3. Described in Saltdale quadrangle as a black to gray-black fine-grained diabase-textured vesicular basalt flow, 50 to 150 feet thick; no superjacent strata. Younger than Ricardo formation and older than oldest terrace deposits in area. Probably Pleistocene.

Named for flows on Black Mountain, 7 miles west of El Paso Peak, Kern County.

Black Mountain Granite[1]

Black Mountain Leucogranodiorite

Age not stated: Southeastern Vermont.

Original reference: C. H. Richardson, 1933, Vermont State Geologist 18th Rept., p. 349–357.

M. S. Church, 1937, Jour. Geology, v. 45, no. 7, p. 763–774. Described as a leucogranodiorite which intrudes interbedded rather gneissoid schists. Texture generally medium grained. Outcrop area described.

Forms Black Mountain and occurs on both sides of the West River at village of West Dummerston, Windham County.

Black Mountain Volcanics[1]

Triassic, Jurassic or Cretaceous: Southern California.

Original reference: M. A. Hanna, 1926, California Univ. Pub. Geol. Sci. Bull., v. 16, no. 7, p. 187–246.

E. S. Larsen, Jr., 1948, Geol. Soc. America Mem. 29, p. 22–23. Name Black Mountain preoccupied. Unit renamed Santiago Peak volcanics.

Well developed on Black Mountain, north part of La Jolla quadrangle, San Diego County.

Black Patch Grit[1]

Lower Cambrian: Eastern New York and western Vermont.

Original reference: T. N. Dale, 1899, U.S. Geol. Survey 19th Ann. Rept., chart opposite p. 178.

George Theokritoff, 1959, New England Intercollegiate Geol. Conf. Guidebook 51st Ann. Mtg., p. 55. Locally, West Castleton formation contains lenses of a dark-gray calcareous grit with conspicuous rounded quartz grains. Dale (1899) named such beds Black Patch grit.

Black Peak Granodiorite and Quartz Diorite

Cretaceous: Northwestern Washington.

Peter Misch, 1952, The Mountaineer, v. 45, no. 13, p. 4 (geol. map), 16–17. Occurs on eastern and western borders of Skagit gneiss. On eastern border, is similar to Chilliwack granodiorite. On west has apparently formed Skagit gneiss, just as Chilliwack rocks have on opposite side of gneiss region. Original eastern contact of Black Peak granodiorite and quartz diorite not preserved because younger intrusive granite occurs (Golden Horn granodiorite, new). To north, down Granite Creek, the Black Peak granodiorite narrows rapidly, and, in lower Granite Creek, across Ruby Creek, and in upper Skagit Valley (Ross Lake), it is reduced to narrow migmatitic belt in which patches of directionless granodiorite have grown in schists and amphibolites which separate Skagit gneiss from Cretaceous phyllites and slates to east.

Black Peak is on border between Chelan County and Skagit County.

Black Point Ash[1]

See Diamond Head Ash.

Black Point Basalt

Quaternary: Southwestern Alaska.

G. C. Kennedy and H. H. Waldron, 1947, U.S. Geol. Survey Alaskan Volcano Inv. Rept. 2, pt. 2, p. 13, pl. 2. Oldest of three extensive lava-flow units filling old canyons and gullies carved in Belkofski tuff (new) and intrusive diorite stocks. Basalt is dark-reddish-brown dense even-textured rock composed of abundant very small phenocrysts; contains a higher percentage of phenocrysts than the other two flows. Crops out south of Arch Point basalt (new).

Crops out at tidewater in Long John Lagoon and along the beach in Chinaman Lagoon in vicinity of Pavlof Volcano, Alaska Peninsula. Forms large domical hill near Black Point.

Black Point Basalt[1] (in Honolulu Volcanic Series)

Pleistocene, upper: Oahu Island, Hawaii.

Original reference: H. T. Stearns, 1935, Hawaii Div. Hydrog. Bull. 1.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 78. Thin lava flow of nepheline basanite, 6 to 25 feet thick, and associated dike of similar composition. Rests on reef limestone correlated with plus 95-foot (Kaena) stand of sea, and on Diamond Head tuff. Overlain by beach limestone of plus 25-foot (Waimanalo) stand of sea.

Name after Black (Kupikipikio) Point, on southeast side of Diamond Head, which consists chiefly of this lava. Exposed over about 40 acres on south side of island, 9½ miles west of Makapuu Head.

Black Point Dolomite Member (of Cherry Creek Series)

Precambrian: Southwestern Montana.

E. S. Perry, 1948, Montana Bur. Mines and Geology Mem. 27, p. 7. Name suggested for dolomitic marble occurring in Cherry Creek series. Weathers to dirty-brown granular surfaces which look dark in distance. Bedding at Black Point nearly vertical. Repetition of beds, either by folding or faulting, may account for the 1½ mile width of the outcrop.

In area about 5 miles long and 1½ miles wide, between Johnny Gulch and Cherry Creek, Madison County. Marble forms conspicuous ridge known locally as Black Point.

Black Point Limestone

Pleistocene: Oahu Island, Hawaii.

H. T. Stearns, 1940, Hawaii Div. Hyrdography Bull. 5, p. 53; G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 78–79. Fossiliferous reef limestone. Underlies Diamond Head tuff and Black Point basalt. Extends to altitude of about 48 feet.

Type locality: East shore of Black (Kupikipikio) Point. Limited exposures on Black Point, on southeast side of Diamond Head, on south coast of Oahu, 9½ miles west of Makapuu Head. Highest marine limestone known on leeward side of Koolau Range.

†Black Prairie Series[1]

Upper Cretaceous (Gulf Series): Texas and Arkansas.

Original reference: R. T. Hill, 1889, Texas Geol. Survey Bull. 4, p. xii–xiv.

Named for Black Prairie of eastern Texas and Arkansas.

Black Prince Limestone

Upper Mississippian or Lower Pennsylvanian(?): Southeastern Arizona.

T. M. Romslo, 1949, U.S. Bur. Mines Rept. Inv. 4505, p. 5. Incidental mention. Limestones of Carboniferous period consisting of Escabrosa, Black Prince, and Naco formations in order named, overlie Martin limestone in Johnson Camp area.

James Gilluly, J. R. Cooper, and J. S. Williams, 1954, U.S. Geol. Survey Prof. Paper 266, p. 13–15. Comprises basal shale member and upper limestone member. Shale, 10 to 20 feet thick, is red to maroon or purple with scattered nodules or pebbles of chert and limestone, lenses of chert conglomerate and, locally thin beds of limestone. Limestone unit consists of 100 to 140 feet of nearly pure limestone in 1- to 4-foot beds. Limestone is medium to coarse grained and light gray to pink; pink beds most conspicuous in upper part. Thickness: 119 feet in Gunnison Hills; 131 and 155 feet in Little Dragoons; 168 feet in Johnny Lyon Hills. Separated from overlying Horquilla limestone (new) of Naco group by 30 to 65 feet of weak rocks which generally are concealed and form topographic sags. Underlies Escabrosa limestone, contact drawn at base of thin but persistent shale member which contrasts with pure limestone beds above and below. Where shale is missing, it is difficult to separate the Black Prince and Escabrosa.

Type section: On west slope of Gunnison Peak 4½ miles southeast of Black Prince mine (from which unit takes its name) in Johnson mining district at east base of Little Dragoon Mountains, central Cochise County.

Black River Group[1] or Formation

Middle Ordovician: New York and Pennsylvania, and Ontario, Canada.

Original reference: L. Vanuxem, 1842, Geology of New York, pt. 3, p. 38-45.

C. Butts, 1918, Am. Jour. Sci., 4th, v. 46, p. 525, 533, 537. In central Pennsylvania, includes Rodman limestone.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 249–251. Black River group comprises (ascending) Pamelia, Lowville, and Chaumont formations. Underlies Trenton group; overlies Beekmantownian.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 178–199. In Virginia only the Lowville-Moccasin and Chambersburg limestones can be definitely recognized as members of Black River group. Eggleston limestone may correspond to Watertown and Amsterdam limestones of New York and also to Chambersburg limestone. Underlies Martinsburg shale; overlies Blount group.

G. M. Kay, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1969. Group in central Pennsylvania includes Valentine limestone, 0 to 145 feet (Lowville); Benner limestone (new) (Pamelia), comprising Stover and Snyder members. Mohawkian series. Underlies Nealmont limestone of Trenton group; overlies "Carlim group," Chazyan(?) series.

F. P. Young, Jr., 1943, Am. Jour. Sci., v. 241, no. 3, p. 143–166; no. 4, p. 211–240. Black River group, with overlying Trenton group, constitutes Mohawkian series of Middle Ordovician. Formations of group, Pamelia, Lowville, and Chaumont, have their type localities in New York. In northwestern New York, Black River group, or some part of it, is present as a belt extending from north of Ingham Mills, Herkimer County, northwestward along Black River valley to Watertown, N.Y., and Thousand Island region. Interrupted by St. Lawrence River, it continues westward across southern Ontario to Lake Simcoe area. Probable that group is also represented on Manitoulin and St. Joseph Islands, Lake Huron. Beds are thus present nearly continuously for distance of about 120 miles in New York and 150 miles in southeastern Ontario.

G. M. Kay, 1943, Econ. Geology, v. 38, no. 3, p. 189, 192–193 (table 1), 194 (table 2). Group, in central Pennsylvania includes Benner limestone below and Curtin limestone (new) above. The Curtin contains Valley View limestone member (new) and Valentine limestone member. Overlies Chazyan Hatter formation; underlies Nealmont limestone of Trenton group.

B. N. Cooper and C. E. Prouty, 1943, Geol. Soc. America Bull., v. 54, no. 6, p. 819–886. In Tazewell County, Va., strata embraced by Chazyan and Black River groups of Butts (1940) are divisible into 29 distinctive zones, most of which have distinctive faunal and lithologic features. Detailed work led to recognition of inconsistencies in use of stratigraphic names Stones River, Murfreesboro, Mosheim, Lenoir, Blount, Holston, Ottosee, Lowville, and Moccasin. Revised stratigraphic nomenclature proposed. Name Lowville should not be used in area until regional studies demonstrate true relationships of supposedly Lowville beds to Pamelia-Lowville-Chaumont succession of New York and Ontario. Name Lowville-Moccasin not acceptable because it implies that Moccasin red beds are of Lowville age.

Marshall Kay, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1401. Rocks younger than Canadian or Beekmantownian and older than Cincinnatian series are commonly referred to Middle Ordovician and placed in two series: Chazyan and Mohawkian. Proposed that latter be divided into Bolarian and Trentonian. Term Black River does not lend itself to conversion to series name (Black Riverian). Suggested that term Bolarian series be used for Chazyan to Trentonian interval.

R. C. Hussey, 1952, Michigan Dept. Conserv., Geol. Survey Div. Pub. 46, Geol. Ser. 39, p. 13–14, 17–22. Black River formation represented by Bony Falls member (new). Underlies Chandler Falls member (new) of Trenton formation.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 66, no. 3, p. 247–298, chart 2. Middle Ordovician strata along Black River valley, west of Adirondacks, has long been considered standard for this part of column in North America, lower part constituting Black River stage and upper part Trenton stage. Kay has proposed to reject Black River as major unit in standard section and replace it with Bolarian series. Thus he would recognize in Middle Ordovician not one series (Champlainian) but three—Chazyan, Bolarian, and Trentonian. Pros and cons of proposal discussed. Majority of committee favored retaining traditional three stages—Chazyan, Black River, and Trentonian on present chart. Black River and Trentonian compose the Mohawkian stage.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 7–9, chart 1. Terms Chazyan and Black River stages not used in this report. Interval subdivided into Marmor, Ashley, Porterfield, and Wilderness stages (all new). Trenton stage restricted by removal of Rockland which has mostly fossils derived from underlying Black River and Witten. Term Black River used on correlation chart to include the Pamelia, Lowville, and Chaumont.

Marshall Kay, 1958, Am. Jour. Sci., v. 256, no. 2, p. 65–96. Discussion of Ordovician Highgate Springs sequence of Vermont and Quebec and Ordovician classification. Blackriveran series seems to be contained in Bolarian series of the Appalachians, but lowest Bolarian seems older and equivalent to upper Chazyan. Isle La Motte formation classified as Blackriveran and correlated with Chaumont limestone of Black River group of New York.

Marshall Kay, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 7, p. 30, 32. Black River group in northern New York divided into three formations, Pamelia, Lowville, and Chaumont, which have been treated as stages. Cooper (1956) divided rocks that he considered younger than type Chazyan into Ashley, Porterfield, and Wilderness "stages," the latter extending into the lowest Trenton of New York; these stages are in continuous stratigraphic succession in the Appalachians, but their correlation with New York is uncertain. On the other hand, the Pamelian, Lowvillian, and Chaumontian are quite provincial and relatively sparse in fauna; methods of carrying correlations to them and distinguishing their equivalents are inadequate. Blackriveran series comprises (ascending) Pamelian, Lowvillian, and Chaumontian stages.

Named for exposures in cliffs of Black River, N.Y.

†Black River Iron-Bearing Schists[1]

†Black River Iron-Bearing Series[1]

†Black River Falls Iron-Bearing Schists[1]

Precambrian (lower? Huronian): Southwestern Wisconsin.

Original reference: C. R. Van Hise, 1892, U.S. Geol. Survey Bull. 86, p. 190, 195, pl. 3, map.

Probably named for exposures at Black River Falls, Jackson County.

Black River Stage

Blackriveran Series

See **Black River Group.**

†Black Rock Diabase[1]

Black Rock Diabase Breccia (in Granby Tuff)

Triassic: Central Massachusetts.

Original references: B. K. Emerson, 1898, U.S. Geol. Survey Geol. Atlas, Folio 50; 1898, Mon. 29, p. 17–18, pl. 34.

Robert Balk, 1957, Geol. Soc. America Bull., v. 68, no. 4, p. 496–497, pl. 1. Diabase breccia consisting of fragments of diabase, tuffaceous diabase, tuff and sedimentary rocks in matrix of vesicular or compact diabase. Cuts sediments above Holyoke diabase sheet and basal members of Granby tuff; relation to diabase flow in Granby tuff unknown. Triassic.

Named for Black Rock south of Mount Holyoke, Mount Holyoke quadrangle.

Black Rock Formation[1]

Lower Ordovician: Northern Arkansas.

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 (column 53). Shown on correlation chart above Smithville limestone and below Everton formation. Chazyan.

Mapped at and around Black Rock, Lawrence County.

Blackrock Limestone[1]

Precambrian: Southeastern Idaho.

Original reference: A. L. Anderson, 1928, Idaho Bur. Mines and Geology Pamph. 28, p. 4.

J. C. Ludlum, 1942, Jour. Geology, v. 50, no. 1, p. 92–93. Overlies Pocatello formation (new); unconformably underlies Brigham quartzite. Maximum thickness 535 feet. Precambrian. Spelling Blackrock used rather than Black Rock as used by Anderson (1928) because former spelling now appears on U.S. Geological Survey topographic map of Pocatello quadrangle.

Named because of occurrence along Blackrock Creek, about 2 miles northeast of Portneuf Siding. Best exposed on north side, where it can be traced up Blackrock Creek several miles.

Blackrock Quartzite

Carboniferous(?): Northeastern Nevada.

A. E. Granger and others, 1957, Nevada Bur. Mines Bull. 54, p. 113, pl. 14. Discussion of Elko County. A thrust fault crops out south of Rio Tinto mine and divides Paleozoic rocks into two groups of formations which as yet cannot be correlated. The "footwall" quartzite is only formation of upper plate group that crops out in area shown on plate 14. This is Blackrock quartzite of Stephens (unpub. rept.) Rocks are light-colored medium-grained quartzite. Stephens estimates minimum thickness of 1,000 feet.

Type locality and derivation of name not stated.

Blacksburg Schist[1]

Ordovician to Mississippian: Northwestern South Carolina and southern North Carolina.

Original reference: A. Keith and D. B. Sterrett *in* G. F. Loughlin and others, 1921, North Carolina Geol. and Econ. Survey Bull. 28, p. 28, 73.

T. L. Kesler, 1944, Geol. Soc. America Bull., v. 55, no. 6, p. 756, 763 (fig. 2). Incidental mention in report on metamorphic rocks in central Carolina piedmont.

U.S. Geological Survey currently designates the age of the Blacksburg as Ordovician to Mississippian on the basis of a study now in progress.

Named for development in Blacksburg, Cherokee County, S.C.

Blacks Fork Glaciation

Blacks Fork glacial stage[1]

Pleistocene: Northeastern Utah and southwestern Wyoming.

Original reference: W. H. Bradley, 1936, U.S. Geol. Survey Prof. Paper 185.

Ernest Antevs, 1945, Am. Jour. Sci., v. 243-A, table 2. Shown on correlation chart as older than Smith Fork stage (Wisconsin).

U.S. Geological Survey has amended the name Blacks Fork glacial stage to Blacks Fork Glaciation to comply with Stratigraphic Code adopted in 1961.

Named for extensive moraines left by its glaciers in valley of Blacks Fork, Utah.

Blacks Fork Member (of Bridger Formation)[1]

Eocene: Southwestern Wyoming.

Original reference: H. E. Wood 2d 1934, Am. Mus. Nat. History Bull. 67, art. 5, p. 241–242.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 15, pl. 1. Basal member of Bridger. Underlies Twin Buttes member. Early Bridgerian.

Named from Black's Fork of Green River which flows past most of best known exposures.

Blacksmith Limestone[1]

Middle Cambrian: Northeastern Utah and southeastern Idaho.

Original reference: C. D. Walcott, 1908, Smithsonian Misc. Colln., v. 53, no. 1804, p. 6, 7.

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1112–1113, 1117 (fig. 4), 1121. As amended, 450 feet thick at type section. Consists of white-gray, dull-steel-gray, and in upper 60 feet dark-lead-gray fine- to medium-grained usually thick-bedded dolomite and interbedded magnesian limestone. Overlies Ute limestone (emended); underlies Bloomington limestone.

J. S. Williams, 1948, Geol. Soc. America Bull., v. 59, no. 11, p. 1130, 1133. Described in Logan quadrangle, Utah, where it forms prominent cliffs. Thickness near Call's Fort 800 feet; on High Creek 710 feet.

Type locality: Blacksmith Fork Canyon, about 8 miles above its mouth and 15 miles east of Hyrum, Cache County, Utah.

Blacksnake Sandstone Member (of Hance Formation)[1]

Pennsylvanian: Southeastern Kentucky.

Original reference: G. H. Ashley and L. C. Glenn, 1906, U.S. Geol. Survey Prof. Paper 49, p. 80, pl. 16.

Cumberland Gap district.

Blackstone Series[1]

Precambrian(?): Eastern Rhode Island.

Original reference: J. B. Woodworth, 1899, U.S. Geol. Survey Mon. 33, p. 8, 104–109.

Alonzo Quinn, R. G. Ray, and W. L. Seymour, 1948, *in* Alonzo Quinn and others, Rhode Island Port and Indus. Devel. Comm. Geol. Bull. 3, p. 9-13, geol. map; A. W. Quinn, R. G. Ray, and W. L. Seymour, 1949, Bedrock geology of the Pawtucket quadrangle, Rhode Island-Massachusetts: U.S. Geol. Survey Geol. Quad. Map [GQ–1]. Name revived for stratified metamorphosed sedimentary and igneous rocks of Precambrian(?) age in Pawtucket quadrangle. Includes (ascending) Mussey Brook schist (new), Westboro quartzite, Sneech Pond schist (new), Hunting Hill greenstone (new), and related rocks. Unconformably underlies Pennsylvanian rocks. Cut by two groups of intrusive rocks. Replaces Marlboro formation of Emerson (1917) which is abandoned in this area; includes Westboro quartzite, which Emerson placed below the Marlboro, in a higher stratigraphic position.

A. W. Quinn, 1953, New York Acad. Sci. Trans., ser. 2, v. 15, no. 8, p. 266. Thickness about 10,000 feet in type area.

G. E. Moore, Jr., 1958, U.S. Geol. Survey Geol. Quad. Map GQ–105. Metasedimentary rocks of Hope Valley quadrangle, which occur as inclusions on roof pendants in Hope Valley alaskite gneiss and other intrusives, are correlated with Blackstone series on basis of similarity in lithology, structure, and metamorphism. Blackstone series in Hopewell quadrangle includes wide variety of lithologic types. In most parts of area, these types are intimately interlayered and are not mapped separately.

Named for typical development in lower course of Blackstone River between Woonsocket and Pawtucket, Providence County.

Blacksville Limestone (in Washington Formation[1] or Group)

Permian: Northern West Virginia and southwestern Pennsylvania.

Original reference: I. C. White, 1891, U.S. Geol. Survey Bull. 65, p. 36.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser. Bull. C–26, p. 135, 150. Lies 210 feet above top of Waynesburg coal which is considered base of Washington group. Thickness including local coals 5 to 20 feet. Occurs below Middle Marietta sandstone and coals and above Lower Marietta sandstone.

Named for village of Blacksville, Monongalia County, W. Va.

Blacktail Formation[1]

Precambrian (Belt Series): Northern Idaho.

Original references: J. L. Gillson, 1925, Am. Min., v. 10, p. 189; 1927, Jour. Geology, v. 35, no. 1, p. 1–32.

C. P. Ross and J. D. Forrester, 1958, Idaho Bur. Mines and Geology Bull. 15, p. 6 (fig. 4). Shown on correlation chart of Belt series in Idaho. Thickness 8,300 feet. Correlates with Creston formation in Boundary County and Priest River National Forest and with St. Regis formation in Coeur d'Alene Mountains, Idaho and Mont. Occurs above Burke formation and below Wallace formation in Pend Oreille region.

Type locality: Blacktail Mountain, near Talache.

Blacktail Formation

Cenozoic(?): Southeastern Arizona.

H. E. Enlows, 1955, Geol. Soc. America Bull., v. 66, no. 10, p. 1217. Thick section of andesitic and dacitic lavas, breccias, and tuffs. Part of formation may be equivalent to Bonita Park formation (new). Also may be correlative with Faraway Ranch formation. Name credited to Raydon (unpub. thesis).

In Portal area, Cochise County.

Blacktail Granite Gneiss

Precambrian (pre-Beltian): Southwestern Montana.

E. W. Heinrich, 1948, (abs.) Geol. Soc. America Bull., v. 59, no. 12, pt. 2, p. 1329. Pre-Beltian red granite cutting both Pony and Cherry Creek rocks.

Robert Scholten, K. A. Keenmon, and W. O. Kupsch, 1955, Geol. Soc. America Bull., v. 66, no. 4, p. 351. Name Dillon granite gneiss introduced by Henrich (1953) to replace term Blacktail previously used for same unit (Heinrich, 1950) because latter term is preoccupied.

Near Dillon Beaverhead County.

Blacktail Deer Creek Basalts

Miocene, lower: Southwestern Montana.

Robert Scholten, K. A. Keenmon, and W. O. Kupsch, 1955, Geol. Soc. America Bull., v. 66, no. 4, p. 374, pl. 1. Named for several basalt flows that are associated with Blacktail Deer Creek formation. Composed of dark locally vesicular groundmass with phenocrysts of feldspar.

Exposed in a northeast-southwest zone northwest of the Snowcrest Range, between U.S. Highway 91 and Blacktail Creek, Beaverhead County.

†Blacktail Deer Creek Beds[1]

Blacktail Deer Creek Formation

Miocene, lower: Southwestern Montana.

Original reference: E. Douglass, 1902, Am. Phil. Soc. Trans., v. 20, new ser., pt. 3, p. 237–245.

C. W. Hibbard, and K. A. Keenmon, 1950, Michigan Univ. Mus. Paleontology Contr., v. 8, no. 7, p. 193–204. Termed Blacktail Deer Creek formation. Thickness at type section, herein designated, about 400 feet; lower and upper limits not definitely established. Beds dip 5° W.; nearby underlying basalts dip to west as much as 30°. Beds from which vertebrate remains were removed consist of varying sequence of light-colored clays, volcanic ash, sandstones, and fine conglomerates; no fossils found in upper 370 feet of beds although they are lithologically similar to fossil-bearing beds. Lower Miocene.

Type section: Near center sec. 8, T. 11 S., R. 6 W., Beaverhead County. Map by the Forest Service, 1947, shows creek as Dry Blacktail Creek. Beds are exposed in west flank of gentle anticline and crop out one-half mile west of West Fork Road, at a point one-half mile southwest of junction of East Fork and West Fork Roads which follow upper tributaries of Blacktail Creek. This is locality described by Douglass.

†Blackwater Formation[1]

Pennsylvanian: Northeastern West Virginia and western Maryland.

Original reference: N. H. Darton and J. A. Taff, 1896, U.S. Geol. Survey Geol. Atlas, Folio 28.

On Blackwater River below Davis, W. Va.

Blackwater Shale and Limestone[1] (in Kanawha Group)

Pennsylvanian: Northeastern West Virginia.

Original reference: D. B. Reger, 1923, West Virginia Geol. Survey Rept. Tucker County, p. 198, 209–210.

J. C. Ludlum, 1958, West Virginia Geol. Survey State Park Ser. Bull. 6, p. 23. Thickness 32 feet. Overlies Lower Gilbert sandstone; underlies Winifrede limestone horizon. Kanawha group. Pottsville series.

Named for exposures on north side of Blackwater River, 2 miles southwest of Davis and one-half mile below Blackwater Falls, Tucker County.

Blackwater Creek Shale (in Little Osage Shale Member of Fort Scott Formation)

Backwater Creek Shale Member (of Fort Scott Formation)

Pennsylvanian (Des Moines Series): Northwestern Missouri.

J. R. Clair, 1943, Missouri Geol. Survey and Water Resources, 2d ser., v. 27, pl. 1. Gray argillaceous shale; locally red. Thickness 19 to 25 feet. Below Higginsville limestone and above Houx limestone. Name appears as Backwater Creek.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 6, fig. 1. Shale at top of Little Osage member of Fort Scott formation. A channel-type sandstone, herein named Flint Hill, occurs above the Blackwater Creek from northern Boone County into southeastern Grundy County.

Type locality and derivation of name not given. First noted in Jackson and Cass Counties.

†Bladen Formation[1]

Bladen Member (of Black Creek Formation)

Upper Cretaceous: Coastal Plain of North Carolina and South Carolina.

Original reference: L. W. Stephenson, 1907, Johns Hopkins Univ. Circ. 71, p. 93–99.

S. D. Heron, Jr., 1958, South Carolina Div. Geology Bull., v. 2, nos. 11–12, p. 85, chart 1. Stephenson's (1907) term Bladen is here applied to lower member of Black Creek formation.

S. D. Heron, Jr., and W. H. Wheeler, 1959, Geol. Soc. America, Southeastern Sec. Guidebook for Coastal Plain Field Trip, p. 5–6, 19. Consists of alternating thin beds of clay and sand, masses of relatively pure loose sand, lignitized wood, and marcasite in basal portion followed by medium to coarse sand and clayey sand; more than 50 percent of member is sand. Thickness about 16 feet. Outcrop relations of Cape Fear, Middendorf, and Bladen units are open to several interpretations; view that Middendorf represents an updip part of the Bladen seems preferable. Bladen rests on the Cape Fear in downdip exposures, and Middendorf rests on the Cape Fear in updip exposures in Fort Bragg.

Named for exposures in Bladen County, N.C., especially along Cape Fear River.

Blaine Gypsum or **Formation**[1] (in Nippewalla, El Reno, or Pease River Group)

Blaine Gypsum (in Double Mountain Group)

Permian: Western Oklahoma, southern Kansas, and northern Texas.

Original reference: C. N. Gould, 1902, Oklahoma Geol. Survey 2d Bienn. Rept., p. 42, 47.

Noel Evans, 1931, Am. Assoc. Petroleum Geologists Bull., v. 15, no. 4, p. 405–432. Formation includes Medicine Lodge, Shimer, Lovedale (new), and Haskew (new) gypsum members.

D. A. Green, 1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 11, p. 1468–1469. In central and west-central Oklahoma, includes (ascending) Medicine Lodge, Alabaster (new), Shimer, Lovedale, and Haskew members. Thickness about 125 feet.

N. H. Darton, L. W. Stephenson, and Julia Gardner, 1937, Geologic map of Texas (1:500,000): U.S. Geol. Survey. Mapped in Double Mountain group.

G. H. Norton, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 12, p. 1764 (fig. 3), 1766, 1793–1799. In Kansas, included in Salt Fork division of Cimarron series. Includes (ascending) Medicine Lodge, Nescatunga (new), Shimer, and Haskew gypsum members. Overlies Flowerpot shale; underlies Dog Creek shales.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 3). Included in El Reno (San Andres) group in Texas.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, pl. 2. Included in El Reno group in Texas; Double Mountain group abandoned.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, p. 158, 161 (fig. 4). In Kansas, included in Nippewalla group. Comprises (ascending) Medicine Lodge, Nescatunga, Shimer, and Haskew gypsum members. Thickness about 50 feet. Underlies Dog Creek shale; overlies Flowerpot shale.

Robert Roth, 1945, Geol. Soc. America Bull., v. 56, no. 10, p. 893–907. Included in Pease River group in Texas.

G. L. Scott, Jr., and W. E. Ham, 1957, Oklahoma Geol. Survey Circ. 42, p. 16–28, pl. 1. In Carter area, redefined to include all strata, characterized by thick gypsum beds, that lie between Flowerpot shale below and Dog Creek shale above. Comprises (ascending) Haystack gypsum, Cedartop gypsum, Collingsworth gypsum, Mangum dolomite, and Van Vacter gypsum (new) members. Three intervening shale beds are unnamed. The thin Chaney and Kiser gypsums are excluded from the Blaine and placed in underlying Flowerpot shale. Thickness 130 to 140 feet. El Reno group.

A. J. Myers, 1959, Oklahoma Geol. Survey Bull. 80, p. 24 (fig. 16), 27–34, pl. 1. Described in Harper County where it consists of four gypsum members interbedded with red shales and some dolomite, which lie above the Flowerpot shale and below the Dog Creek. Named members are (ascending) Medicine Lodge, Nescatunga, Shimer, and Haskew. Thickness about 90 feet. El Reno group. Guadalupian.

Type locality: In Salt Creek (Henquenet's) Canyon, northern Blaine County, Okla.

Blair 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 is about 360 feet thick in Flaming Gorge area; underlies Rock Springs formation, and overlies Hilliard shale. Toward the east, intertongues with upper part of Hilliard shale, and at east end of Antelope Flat is entirely replaced by the Hilliard.

Named for exposures at Blair Ranch, east of Aspen Mountain, Sweetwater County, Wyo.

Blakeley Formation[1]

Blakeley Stage

Oligocene: Western and southwestern Washington.

Original reference: C. E. Weaver, 1912, Washington Geol. Survey Bull. 15, p. 10–22.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 114–115. Type section of the Blakeley comprises sandstones, shales, and conglomerates, exposed in sea cliffs along entrance to Bremerton Inlet, an arm of Puget Sound. Lowermost beds occur at Orchard Point and consist of conglomerates; uppermost strata are also composed of conglomerates cropping out at north entrance of Blakeley Harbor on southern portion of Bainbridge Island. Fossiliferous horizon within formation from which bulk of fauna of the Blakeley have been obtained, occurs at Restoration Point about one-third the thickness of the formation downward from the top. Term Blakeley was applied by Weaver (1912) to section consisting of about 8,000 feet of shales, sandstones, and conglomerates at Restoration Point. At the time that report was written, the writer [Weaver] had in mind the entire sequence of beds between Port Blakeley and Orchard Point, but as result of incomplete statement referred only to Restoration Point. Formation has thickness of 8,900 feet including about 1,800 feet of conglomerate at base and 1,300 feet of conglomerate at top. Between are 4,800 feet of massive and stratified sandy shales, and thick members of interstratified conglomerate. It is possible lower Orchard Point conglomerate (new) may belong to middle Oligocene, and represent equivalent of Lyre formation (new).

C. E. Weaver and others, 1944, Geol. Soc. America Bull., v. 55, no. 5, chart 11. Shown on correlation chart as stage and 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.

C. V. Fulmer, 1954, (abs.) Geol. Soc. America Bull., v. 65, no. 12, pt. 2, p. 1340–1341. Weaver (1912) applied name Blakeley formation to Bainbridge Island section consisting of approximately 8,000 feet of conglomerates, sandstones, siltstones, and shales. Later, Weaver included in Blakeley a basal conglomeratic unit exposed at Orchard Point. Strata consisting of type Blakeley, as recognized by Weaver, can be grouped into three units. Lowermost 845 feet consists of well-bedded, hard, marine, gray sandstones, and massive conglomerates, the Orchard Point member. Middle unit consists of about 4,000 feet of marine hard massive gray-tan siltstone interbedded with thin hard fine-grained sandstone; soft limonitic-stained sandstone largely covered with beach gravels; and massive dark-gray silty shale. This unit is Restoration Point member and contains the typical Blakeley molluscan faunule. Upper unit consists of about 4,650 feet of massive nonmarine conglomerates interbedded with thin gray sandstones, and soft carbonaceous shale. Recommended that Blakeley be restricted to Orchard Point and Restoration Point members, and that overlying nonmarine conglomeratic interval be referred to a new formation.

R. D. Brown, Jr., and H. D. Gower, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 10, p. 2496–2497. Blakeley formation as used by Weaver is included in redefined Twin River formation.

Type section: Restoration Point, Kitsap County, opposite Seattle, at entrance to Bremerton Navy Yard. Highest strata crop out on north shores of Blakeley Harbor.

Blakely Sandstone[1]

Lower Ordovician: Southwestern Arkansas and southeastern Oklahoma.

Original reference: E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, p. 676.

W. D. Pitt, 1955, Oklahoma Geol. Survey Circ. 34, p. 23–24. As defined by Miser (1917, U.S. Geol. Survey Bull. 660), lies stratigraphically above Mazarn shale and below Womble shale. In Oklahoma, Honess (1923, Oklahoma Geol. Survey Bull. 32) mentioned two general outcrops of Blakely. One in sec. 16, T. 5 S., R. 23 E., and southwest therefrom, where Honess noticed that the only good exposure is the lower 10 to 15 feet at bottom of cliff on Glover Creek. A series of beds distinct lithologically from Mazarn shale below and Womble siltstone above was noted by present writer [Pitt] near above location. This 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 type area. Other occurrence of Honess' Blakely sandstone is in sec. 25, T. 5 S., R. 23 E., and parts of neighboring sections. Honess noted that "there is some doubt about correlation with the beds to the north" because the "sandstones are not bronze colored." Present writer disagrees with Honess' correlation. Honess' two occurrences of Blakely sandstone are not similar lithologically because the outcrops in the two areas represent two stratigraphic units rather than one stratigraphic unit with several facies. Outcrop that Honess describes as Blakely sandstone consists of one sandstone bed 15 feet thick, which is not at all similar to the 400 feet of interbedded shale and sandstone that Miser describes as Blakely at type locality.

Named for Blakely Mountain, Garland County, Ark.

Blanca Tuff[1]

Miocene: Southern California.

Original reference: W. W. Rand, 1931, Mining in California, v. 27, no. 2, p. 217.

On Santa Cruz Island. Derivation of name not stated.

Blancan Age

Pliocene: North America.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 12, pl. 1. Provincial time term, based on the local fauna at "Mt. Blanco" and adjoining draws, near "old rock house," north of Crawfish Draw, Crosby

County, Tex. Covers an interval in the upper Pliocene above the Hemphillian age. Report defines 18 provincial time terms, based on mammal-bearing units, for North American continental Tertiary. [For sequence, see under Puercan.]

Blanchester Member (of Waynesville Formation)

Blanchester division (in Richmond Group)[1]

Upper Ordovician: Southwestern Ohio, southeastern Indiana, and north-central Kentucky.

Original reference: A. F. Foerste, 1909, Denison Univ. Sci. Lab. Bull. 14, p. 291.

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 uppermost member of Waynesville formation. Overlies Clarksville member; underlies Liberty formation.

Named for Blanchester, Clinton County, Ohio.

Blanco Formation[1]

Pliocene, middle: Texas and Kansas.

Original reference: E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept., p. lxxi, pl. 3.

G. L. Evans and G. E. Meade, 1944, Texas Univ. Bur. Econ. Geology Pub. 4401, p. 485–507. Blanco beds consist mainly of well-bedded light-gray calcareous sands and clays with some fresh-water limestones, tuffs, diatomite, and coarse gravels. Thickness 56 to 74 feet. Unconformably underlain by reddish-brown sands and clays of middle Pliocene and overlain by widespread sheet of surface sands of probably eolian origin. Nebraskan age. Pleistocene age assignment based upon Meade's study of faunas. Blanco beds are believed to be lacustrine deposits laid down in broad shallow basins rather than deposits of a large stream valley as was interpreted by earlier writers.

G. L. Evans, 1949, West Texas Geol. Soc. Guidebook Field Trip 2, Nov. 6–9, p. 7–8. Unconformably overlies Bridwell formation (new).

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 58–68. In Kansas, as in other areas of the Great Plains, deposits correlated with Blanco formation commonly are coarse textured in lower part and grade upward into finer textured clastics. Although conformable and gradational, these contrasting lithologies merit recognition as named members. In Nebraska, equivalent units are named Holdrege and Fullerton formations; in Kansas, these names are used to designate comparable members of Blanco formation. In central Kansas, Blanco formation was described by Fent (1950) who proposed name Chase Channel formation, containing Holdrege and Fullerton members, for these deposits in Rice County. In this area, formation known primarily from test hole data. South and southeast of Rice County, the Blanco crops out along valleys of Arkansas, Chickaskia, and Ninnescah Rivers in Harper, Kingman, Reno, and Sedgwick Counties. Quantitatively, the Blanco in Kansas has its maximum development in southwestern area where it 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 formation. At type locality and west of Channing, Tex., in central Meade County, Kans., and in Rice County, Kans., Blanco beds are overlain by Meade formation (in Texas classed as Tule), including Sappa member with Pearlette volcanic ash bed. At all of these localities, unconformable relationships of Blanco to Pliocene Ogallala formation is clear. Pleistocene (Nebraskan).

Named for Blanco Canyon, Dickens County, and Mount Blanco post office, Crosby County, Tex.

Blanco Sandstone (in Puente Formation)

Miocene, upper: Southern California.

M. L. Krueger, 1943, California Div. Mines Bull. 118, p. 363. Shown on structure section as underlying Cubierto shale (new) and overlying Papel Blanco shale (new).

A. O. Woodford, T. G. Moran, and J. S. Shelton, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 4, p. 521. Light-colored medium- and coarse-grained sandstone 337 feet thick. 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.

Blanco Basin Formation[1]

Oligocene(?): Southwestern Colorado.

Original reference: E. S. Larsen, 1935, U.S. Geol. Survey Bull. 843.

F. B. Van Houton, 1957, Geol. Soc. America Bull., v. 68, no. 3, p. 387 (table 1), 388. There is no evidence for assigning Telluride and apparently equivalent Blanco Basin formation an Oligocene(?) age. They are more probably arkosic border facies of upper Paleocene and lower Eocene San Jose (Wasatch formation).

Named for development about Blanco Basin, central part of Summitville quadrangle.

†Blanco Canyon Beds[1]

Pliocene: Panhandle of Texas.

Original reference: E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept., p. lxxi, pl. 3.

Named for Blanco Canyon, Dickens County, and Mount Blanco post office, Crosby County.

†Blan[d]ford Limestone[1]

Precambrian: Western Massachusetts.

Original reference: E. Hitchcock, 1883, Rept. Geol., Min., Bot., and Zool. of Massachusetts, p. 305.

Exposed in northwestern part of town of Blan[d]ford, Hampden County.

Blandford Serpentine and Pyroxenite[1]

Age(?): Massachusetts.

Original reference: B. K. Emerson, 1898, U.S. Geol. Survey Mon. 29, p. 85.

Blaylock Sandstone[1]

Silurian: Southwestern Arkansas and southeastern Oklahoma.

Original reference: A. H. Purdue, 1909, (abs.) Geol. Soc. America Bull., v. 19, p. 557.

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

W. D. Pitt, 1956, Ardmore Geol. Soc. Guidebook Ouachita Mountains Field Conf., p. 39. Consists of thin-bedded sandstones and dark shales which weather red or brown. Sandstones are silty, normally greenish gray or brown on fresh fracture. Thickness 670 to slightly over 800 feet. Overlies Polk Creek shale; underlies Missouri Mountain shale.

Named for Blaylock Mountain, Montgomery County, Ark.

Bledsoe Limestone[1]

Silurian (Niagaran): Western and central Tennessee.

Original reference: A. F. Foerste, 1901, Geol. Soc. America Bull., v. 12, p. 397, 402.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 269–270, fig. 80. In this report, all occurrences of post-Waldron Silurian strata in Central Basin are called Bledsoe limestone. Thickness 18 feet at Bakers Station, 35 feet at Shackle Island, and 80 feet at Bransford. Conformably overlies Waldron shale; unconformably overlain by either Pegram formation or Chattanooga shale.

Named for Bledsoe, Sumner County.

Blind Lake Glaciation or **Drift**

Pleistocene, upper: South-central Utah.

R. F. Flint and C. S. Denny, 1958, U.S. Geol. Survey Bull. 1061-D, p. 117 (fig. 25), 125–126, pl. 6. Drift consists of three small deposits marked at their peripheries by end moraines varying from a few feet to 60 feet in height. Largest mass extends only 1 mile beyond toe of cliff, down to an altitude of 9,900 to 10,200 feet, and includes basins of Blind and Pear Lakes. Second deposit marked by moraine that forms basin of Fish Creek Lake. Third includes small basin of Clark Lake. Pinedale(?) stage.

Type locality: In Fish Creek-Grover drift lobe, on flanks of Boulder Mountain, Wayne and Garfield Counties.

†Bliss Basalt[1] or Volcanics

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. 78–79, pl. 5. Thickness of volcanics about 100 feet. Contemporaneous with McKinney basalt and probably a part of it.

Type locality: Bliss Cone and Bliss Bridge, sec. 11, T. 6 S., R. 12 E., Twin Falls County, also Bliss Spring, Gooding County.

Bliss Sandstone[1]

Bliss Formation

Upper Cambrian and Ordovician: Western Texas and southern New Mexico.

Original reference: G. B. Richardson, 1904, Texas Univ. Min. Survey Bull. 9, p. 27.

P. B. King, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 153–156. Type Bliss has hitherto been classed as Cambrian, but paleontological evidence for this is questionable. Type locality may be Ordovician.

H. E. Rothrock, C. H. Johnson, and A. D. Hahn, 1946, New Mexico Bur. Mines Mineral Resources Bull. 21, p. 19–20. In this report, Bliss sandstone in New Mexico is considered to be of Cambrian age because of (1) valid evidence in Silver City area and in Sierra Caballos, (2) presence of thick sandstones of known Cambrian age in southeastern Arizona, and (3) lithologic and stratigraphic similarity between Silver City and Sierra Caballos occurrences and outcrops of basal sandstones called Bliss in Cooks Peak and in Mimbres, Florida, Organ, and San Andres Mountains.

P. E. Cloud, Jr., and V. E. Barnes, 1948, Texas Univ. Bur. Econ. Geology Pub. 4621, p. 67–69, 369 [1946]. Age of Bliss sandstone remains unsettled, but evidence seems slightly to favor its tentative consideration as Lower Ordovician.

V. C. Kelley, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 10, p. 2200–2213. Sandstone underlies Sierrite limestone (new) of El Paso group. Upper Cambrian.

V. C. Kelley and Caswell Silver, 1952, New Mexico Univ. Pubs. in Geology 4, p. 31 (table), 33–39. Designated as formation because of diverse lithology. Overlies Precambrian; underlies Sierrite formation of El Paso group. Thickness 110 to 160 feet. Cambrian. Area of report is Caballo Mountains.

R. H. Flower, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 8, p. 2054–2055. Paleontological evidence indicates that base of Bliss may be as old as middle of Franconia and its top may extend into basal Ordovician.

F. E. Kottlowski and others, 1956, New Mexico Bur. Mines Mineral Resources Mem. 1, p. 14-16. Bliss sandstone in San Andres Mountains considered to be Ordovician in age. At base of Bliss, however, are unfossiliferous beds lithologically similar to those bearing Upper Cambrian fossils in Caballo and San Diego Mountains. Summary discussion of unit.

Named for Fort Bliss, southeastern part of Franklin Mountains, El Paso County, Tex.

Blocher Formation (in New Albany Shale)

Blocher Member (of New Albany Shale)

Middle Devonian: Southeastern Indiana.

Guy Campbell, 1946, Geol. Soc. America Bull., v. 57, no. 9, p. 835, 837, 840–842. Thinly laminated black shale that locally contains sandstone lenses ½ to 1 inch thick in basal part. Contains conodont fauna. Commonly 8 to 10 feet thick, but ranges from 2 to 15 feet. Locally includes, at top, an additional bed 1 to 3 feet thick composed of black shale and layers of sandstone. Underlies Blackiston formation (new) with contact disconformable; overlies limestones of Hamilton age; at type locality overlies Swanville limestone.

H. H. Murray and others, 1955, Indiana Geol. Survey Field Conf. Guidebook 8, p. 43, pl. 1. Indiana Geological Survey uses term Blocher with member rank.

Type section: One and one-half miles southeast of Blocher, Scott County, 1 mile east of Baltimore and Ohio Railroad, on Highway 50.

Block Limestone[1] Member (of Cherryvale Formation)

Block Limestone Member (of Sarpy Formation)

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

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. 6th Ann. Field Conf., Guide Book, p. 85, 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), 94–95. Member of Cherryvale; underlies Wea shale member; overlies Fontana shale member. This is classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma with proviso that some differences may be required by regional variation.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 38. In Nebraska, basal member of Sarpy formation (new). Underlies Wea shale member of Sarpy; overlies Fontana formation; thickness one-third to two-thirds foot. Thickness in Iowa 4 feet. Type locality stated.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 27, fig. 5. Gray limestone nodules enclosed in gray shale matrix. Thickness one-half foot. Member of Cherryvale; underlies Wea shale member; overlies Fontana shale member.

Type locality: Roadcuts near center south line sec. 6, T. 18 S., R. 24 E., and center west line sec. 18, T. 19 S., R. 23 E., Miami County, Kans. Named for hamlet of Block, Miami County.

Blockhouse Shale

Middle Ordovician: Eastern Tennessee.

R. B. Neuman, 1955, U.S. Geol. Survey Prof. Paper 274–F, p. 145, 148–154, table 3, pl. 28. Dark-gray calcareous shale with thin beds and lenses of dark-gray dense limestone forms main body of unit 150 to 950 feet thick. In southwestern part of Tellico-Sevier belt, these fine-grained rocks are partly replaced by fine- to coarse-grained Toqua sandstone member (new) which underlies unnamed shale member. Thin argillaceous limestone forms basal member, and term Whitesburg limestone member is applied to it. Overlies Lenoir limestone; underlies Tellico formation. Blockhouse shale as defined in this report was included by Keith (1895, U.S. Geol. Survey Geol. Atlas, Folio 16) and Rodgers (1953) in lower part of Athens shale.

Type section: Base of section 800 feet southwest of bench mark F132Y (elevation 972 feet) extending southeastward up a gullied hillside, Blockhouse quadrangle, Blount County.

Bloody Run zone[1]

Upper Devonian: North-central Iowa.

Original reference: C. L. Fenton and C. L. Webster, 1924, Univ. Michigan Pub., Contr. Mus. Geol., v. 1, frontispiece, map.

Bloomfield Limestone (in Conemaugh Formation)[1]

Pennsylvanian: Southeastern Ohio.

Original reference: W. Stout, 1918, Ohio Geol. Survey, 4th ser., Bull. 21, p. 242.

M. T. Sturgeon and others 1958, Ohio Geol. Survey Bull. 57, p. 120–121. Member of Anderson cyclothem, Conemaugh series. Underlies Anderson clay member; overlies Bakerstown shale and (or) sandstone member.

According to Waagé (1950, Maryland Dept. Geology, Mines and Water Resources Bull. 9) Hennen and Reger (1914) named an equivalent limestone in Preston County, W. Va., the Albright limestone. Thus, Albright has precedence over Bloomfield. Recommended that Albright replace Bloomfield if and when positive correlation is determined.

Named for exposures west of Bloomfield, Muskingum County.

Bloomfield sand[1]

Eocene: Southeastern Missouri.

Original reference: C. R. Keyes, 1894, Missouri Geol. Survey, v. 4, p. 30.

Named for Bloomfield, Stoddard County.

Bloomfield Sandstone (in Cayuga Group)[1]

Silurian: Central Pennsylvania.

Original reference: E. W. Claypole, 1885, Pennsylvania 2d Geol. Survey Rept. F_2, p. 54, 401.

Underlies New Bloomfield, and exposed on road to Newport, one-half mile east of town. Perry County.

Bloomingdale Limestone Member[1] (of Conococheague-Copper Ridge formation)

Upper Cambrian: Eastern Tennessee.

Original reference: C. R. L. Oder, 1934, Jour. Geology, v. 42, no. 4, p. 478–479, 492, 496.

C. E. Resser, 1938, Geol. Soc. America Spec. Paper 15, p. 3, 18. Abandoned. Morristown and Bloomingdale limestone members (Oder, 1934) are parts of the Copper Ridge or Conococheague; use of these terms does not seem warranted.

Josiah Bridge, 1956, U.S. Geol. Survey Prof. Paper 277, p. 33. It is now thought that most of strata placed in Bloomingdale by Oder belong in lower part of Chepultepec dolomite as now recognized.

Type section: Along a branch of Reedy Creek 1½ miles northwest of Bloomingdale 4 miles northeast of Kingsport, Sullivan County.

Bloomington Drift, Substage

Pleistocene (Wisconsin): Northern Illinois.

H. B. Willman and others, 1942, Illinois Geol. Survey Bull. 66, p. 145 (fig. 85), 146 (fig. 86), 158–159. Consists largely of pink till, locally underlain by outwash gravel of advancing glacier and overlain by outwash gravel of retreating glacier. Maximum thickness about 50 feet. Most commonly overlies earlier Wisconsin deposits, but in large areas rests directly on bedrock, and in some places overlies Sangamon deposits and Illinoian drift; mostly overlain by Cropsey, Farm Ridge, Chatsworth, and Marseilles drifts. [Report lists six drifts in the Tazewell; for sequence see under Shelbyville.]

Leland Horberg, 1951, Illinois Geol. Survey Bull. 75, pt. 1, p. 19. In Peoria area, Bloomington drift is listed as older than Metamora drift and younger than Leroy drift.

J. L. Hough, 1958, Geology of the Great Lakes: Urbana, Univ. Illinois Press, p. 94. Listed as glacial substage (late Tazewell).

Named for Bloomington, McLean County. Widely distributed throughout Marseilles-Ottawa-Streater area.

Bloomington Formation[1]

Middle Cambrian: Southeastern Idaho and northeastern Utah.

Original reference: C. D. Walcott, 1908, Smithsonian Misc. Colln., v. 53, no. 1804, p. 6, 7.

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1110–1112, 1117 (fig. 4), 1121–1122. Described in Blacksmith Fork area, Utah, where it is 1,275 feet thick; Hodges member about 163 feet thick. Overlies Blacksmith dolomite (emended); underlies Nounan dolomite.

G. B. Maxey, 1958, Geol. Soc. America Bull., v. 69, no. 6, p. 651–653, 672, 673 (fig. 3). Consists of basal tawny-olive shale and interbedded thin layers of light- to dark-gray limestone (Hodges shale member), overlain by middle unit of thinly to thickly bedded, light- to dark-gray limestone about 720 feet thick, overlain by an upper tawny-olive shale unit with some interbedded platy limestone, the Calls Fort member (new). Total thickness 1,495 feet. Overlies Blacksmith dolomite; underlies Nounan formation.

Type locality: About 6 miles west of Bloomington, Bear Lake County, Idaho. Bloomington Creek, near type locality, passes through formation. Crops out throughout southeastern Idaho and northeastern Utah as far south as northern margin of Great Salt Lake and Brigham City. Recognized in Lakeside Range, on west margin of Great Salt Lake.

Bloomsburg Redbeds (in Cayuga Group)[1]

Bloomsburg Formation (in Cayuga Group)

Upper Silurian: Central and southern Pennsylvania, western Maryland, western Virginia, and northern West Virginia.

Original reference: I. C. White, 1883, Pennsylvania 2d Geol. Survey Rept. G_7, p. 252.

C. K. Swartz, 1941, Geol. Soc. America Bull., v. 52, no. 8, p. 1184, measured section. Red sandstone and shale. Thicknesses: about 2,000 feet at Lehigh Gap; 1,815 feet southwest of New Ringgold; and 1,900 feet near Delaware Water Gap. Underlies and intertongues with Poxono Island shale; overlies [southeastern Pennsylvania] Clinton shale and Tuscarora sandstone at Schuylkill River and Shawangunk conglomerate at Delaware River.

H. P. Woodward, 1941, West Virginia Geol. Survey, v. 14, p. 149–150. Term Bloomsburg facies applied to red phase of Cayugan series. This term replaces units previously called Bloomsburg "shale" or Bloomsburg "sandstone." Green or brown sandstone of western Silurian belt cannot properly be called "Bloomsburg" as it is not the true facies to which that name is now restricted. Term Williamsport sandstone is herein revived and redefined to include the green or brown sandstone. Williamsport is basal member of Cayugan group. Identity of Williamsport in eastern Silurian outcrops is obliterated by or absorbed in red nonmarine Bloomsburg facies.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Shown on correlation chart as Niagaran and Cayugan.

Ernst Cloos, 1951, Maryland Dept. Geology, Mines and Water Resources Washington County [Rept. 14], p. 77. Bloomsburg formation in Cayuga group. Has been considered member of Wills Creek in Maryland. Thickness 20 to 200 feet. Underlies Wills Creek shale; overlies McKenzie formation.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 5, 20, 22, 31, pl. 1. Formation, in central Pennsylvania, consists of red fine-grained siltstone with some interbedded sandstone and shale. Lower part of section generally calcareous and commonly contains green interbeds, lenses, and blebs, while upper part is commonly very sandy. In Loysville quadrangle, a lenticular clean white quartzose sandstone (Bridgeport member) occurs in middle of unit. Thickness 1,000 feet at Susquehanna Gap; 500 feet in Loysville area; 200 to 400 feet in west-central part of state. Underlies Wills Creek formation; overlies Mifflin formation (new) in Mifflinton [Mifflintown] area; elsewhere overlies McKenzie formation. Eastward, the Bloomsburg includes more and more of both the McKenzie and the Wills Creek until in eastern Pennsylvania the Bloomsburg occupies a 2,000-foot section.

Named for exposures at Bloomsburg, Columbia County, Pa.

Bloomsdale Formation (in Plattin Group)

Middle Ordovician: Southeastern Missouri.

E. R. Larson, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 9, p. 2046–2048. Named as lowermost formation of group. Dominantly fine-textured well-bedded dolomite, with interbeds of light-gray-weathering oolitic and carbonate pebble-bearing calcilutite; green shale layers common; sparsely fossiliferous. Thickness at type locality 61 feet. Overlies Rock Levee formation; overlapped by Beckett formation (new).

Type section: In bed of stream rising in SW¼NE¼ sec. 15, T. 38 N., R. 8 E., 3½ miles east of Bloomsdale, near Belleville School, Ste. Genevieve County.

Blossburg[1]

Blossburg Red Beds

Upper Devonian: New York and central northern Pennsylvania.

Original reference: G. H. Chadwick, 1933, Pan-Am. Geologist, v. 60, no. 2, p. 99, 279, 282, 357.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Correlation chart shows Blossburg red beds in New York. Above "Mansfield beds." Upper Devonian.

First mentioned in Tioga County, Pa.

Blossom Sand[1]

Blossom Sand (in Austin Group)

Upper Cretaceous (Gulf Series): Northeastern Texas.

Original reference: C. H. Gordon, 1909, Am. Jour. Sci., 4th, v. 27, p. 371, 373.

L. W. Stephenson and others, 1942, Geol. Soc. America Bull., v. 53, no. 3, chart 9. Shown on correlation chart above Bonham equivalents and below Brownstown marl.

D. L. Frizzell, 1954, Texas Univ. Bur. Econ. Geology Rept. Inv. 22, p. 35, fig. 1. Included in Austin group. Foraminifera described.

Named for Blossom, Lamar County.

†Blount Group[1]

Middle Ordovician: Eastern Tennessee, Alabama, northwestern Georgia, western Virginia, and West Virginia.

Original reference: E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, p. 379, 382, 413, 567, 576, 627, pl. 27.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 23 (table 1), 147–183. Group comprises (ascending) Holston limestone, Whitesburg limestone, Athens shale, Tellico sandstone, Ottosee limestone—Sevier shale. Nowhere, so far as known, are all formations present in continuous vertical section. Overlies Stones River group; underlies Black River group. Chazyan series.

B. N. Cooper and C. E. Prouty, 1943, Geol. Soc. America Bull., v. 54, no. 6, p. 819–886. Revised stratigraphic nomenclature proposed for lower Middle Ordovician succession of Tazewell County and other parts of southwestern Virginia. Further use of terms Stones River, Murfreesboro, Mosheim, Lenoir, Blount, Holston, Ottosee, Lowville, and Lowville-Moccasin seems inadvisable. In Tazewell County, part of Ulrich's Blount group (upper Chazy) occurs beneath beds containing fauna of Murfreesboro limestone of Central basin of Tennessee.

Charles Butts and Benjamin Gildersleeve, 1948, Georgia Geol. Survey Bull. 54, p. 27–29, geol. map. Group in Georgia comprises (ascending) Holston marble, Athens shale, Tellico formation, and Ottosee (Sevier) shale. Overlies Stones River group.

Josiah Bridge, 1956, U.S. Geol. Survey Prof. Paper 277, p. 57. No complete section of Blount group has ever been found; at present the idea that such a unit exists, intermediate between the Chazy and Black River and represented only in southern Appalachians, has been completely discarded.

Named for Blount County, Tenn.

Blounts Creek Member (of Fleming Formation)

Miocene: Central Louisiana.

H. N. Fisk, 1940, Louisiana Dept. Conserv. Geol. Bull. 18, p. 118 (fig. 26), 168–170, 174, geol. map. Uppermost member of formation. Consists of group of silty clays and sands; some beds as much as 10 feet thick. Thickness about 500 feet. Overlies Castor Creek member (new); underlies Quaternary deposits.

Well exposed south of Hinestone in northern slopes of Blounts Creek, Rapides Parish.

Blowing Rock Gneiss[1]

Precambrian: Western North Carolina.

Original reference: A. Keith, 1903, U.S. Geol. Survey Geol. Atlas, Folio 90, p. 3.

J. L. Stuckey and S. G. Conrad, 1958, North Carolina Div. Mineral Resources Bull. 71, p. 18; J. L. Stuckey, 1958, Geologic map of North Carolina (1: 500,000): North Carolina Div. Mineral Resources. Consists of two varieties, one containing large porphyritic crystals of orthoclase feldspar embedded in groundmass of quartz, feldspar, biotite, and muscovite, and the other consisting of the same minerals in grains of uniform size. Precambrian (?)

Named for Blowing Rock in Cranberry quadrangle, Watauga County.

†Blowout Mountain Sandstone (in Double Mountain Group)[1]

Permian: Central northern Texas.

Original reference: W. E. Wrather, 1917, Southwestern Assoc. Petroleum Geologists Bull., v. 1, p. 95, 96, 98, pl.

Named for exposure in Blowout Mountain, southwest of Merkel, Taylor County.

Bloyd Shale[1] or Formation

Lower Pennsylvanian (Morrow Series): Northwestern Arkansas and eastern Oklahoma.

Original reference: A. H. Purdue, 1907, U.S. Geol. Survey Geol. Atlas, Folio 154.

C. A. Moore, 1947, Oklahoma Geol. Survey Bull. 66, p. 38–39, strat. sections. Formation geographically extended into northeastern Oklahoma, where it contains representatives of both the Brentwood and Kessler limestone lentils as recognized in Washington County, Ark. Thickness 191 feet at Arkansas-Oklahoma line; thins westward.

L. G. Henbest, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 8, p. 1942–1945, 1948 (fig. 2). Shale consists of (ascending) Brentwood limestone member, Woolsey member (new) composed of terrestrial sediments, and an unnamed shale division, which includes Kessler limestone lentil and which represents the upper half to two-thirds of formation. Overlies Prairie Grove member (new) of Hale formation; underlies Greenland sandstone member (new) of Atoka formation.

G. G. Huffman and others, 1958, Oklahoma Geol. Survey Bull. 77, p. 80–82, strat. sections, pls. 4, 5. Formation described and mapped on south and west flanks of Ozark uplift. Traced around various outliers and fault blocks from Arkansas line westward to Arkansas River valley, northward to Mayes-Wagoner County line, where it is beveled by pre-Atoka erosion. A sequence of alternating shales and limestones; thin coal bed. Maximum thickness 225 feet in Stilwell area; 58 feet at Braggs Mountain. Conformable and gradational with underlying Hale; unconformable with overlying Atoka.

Named from Bloyd Mountain, 9 miles southwest of Fayetteville, Washington County, Ark.

†Blue chert series[1]

Devonian(?): Northwestern California.

Original reference: O. H. Hershey, 1906, Am. Jour. Sci., 4th, v. 21, p. 58–66.

Klamath Mountains. Named for its most characteristic constituent, blue chert.

Blue conglomerate (in Conococheague Formation)

Upper Cambrian: Central Pennsylvania.

Carlyle Gray and D. M. Lapham, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 149 (fig. 3), 150. Local name applied to conglomerate in lower part of Conococheague in Cornwall district.

Blue Ball Fire Clay (in Allegheny Formation)[1]

Pennsylvanian: Central Pennsylvania.

Original reference: H. M. Chance, 1884, Pennsylvania 2d Geol. Survey Rept. H_7.

In Clearfield County.

Blue Beach Conglomerate

Cretaceous: Virgin Islands.

P. T. Cleve, 1871, Kongl Svenska Vetenscaps Akad. Handlengar, v. 9, no. 12, p. 4–5. Dark-bluish-green conglomerate on breccia. Thickness as much as 2,000 meters. Cretaceous.

R. W. Imlay, 1944, Geol. Soc. America Bull., v. 55, no. 8, p. 1007. Similar to Mount Eagle series on St. Croix.

D. J. Cederstrom, 1950, U.S. Geol. Survey Water-Supply Paper 1067, p. 17. Term "blue beach" was originally used by Cleve (1871) to apply to conglomerate or breccia having angular pieces of dark porphyry or felsite and rounded scoriaceous stones cemented together by greenish matrix, probably derived from decomposed hornblende, which is widely distributed in St. Thomas. Term has since been used loosely and is now used by natives of St. Croix to apply to all older dark indurated rocks of the island.

Exposed on St. Thomas Island.

Bluebell Dolomite[1]

Upper Ordovician, Silurian, and Devonian: Central northern Utah.

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

Paul Billingsley *in* J. M. Boutwell, 1933, 16th Internat. Geol. Cong. [United States] Guidebook 17, Excursion C–1, p. 110 (fig. 14). Subdivided into (ascending) Eagle, Beecher, Dora, and Noah members.

H. T. Morris, 1957, Utah Geol. Soc. Guidebook 12, p. 11 (fig. 3), 12, pl. 4. Described in Tintic mining district, where it is 350 to 600 feet thick. Separated into two members of nearly equal thickness by bed of crinkly-laminated medium- and light-gray dolomite about 10 feet thick. Lower member chiefly light- to medium-gray-weathering, thin- to medium-bedded, medium- to fine-banded dolomite; upper member principally medium- to dark-gray, medium- to thick-bedded, medium- to coarse-grained dolomite. Overlies Fish Haven dolomite; underlies Victoria formation. Includes beds that contain fossils of Late Ordovician, Silurian, and Devonian age, but systemic boundaries within formation cannot be recognized by lithologic differences.

H. J. Bissell, 1959, Utah Geol. Soc. Guidebook 14, p. 143–144. Because of loose manner in which name Bluebell (or Blue Bell) has been used stratigraphically and because field names Eagle, Beecher, Dora, and Noah dolomites are inappropriate as formal stratigraphic names, it is proposed that name Bluebell (or Blue Bell) be suppressed and that well-defined and time-rock established names as Fish Haven, Laketown, Sevy, and Simonson be applied in area of this report [Fivemile Pass and North Boulter Mountains quadrangles].

Named for Bluebell mine near Eureka, Tintic district.

Blueberry Mountain Argillite[1]

Lower(?) Devonian: Northwestern New Hampshire.

Original reference: C. H. Hitchcock, 1905, Geology of Littleton, N.H., Univ. Press, Cambridge.

Blueberry Mountain is northern part of ridge 2 miles west of Littleton, Grafton County.

Blueberry Mountain Series[1]

Silurian and Devonian: Northwestern New Hampshire.

Original reference: F. H. Lahee, 1913, Am. Jour. Sci., 4th, v. 36, p. 231–250.

Blueberry Mountain is northern part of ridge 2 miles west of Littleton, Grafton County.

†Bluebird Aplite[1]

Eocene: Montana.

Original references: W. H. Weed, 1899, Jour. Geology, v. 7, p. 744–747; 1903, U.S. Geol. Survey Bull. 213, p. 170.

In Butte district.

Bluebird Dolomite[1]

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), 7–8. Described in East Tintic Mountains, where it is 150 to 220 feet thick, overlies Herkimer limestone, and underlies Cole Canyon dolomite. Consists of dusky blue-gray medium-grained dolomite studded with short white dolomite rods a centimeter or so long and 1 to 2 centimeters in diameter; white rods are straight, slightly curved, or branched and resemble minute twigs. Middle Cambrian.

J. K. Rigby, 1958, Utah Geol. Soc. Guidebook 13, p. 19, 20–21. In Stansbury Mountains, consists of dark-gray medium-crystalline dolomite, 75 to 80 feet thick, at base of Cole Canyon formation; overlies Bowman limestone.

Well exposed along backbone of Bluebird Spur for nearly 1,000 feet, north of Eureka Gulch and west of Cole Canyon, Tintic district.

Bluebonnet Member (of Lake Waco Formation)

Cretaceous (Gulf Series): Central Texas.

W. S. Adkins and F. E. Lozo *in* F. E. Lozo, 1951, Fondren Sci. Ser., no. 4, p. 122–123, 139 (fig. 17), 141 (fig. 18). Consists of limestone flagstones interbedded with calcareous shale and bentonites. Thickness 12 to 18 feet. Underlies Cloice member (new); overlies Pepper formation.

Type area and section: Along Bosque Escarpment from old South Bosque brickyard southwest into Moody Hills, then southward past Moody, McLennan County; type section is opposite Baggetts Station, on east side of McGregor-Moody Road (State Highway 17), about 4½ miles south-southeast of McGregor.

†Blue Canyon Formation[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 Mississippian correlation chart as underlying Tightner formation in Colfax area.

Named for exposures at village of Blue Canyon, Placer County.

Bluecastle Sandstone Member (of Neslen Formation)

Bluecastle Sandstone Member (of Price River Formation)

Bluecastle Sandstone Bed (in Price River Formation)[1]

Upper Cretaceous: Central eastern Utah.

Original reference: D. J. Fisher, 1936, U.S. Geol. Survey Bull. 852.

D. J. Fisher, C. E. Erdmann, and J. B. Reeside, Jr., 1960, U.S. Geol. Survey Prof. Paper 332, p. 11, 14, 17, pls. 10, 11, 12. In western Book Cliffs

(Utah, west of Green River), the Bluecastle is a member at top of Price River formation; in central Book Cliffs (Utah, east of Green River) it is a member in upper part of Neslen formation.

Named for Bluecastle Canyon, Book Cliffs.

Blue Creek Coal Member (of Mansfield Formation)

Pennsylvanian: South-central Indiana.

H. H. Gray, R. D. Jenkins, and R. M. Weidman, 1960, Indiana Geol. Survey Bull. 20, p. 25, 72. Important marker bed in upper part of Mansfield in Huron area. Thickness 4⅔ feet at type section. Lies approximately 100 feet above base of upper Mansfield in a sequence of sandstones with wavy bedding.

Type section: SW¼NW¼ sec. 10, T. 1 N., R. 3 W., in abanoned strip mine at west end of ridge, Martin County. Named for exposures at headwaters of Blue Creek.

Blue Creek series[1]

Cambrian: Southwestern Oklahoma.

Original reference: H. F. Bain, 1900, Geol. Soc. America Bull., v. 11, p. 135, 138–140.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 99. Abandoned by Oklahoma Geological Survey. Unit is Reagan sandstone and lower sandy part of the Honey Creek formation. No series concept is warranted.

Named for Blue Creek, Comanche County.

Blue Creek Canyon Group

Cambrian: Oklahoma.

W. E. Ham, 1949, Oklahoma Geol. Survey Circ. 26, p. 19. Name used to include (ascending) Fort Sill limestone, Royer dolomite, Signal Mountain limestone, and Butterly dolomite. Overlies Timbered Hills group. Name credited to E. A. Frederickson (unpub. thesis).

Derivation of name not stated.

Blue Cut Shale[1]

Lower Cretaceous (Comanche Series): Central southern Kansas.

Original reference: F. W. Cragin, 1895, Am. Geologist, v. 16, p. 361, 380.

Named for Blue cut, a deep railway cut a few miles south-southwest of Belvidere, Kiowa County.

Blue Earth Siltstone[1]

Ordovician: Southern Minnesota.

Original reference: L. H. Powell, 1935, St. Paul Inst. Sci. Mus., Sci. Bull. 1.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 50 (fig. 13), 54–55. Bed of white to greenish very fine grained silty shale commonly referred to as siltstone. Seldom more than 2 feet thick; 6 inches in section in quarry on Minnesota River, Le Sueur County. Underlies Oneota dolomite; overlies Kasota sandstone, but, where that is lacking, is in direct contact with Jordan sandstone.

Named for exposures along Blue Earth River, near Mankato.

Bluefield Shale[1] or Formation

Bluefield Group

Upper Mississippian: Southern West Virginia, eastern Kentucky, and southwestern Virginia.

Original reference: M. R. Campbell, 1896, U.S. Geol. Survey Geol. Atlas, Folio 26, p. 3.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey Greenbrier County, p. 255, 262–265. Bluefield group is largest subdivision of Mauch Chunk series in county. Thickness 900 to 1,200 feet. Includes (ascending): Lillydale shale, Webster Springs sandstone, Reynolds limestone, and Droop sandstone members. Overlies Greenbrier; underlies Hinton group.

R. H. Wilpolt and D. W. Marden, 1959, U.S. Geol. Survey Bull. 1072–K, p. 596–597, 598 (fig. 26), geol. section, pls. 28, 29. Referred to as formation because of heterogeneous character of rocks. Thickness 118 to 449 feet. Overlies Greenbrier limestone; underlies Stony Gap sandstone member of Hinton formation. Geographically extended into Kentucky where it is 191 feet thick on Pine Mountain near Whitesburg. Probably early Chester age.

Named for exposures at Bluefield, Mercer County, W. Va.

†Blue Gate 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 the 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 the Lewis shale; and Masuk sandstone, with so-called Laramie sandstone of southwestern Colorado. Some geologists, however, believe entire succession corresponds to Mancos shale. Blue Gate sandstone consists of yellow to brown irregularly bedded medium to massive sandstone. Thickness 230 to 1,000 feet.

H. E. Gregory and R. C. Moore, 1931, U.S. Geol. Survey Prof. Paper 164, p. 108. In Kaiparowits region, Blue Gate sandstone is uppermost member of Mancos. Thickness 276 feet on east side of Circle Cliffs, Garfield County. Overlies "Blue Gate shale" of Gilbert.

C. B. Hunt, Paul Averitt, and R. L. Miller, 1953, U.S. Geol. Survey Prof. Paper 228, p. 84. Emery sandstone member extended into Henry Mountains; replaces Blue Gate sandstone as used by Gilbert.

Probably named for occurrence on Blue Gate Plateau, Henry Mountains.

Blue Gate Shale Member (of Mancos Shale)

†Blue Gate 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 the 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 the Lewis shale; and Masuk sandstone, with so-called Laramie sandstone of southwestern Colorado. Some geologists, however, believe entire succession corresponds to Mancos shale. Thickness of "Blue Gate shale" 1,100 to 1,200 feet.

H. E. Gregory and R. C. Moore, 1931, U.S. Geol. Survey Prof. Paper 164, p. 108. In Kaiparowits region, "Blue Gate shale" of Gilbert overlies Tununk sandstone member of Mancos shale and underlies Blue Gate sandstone member of Mancos. Thickness 1,100 feet on east side of Circle Cliffs, Garfield County.

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 Blue Gate shale member of Mancos shale above Ferron sandstone member and below Emery sandstone member. Thickness 1,500 feet.

C. B. Hunt, Paul Averitt, and R. L. Miller, 1953, U.S. Geol. Survey Prof. Paper 228, p. 37, 83–84, pl. 1. Composed almost wholly of dark-gray finely laminated marine shale. Shale includes some very thin beds of bentonite, shaly sandstone, and sandy or shaly limestone. Thickness about 1,400 feet. Overlies Ferron sandstone member; underlies Emery sandstone member. Ferron sandstone replaces Gilbert's (1877) Tununk sandstone and Emery sandstone replaces Gilbert's, (1877) Bluegate [Blue Gate] sandstone.

In Blue Gate Plateau, Henry Mountains region.

Blue Grass Group[1]

Middle Ordovician: Central Kentucky.

Original reference: S. S. Lyon, 1873, Ohio Geol. Survey, v. 1, pt. 1, p. 119–120.

Named for Blue grass region about Lexington.

Blue Hill Granite Porphyry[1]

Devonian or Carboniferous: Eastern Massachusetts.

Original reference: W. O. Crosby, 1880, Boston Soc. Nat. History Occ. Papers 3, with map.

W. H. Dennen, 1951, Geol. Soc. America Bull., v. 62, no. 6, p. 550, 551. Referred to as Blue Hills porphyry.

Occurs on higher hills of Blue Hills Range.

Blue Hill Shale Member (of Carlile Shale)[1]

Upper Cretaceous: Western Kansas and southeastern Colorado.

Original reference: W. N. Logan, 1897, Kansas Univ. Geol. Survey, v. 2, p. 218, 225, 228, 229.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 24. Clayey gray-black to dark-gray noncalcareous shale; abundant ordinary and septarian concretions and selenite crystals. Contains Codell sandstone zone in upper part. Thickness 75 feet in Hamilton County to 200 feet in Russell County. Overlies Fairport chalky shale member; underlies Fort Hayes limestone member of Niobrara formation.

T. G. McLaughlin, 1954, U.S. Geol. Survey Water-Supply Paper 1256, p. 121. In Baca County, Colo., member constitutes more than half the formation and consists of dark-gray to black fissile clay shale having a few thin layers of brown platy shale; zone of gray to light-brown septarian concretions about 15 to 20 feet below top of shale. Underlies Codell sandstone member.

Apparently named Blue Hills in Mitchell, Russell, and Republic Counties, Kans.

†Blue Hills Complex[1]

Cambrian and later and older?: Eastern Massachusetts.

Original reference: W. O. Crosby, 1900, Boston Soc. Nat. History Occ. Papers, v. 1, pt. 3.

Includes the Blue Hills proper and extends thence eastward across Quincy and northern parts of Braintree and Weymouth, Suffolk County.

Bluejacket cyclothem

See **Bluejacket Sandstone Member** (of Boggy Shale or Formation).

Bluejacket Sandstone Member (of Boggy Shale or Formation)[1]

Bluejacket Sandstone Member (of Krebs Formation)

Bluejacket Formation (in Cherokee Group or Krebs Group)

Bluejacket Sandstone Member (of Cherokee Shale)

Pennsylvanian (Des Moines Series) : Northeastern Oklahoma, southeastern Kansas, and southwestern Missouri.

Original reference: A. W. McCoy, 1921, Am. Assoc. Petroleum Geologists Bull., v. 5, no. 5, p. 541-550.

G. E. Abernathy, 1937, Kansas Geol. Soc. Guidebook 11th Ann. Field Conf., p. 18, 21-22; 1938, Kansas Acad. Sci. Trans., v. 41, p. 193. Cherokee group divided into 15 cyclic formational units. Bluejacket formation (cyclothem), fourth in sequence (ascending), overlies the Columbus and underlies the Knifeton. Average thickness 68 feet. Includes Bluejacket sandstone at base. [For complete sequence see Cherokee group.]

W. G. Pierce and W. H. Courtier, 1938, Kansas Geol. Survey Bull. 24, p. 27-30, pl. 1. Bluejacket sandstone has been mapped northward from type locality to Oklahoma-Kansas line. Although Bluejacket cannot be traced with certainty as continuous unit in Kansas, name is applied to prominent sandstone exposed just east and south of Columbus, and that caps the Timbered Hills 2 miles southwest of Columbus. Base of Bluejacket as shown on plate 1 represents base of fairly thick sandstone unit. It was not mapped northeastward beyond sec. 33, T. 32 S., R. 24 E., about 4 miles northeast of Columbus. In places the sandstone is underlain by Rowe coal bed. Term Columbus sandstone was proposed by Haworth and Kirk (1894) for the sandstone exposed southeast of Columbus but was defined rather loosely and would probably include both Little Cabin and Bluejacket sandstone members. Thickness between 20 and 50 feet. Base is 50 to 100 feet below Weir-Pittsburg coal.

W. B. Howe, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 9, p. 2087-2091. Type section revised. As originally defined by Ohern (1914, unpub. ms.), type section of formation includes several sandstone beds, some of which are similar to the Bluejacket, and actual unit called Bluejacket is not clearly differentiated. Trace of base of Bluejacket sandstone, as shown on Ohern's unpublished map and on Geologic map of Oklahoma (1926) in vicinity of Bluejacket, Vinita, and Whiteoak, delineates base of sandstone that occurs 30 to 35 feet below the Bluejacket, as here restricted, in type section. Lower sandstone grades into shale southward, and south of Craig County the Bluejacket line on the "Geologic map of Oklahoma" consistently marks base of Bluejacket sandstone as restricted in this paper. Same conditions obtain northward, and Bluejacket sandstone, restricted, is continuous with Columbus sandstone of Haworth and Crane (1898, Kansas Univ. Geol. Survey, v. 3) as mapped by Pierce and Courtier (1937, Kansas Geol. Survey Bull. 28 [1938, Kansas Geol. Survey Bull. 24]). Bed which apparently should be regarded as Bluejacket sandstone is a well-defined lithologic and mappable unit typically exposed in NE¼NE¼ sec. 25, T. 27 N., R. 20 E., along road from Bluejacket west to Pyramid Corners, in east slope of Timbered Hill, on Oklahoma Highway 25, in Craig County. In Oklahoma, Bluejacket sandstone is member of Cherokee formation and lies above Little Cabin sandstone member and below Broken Arrow coal member; in Kansas, Bluejacket is formation in Cherokee group and lies between Rowe coal below and Weir-Pittsburg coal above.

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 column as Bluejacket formation in Krebs group. Overlies Drywood formation; underlies Seville formation.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped as sandstone member of Boggy formation.

W. B. Howe, 1956, Kansas Geol. Survey Bull. 123, p. 22 (fig. 5), 39–43, measured sections. Formation includes beds directly above Dry Wood coal and extending to top of Bluejacket coal. Succession includes Bluejacket sandstone (Ohern, 1914; Howe, 1951) from which formation takes its name. Overlies Dry Wood formation; underlies Seville formation. Krebs subgroup of Cherokee group.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. Shown on chart as Bluejacket sandstone in Krebs formation.

Type locality: NE¼NE¼ sec. 25, T. 27 N., R. 20 E., along road from Bluejacket west to Pyramid Corners, on east slope of Timbered Hill, Craig County. Okla.

Bluelick Limestone (in Conemaugh Formation)[1]

Pennsylvanian: Western Maryland.

Original reference: C. K. Swartz, 1922, Maryland Geol. Survey, v. 11, p. 114.

In Castleman Basin.

Blue Mountain Gravel

Quaternary: Northwestern Arizona.

Donaldson Koons, 1948, Plateau, v. 20, no. 4, p. 54 (fig. 1), 58. Bedded deposits of well-rounded pebbles and cobbles of granite, gneiss, schist, and red and white quartzite, up to 20 inches in the long diameter. Deposits generally deeply weathered. Maximum measured thickness 150 feet, but generally somewhat thinner. Found at elevations ranging from 5,775 feet near Blue Mountain to 7,125 feet near the Pinnacle.

Erich Blissenbach, 1952, Plateau, v. 24, no. 4, p. 121. Underlies Blue Mountain lavas and volcanics.

Named after Blue Mountain, Coconino County, where formation is well exposed.

Blue Mountain Lavas, Volcanics

[Pliocene or later]: Northwestern Arizona.

Erich Blissenbach, 1952, Plateau, v. 24, no. 4, p. 121. Mentioned as overlying Blue Mountain gravels.

Exposed at Blue Mountain, Coconino County.

Bluepoint Limestone[1]

Upper Mississippian: Southeastern Nevada.

Original references: C. R. Longwell, 1921, Am. Jour. Sci., 5th, 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 dark-gray limestone. About 500 feet thick. Overlies Rogers Spring limestone; underlies Callville limestone.

Named for town of Bluepoint, Clark County, Muddy Mountains area.

Blue Rapids Shale (in Council Grove Group)[1]

Permian: Eastern Kansas and southeastern Nebraska.

Original reference: G. E. Condra and J. E. Upp, 1931, Nebraska Geol. Survey Bull. 6, 2d ser., p. 22.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 39, p. 65. Proposed that Bigelow be dropped as stratigraphic term and that Crouse limestone, Blue Rapids shale, and Funston limestone be recognized as formations.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 46. Gray, green, and red shale; contains local limestones and locally a coal bed in Geary County. Thickness 15 to 30 feet. Underlies Funston limestone; overlies Crouse limestone. Wolfcamp series.

Type locality: In cuts of Highway 77, about 1½ miles north of Blue Rapids, Marshall County, Kans.

Blue Ridge Conglomerates[1]

Cambrian: Pennsylvania.

Original reference: F. Platt, 1877, Pennsylvania 2d Geol. Survey Rept. H_2, p. xxiv.

Blue Ridge Member (of Crack Canyon Formation)

Upper Jurassic[?] or Cretaceous[?]: Northern California.

J. E. Lawton, 1956, Dissert, Abs., v. 16, no. 10, p. 1885. Listed as lower member of formation. Underlies Grizzly Creek (new); overlies Sulfur Creek formation (new). Upper Jurassic and Cretaceous section, about 40,000 feet thick, consists of sequences of shale and silty shale which alternate with sequences of sandstone.

Occurs in Morgan-Wilbur area in Lake, Yolo, and Colusa Counties.

†Blue Ridge Sandstone[1]

Ordovician and Silurian: Northeastern West Virginia, western Maryland, and northern Virginia.

Original reference: A. Keith and H. R. Geiger, 1891, Geol. Soc. America Bull., v. 2, p. 155–164.

†Blue Ridge Shale[1]

Ordovician: Northeastern West Virginia, western Maryland, and northern Virginia.

Original reference: A. Keith and H. R. Geiger, 1891, Geol. Soc. America Bull., v. 2, p. 155–164.

Blue River Group

Mississippian (Chester Series): South-central Indiana.

H. H. Gray, R. D. Jenkins, and R. M. Weidman, 1960, Indiana Geol. Survey Bull. 20, p. 48–51, pl. 1. Comprises (ascending) St. Louis limestone, Ste. Genevieve limestone, and Paoli limestone (amended). Only upper 70 feet of group exposed in Huron area; well records show group to be about 400 feet thick. Underlies West Baden group.

Well exposed along banks of Blue River which drains parts of Washington, Harrison, and Crawford Counties.

Blue Springs Muscovite Schist 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. Underlies White Ridge quartzite (new); overlies Sais 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. 1130–1133, pl. 1. Massive and brittle beds of red and gray slates and siltstones characterize basal parts of Blue Springs schist. Central parts largely green, sericitic schists in which some zones are predominently contorted and crenulated. Schistose beds intercalated with more massive slates and arenaceous siltstones. Many beds spotted with biotite and blebs of granulated white quartz. Near top of formation are beds of dense red and gray arenaceous slates, which become increasingly schistose as overlying White Ridge quartzite is approached. Thickness ranges from about 300 feet, between Abo Pass and Highway 60, to nearly 4,000 feet in vicinity of Sierra Montosa.

Named for exposures at Blue Springs, a large seepage area where water issues from Blue Springs schist, north of Highway 60 at western flank of Los Pinos Mountains.

Blue Springs Shale Member (of Matfield Shale)

Blue Springs 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. 38.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 45. Middle member of Matfield. Shale, chiefly red and gray, and relatively minor amount of limestone, except in southern Kansas where several limestone beds occur in upper part of member; farther north, member is less calcareous and limestone is absent; fossils occur in thin limestones and in gray shale beds in southern part of outcrop area. Thickness about 30 feet. Overlies Kinney limestone member; underlies Florence limestone member of Barneston limestone. Wolfcamp series.

Type locality: In foot of Blue River bluffs southeast of Blue Springs, Gage County, Nebr.

Bluestone facies (of New Providence Formation)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 77, 125–132. Intermediate between Stanton facies (new) to south-southwest and Vanceburg facies to north. Consists of smooth and regular siltstone layers in lower third; remainder composed of undifferentiated silty shale and soft siltstone, shaly to massive. Thickness, as shown by composite sections, about 300 feet. Includes Henley shale member and Farmers siltstone member (new) near base. Underlies Christy Creek siltstone member of Brodhead formation, Morehead facies (all new); overlies Sunbury black shale.

Name derived from village of Bluestone, western Rowan County, where excellent section of lower part of formation is exposed at and adjoining the quarry of Kentucky Bluestone Co. No one locality shows a good continuous exposure of entire formation.

Bluestone Formation[1] (in Pennington Group)

Bluestone Group

Upper Mississippian: Southern West Virginia, eastern Kentucky, and southwestern Virginia.

Original reference: M. R. Campbell, 1896, U.S. Geol. Survey Geol. Atlas, Folio 26.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey Greenbrier County, p. 259–260. Bluestone group (Mauch Chunk series) overlies Princeton group; from southeast to northwest, successively older horizons are in contact with basal beds of Pottsville series. Thickness 80 to 675 feet.

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 181–187, pl. 15. Reger (1926, West Virginia Geol. Survey [County Rept.] Mercer, Monroe, and Summers Counties) named many subdivisions of the Bluestone in West Virginia. In present report (Burkes Garden quadrangle, Virginia), these units are redefined and renamed as members of Bluestone formation (ascending): Pride shale, Pipestem shale, Glady Fork sandstone, Mud Fork, Belcher, Bratton sandstone, and Bent Mountain. Conformable with underlying Pennington; in Tazewell County underlies Pennsylvanian Lee formation in normal sequence; in Burkes Garden quadrangle has been faulted out along southeastern edge of Pennsylvanian belt.

R. H. Wilpolt and D. W. Marden, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 38, sheet 1. Age of Bluestone formation given as Upper Mississippian.

L. D. Harris and R. L. Miller, 1958, U.S. Geol. Survey Geol. Quad. Map GQ–111. Assigned to Pennington herein raised to group rank; uppermost formation in group. Overlies Princeton sandstone.

R. H. Wilpolt and D. W. Marden, 1959, U.S. Geol. Survey Bull. 1072–K, p. 598 (fig. 26), 602–603, geol. sections, pls. 28, 29. Interbedded shale, mudstone, siltstone, sandstone, and limestone; impure coal beds. Thickness (measured sections) 228 to 692 feet. Conformable above Princeton sandstone; regionally several hundred feet of beds in upper part may have been truncated before basal sandstone of Pottsville was deposited. Geographically extended into Kentucky.

Well exposed along Bluestone River, Mercer County, W. Va.

Blue Water Basalt Flow[1]

Pleistocene: West-central New Mexico.

Original reference: R. L. Nichols, 1936, Jour. Geology, v. 44, no. 5, p. 628.

In San Jose Valley between Blue Water and the Rio Puerco, Valencia County.

Bluewater Formation

Permian: New Mexico and Arizona.

S. B. Talmage and T. P. Wootton, 1937, New Mexico Bur. Mines Mineral Resources Bull. 12, p. 30. Name applied to so-called Moenkopi of previous reports. Consists largely of red, brown, and purplish shales but includes some beds of sandstone and conglomerate. Thickness about 1,000 feet in Zuni Mountains. Not recognized east of Rio Grande.

Derivation of name not stated.

Bluff Bed[1]
Bluff Formation or Limestone } (in Trinity Group)

Lower Cretaceous (Comanche Series): Western Texas.

Original reference: J. A. Taff, 1891, Texas Geol. Survey 2d Ann. Rept., p. 727, 736.

R. M. Huffington, 1943, Geol. Soc. America Bull., v. 54, no. 7, p. 992 (fig. 2), 1000–1003. Formation described in northern Quitman Mountains, where it is 1,500 to 1,800 feet thick. Underlies Cox formation; overlies Yucca formation. Both Bluff and Finlay formations have been called Finlay by Baker (1927). Taff (1891) divided rocks in Quitman Gap into Mountain bed and Quitman bed. Mountain bed is equivalent to Yucca formation; Quitman bed is equivalent to lower part of Bluff formation.

Elliot Gillerman, 1953, U.S. Geol. Survey Bull. 987, p. 16–21. Preoccupied name Bluff replaced by Bluff Mesa formation.

D. L. Amsbury, 1958, Texas Univ. Bur. Econ. Geology Geol. Quad. Map 22. Formation described in Pinto Canyon area, Presidio County, where it consists of 200 feet of very light gray thick-bedded limestone overlain by 450 feet of dark-gray nodular *Orbitolina*-bearing limestone interbedded with light-colored crossbedded sandstone. Overlies Yucca formation; underlies Cox formation.

R. K. DeFord and L. W. Bridges, 1959, Texas Jour. Sci., v. 11, no. 3, p. 291. Bluff limestone underlies Tarantula gravel (new).

Named for Bluff Mesa, El Paso County.

Bluff Bone Bed (in Wichita Group)[1]

Permian: Central northern Texas.

Original reference: J. A. Udden and D. M. Phillips, 1912, Texas Univ. Bull. 246, p. 35–42.

Named for Bluff Creek, south of Electra, Wichita County.

Bluff Sandstone (in San Rafael Group)

Bluff Sandstone Member (of Entrada Sandstone)

Bluff Sandstone Member (of Morrison Formation)[1]

Upper Jurassic: Sotheastern Utah, northeastern Arizona, southwestern Colorado, and northwestern New Mexico.

Original reference: A. A. Baker, C. H. Dane, and J. B. Reeside, Jr., 1936, U.S. Geol. Survey Prof. Paper 183, p. 21.

H. E. Gregory, 1938, U.S. Geol. Survey Prof. Paper 188, p. 58, pl. 15. In San Juan County, Utah, is basal member of Morrison. Typically one massive bed 200 to 350 feet thick. Underlies Recapture shale member (new); overlies Summerville(?) formation.

W. L. Stokes, 1944, Geol. Soc. America Bull., v. 55, no. 8, p. 959–960, table 1. As here interpreted, the Bluff is local phase of the Entrada. This correlation is based on regional considerations, tracing of units, and lithologic pecularities. Bluff can be traced southward into Carrizo Mountains, thinning from about 250 to about 15 feet. At Horse Mesa, Ariz., is separated by about 175 feet of sediments from Todilto limestone. Table shows Bluff sandstone in San Rafael group.

W. B. Hoover, 1950, New Mexico Geol. Soc. Guidebook 1st Field Conf., p. 77–80. Entrada, at type locality, is overlain by Curtis and Summerville. Curtis apparently grades into Summerville, and Summerville, in part, grades into Moab tongue of Entrada. Farther south, Entrada divides again into a lower bed, Entrada proper, and Bluff sandstone member. Name Red Mesa is introduced for the crinkly shale and sandstone beds, 100 feet thick, between Entrada and Bluff member. Crinkly beds of Red Mesa are similar in appearance to Carmel at Moab which led Stokes (1944) to conclude that Bluff and Entrada were one and same bed.

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, Bluff sandstone member, and Recapture shale member of Morrison formation grade laterally southward into a distinct sand facies here named Cow Springs sandstone.

L. C. Craig and others, 1955, U.S. Geol. Survey Bull. 1009–E, p. 133–134. Included in San Rafael group. West of Gallup, N. Mex., the Bluff constitutes an inseparable part of Cow Springs sandstone. It has also been observed to tongue and grade into Summerville formation in southeastern Utah, and part of Bluff tongues with overlying Salt Wash member of Morrison formation in northeastern Arizona. Thus the sandstone unit is related to both Summerville and Morrison formations. Bluff sandstone and correlative Junction Creek sandstone are here arbitrarily assigned to San Rafael group.

V. L. Freeman and L. S. Hilpert, 1956, U.S. Geol. Survey Bull. 1030–J, p. 313, 315 (fig. 60). In Gallup-Albuquerque area, considered of formational rank. Underlies Recapture member of Morrison, and over most of area is conformable with it; near Laguna, interfingers with Recapture.

J. W. Harshbarger, C. A. Repenning, and J. H. Irwin, 1957, U.S. Geol. Survey Prof. Paper 291, p. 42–43. In this report [Navajo country], Bluff sandstone believed to be tongue of Cow Springs sandstone, extending northward from main mass of Cow Springs, but, because of its homogeneous and mappable character and its areal extent, it is considered a separate formation and assigned to upper part of San Rafael group. Ranges in thickness from few feet to about 300 feet.

Named for exposures that form cap rock of cliffs at Bluff, San Juan County, Utah.

Bluff Creek Shale Member (of Graham Formation)[1]

Upper Pennsylvanian: Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 387, 400.

C. O. Nickell, 1938, Texas Univ. Bur. Econ. Geology Pub. 3801, p. 118–119. Bluff Creek shale member was defined by Drake as including shale interval from top of his Home Creek limestone to base of his *Campophyllum* beds, the name being derived from locality south of Colorado River, where his term "Home Creek limestone" was used consistently. Name was used by Plummer and Moore (1921, Texas Univ. Bull. 2132) to include beds from top of their Home Creek limestone (a higher limestone than Home Creek limestone on Home Creek) to base of Gunsight limestone, and that usage is followed in this report [Brown and Coleman Counties]. Thickness 47 feet. Overlies Home Creek limestone member of Caddo Creek formation.

D. H. Eargle, 1958, San Angelo Geol. Soc. Guidebook, Apr. 17–19, p. 50. Shown on columnar section, Brown and Coleman Counties, below Gunsight limestone and above Home Creek limestone member of Caddo Creek formation. Thickness about 90 feet. Consists of shale, limestone and sandstone; shale is gray and very fossiliferous above upper limestone, with ammonoids, gastropods, brachiopods, pelecypods abundant, *Conularia* and shark teeth rare. Upper limestone is gray, oolitic, foraminiferal, and massive and contains fusulinids, "seaweed" structures, and fossil fragments; called Bunger limestone by Bullard and Cuyler (1935, Texas Univ. Bull. 3501). Lower limestone thinner, ferruginous, foraminiferal, and fusulinid-bearing. Sandstones near base lenticular and channel filling near Colorado River.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 69–70, pl. 27. Bluff Creek shale member was first described by Drake (1893) as Bluff Creek bed from exposures along tributary of Colorado River in McCulloch County. Plummer and Moore (1921, Texas Univ. Bull 2132) called the member Bluff Creek shale and stated that a thin yellow limestone in middle of unit may be equivalent to Bunger limestone member in Young and Stephens Counties. Bullard and Cuyler (1935, Texas Univ. Bull. 3501) retained name Bunger for bed in McCulloch County that they said is unlikely to be continuous with one at type locality in Young County but occupies same stratigraphic position. The shale above this Bunger they termed Upper Bluff Creek shale and the shale below, Lower Bluff Creek shale. They named a persistent ferruginous limestone bed lying 15 to 20 feet below their Bunger limestone and 35 feet above base of their Lower Bluff Creek shale the White Ranch limestone. Hudnall and Pirtle (1929, Geologic map of Coleman County) called a limestone unit in this interval in Brown County the North Leon limestone, believing it to be correlative with bed in Eastland County named North Leon by Reeves (1922). Cheney (1950, Abilene Geol. Soc. [Guidebook] Nov. 2–4) and Cheney and Eargle (1951, Geologic map of Brown County) added North Leon and Gonzales to list of limestones in lower part of Graham formation in Brown County. As many as six thin limestone units in lower part of Bluff Creek shale member are traceable for considerable distances across Brown and Coleman Counties [this report], but most of these are discontinuous. Lenticular beds of sandstone are also found in several stratigraphic positions. Exact correlation of the limestones in lower part of Bluff Creek could not be determined because of abrupt changes in intervals of shale between them. Hence formal usage of individual names for these beds whose type localities are chiefly in Brazos River valley is not recommended for Colorado River valley until more definite correlations can be established. Bluff Creek shale of present report ranges in thickness from about 90 feet along Colorado River to about 140 feet in north-central Brown County. Underlies Gunsight limestone member; overlies Home Creek limestone member of Caddo Creek formation.

Named for Bluff Creek, McCulloch County.

Bluff Dale Sand (in Travis Peak Formation)[1]

Lower Cretaceous (Comanche Series): Central northern Texas.

Original reference: R. T. Hill, 1901, U.S. Geol. Survey 21st Ann. Rept., pt. 7, p. 152, 154, 462, 463, 464, 474, 491.

Named for Bluff Dale, Erath County.

Bluff Mesa Formation (in Trinity Group)

Lower Cretaceous: Southwestern Texas.

Elliot Gillerman, 1953, U.S. Geol. Survey Bull. 987, p. 12 (table 1), 16–19, 21, pls. 1, 8. Term used to designate unit previously called Bluff beds by Taff (1891) and Bluff formation by Smith (1940). Name Bluff preoccupied. In Eagle Mountains area, consists of black nodular limestone weathering blue gray, limestone pebble conglomerates, brown shales, and some sandstones; limestones contain abundant *Orbitolina*, and some rudistid reef beds. Thickness 147 to a little more than 1,000 feet; greatest thickness is exposed on northeastern front of mountains north of Spar Valley. Conformable upon Yucca formation and unconformable upon Permian(?) beds where Yucca is missing; grades upward into quartzites of Cox sandstone through series of interbedded shales and thin quartzitic sandstones.

Bluff beds named from exposures at Bluff Mesa, El Paso County.

Bluff Point Siltstone Bed (in West River Shale Member of Genesee Formation)

Bluff Point Flagstone[1] Member (of Standish Shale and Flags)

Upper Devonian: Western and west-central New York.

P. D. Torrey and others, 1932, Am. Petroleum Inst. Div. Production Paper 826–4A, p. 16, figs. 6, 7. Thin persistent member of the Standish. Occurs above Crosby sandstone [member].

Wallace de Witt, Jr., and G. W. Colton, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2825. Highly cross-laminated ripple-marked layer of siltstone 1 to 2 inches thick is present at base of upper third of West River shale member of Genesee formation in most exposures of member between Lake Erie and Canandaigua Lake. This key bed, which is present in more than 500 square miles in western and west-central New York, was traced eastward to Keuka Lake where it was found to be the 3- to 4-inch Bluff Point flagstone of Torrey and others (1932), the same bed that was named Keuka flagstone by Fox (1932). Torrey's Bluff Point flagstone is present as far east as Plum Point Creek, one-half mile west of village of Himrod, where it is 2½ feet above top of Ithaca member of Genesee. Thick-bedded fossilferous siltstones at top of Ithaca member near Ithaca are at approximately same stratigraphic position as Torrey's Bluff Point flagstone.

U.S. Geological Survey currently classifies the Bluff Point Siltstone as a bed in the West River Shale Member of the Genesee Formation on the basis of a study now in progress.

Type locality not stated.

Bluffport Marl Member (of Demopolis Chalk)

Upper Cretaceous: Western Alabama and eastern Mississippi.

W. H. Monroe, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 11, p. 2740–2742. Bed of calcareous, more or less sandy, silty clay about 65 feet thick, that rests on typical Demopolis chalk and gradationally underlies calcareous clayey sand of Ripley formation; lithology varies from very clayey chalk to compact very chalky clay.

R. J. Hughes, Jr., 1958, Mississippi Geol. Survey Bull. 84, p. 53–59, pls. 1, 5, 6, 10. Described in Kemper County where it is about 50 feet thick. Underlies Ripley formation.

Type locality: On Bluffport road in NW¼ sec. 27, T. 19 N., R. 1 W., Sumter County, Ala., about 6½ miles due east of Livingston. Crops out in many of raised blocks of Livingston fault zone. Named for Bluffport Bluff along Tombigbee River.

†Bluff Springs Granite[1]

Post-Carboniferous: Eastern Alabama.

Original reference: W. F. Prouty, 1923, Alabama Geol. Survey County Rept. 1, p. 16, 51, 52, 53, 62, 65.

Named for development around Bluff Springs, Clay County.

Blufftown Formation (in Selma Group)

Blufftown Marl[1]

Upper Cretaceous: Western Georgia and eastern Alabama.

Original reference: J. O. Veatch, 1909, Georgia Geol. Survey Bull. 18, p. 86, 88–89.

L. W. Stephenson and W. H. Monroe, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 12, p. 1648–1649. Geographically extended into Alabama. Blufftown formation grades westward into lower part of Selma chalk. As defined here, Blufftown includes additional beds below the marl (as originally defined) that were correlated with upper part of Eutaw formation by Veatch and with "typical beds of Eutaw" by Stephenson (1911 Georgia Geol. Survey Bull. 26). These beds consist of irregularly bedded sands and clays, in part lignitic, and at their base are coarse pebbly sands and sandstones. Unconformably underlies Cusseta formation, which overlaps it toward northeast in Georgia.

D. H. Eargle, 1950, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 105. In eastern Alabama, Blufftown grades laterally into Mooreville chalk and basal part of Demopolis chalk. Intertonging relationships discussed in detail. Overlain by Cusseta member of Ripley formation. Included in Salem group.

D. H. Eargle, 1955, U.S. Geol. Survey Bull. 1014, p. 32–43, pls. 1, 2. Described in Georgia where, in Chattahoochee River valley, it consists of basal unit of crossbedded coarse sand, about 150 feet thick, overlain by laminated more or less sandy carbonaceous highly micaceous fossiliferous clay, about 260 feet thick. Toward the east, upper clay member grades rapidly laterally into unfossiliferous coarse sand that is difficult to distinguish either from basal sand member or overlying Cusseta sand. Historical summary of usage of name.

Named for exposures at Blufftown, Stewart County, Ga. In Georgia, crops out in belt from Chattahoochee River valley east-northeastward to Flint River; east of Flint River, becomes indistinguishable from underlying Eutaw formation and overlying Cusseta sand.

Board Cabin Formation

Precambrian: East-central Arizona.

Gordon Gastil, 1958, Geol. Soc. America Bull., v. 69, no. 12, pt. 1, p. 1498 (table 1), 1502–1504. Quartzose, feldspathic, and volcanic sandstones, tuffaceous wackes, fine and coarse conglomerates, pyroclastic rocks, and thin basaltic lavas, so intimately interbedded and interfingered that accurate mapping is exceedingly difficult. Intraformational unconformaties common, and most conglomerates, sandstones, and wackes contain angular fragments of immediately underlying rock. Rocks of Board Cabin formation, Flying W formation (new), and parts of Haigler formation (new) so similar that the only reliable distinction is their stratigraphic position. Porphyritic lava the most distinctive and abundant rock type. Sedimentary rocks become coarser grained upward in section, and there are none finer than conglomerate in upper half of formation. Typical sedimentary rock is coarse, relatively well sorted, and composed of locally derived materials. Volcanic rock facies more prominent to the west, and there is little sedimentary rock in formation west of Board Cabin Draw. Thickness 250 to 1,820 feet. Conformably overlies Houden formation (new) ; underlies Haigler formation with slight unconformity.

Type section: On Board Cabin Draw between approximate elevations of 4,550 and 4,750 feet, Diamond Butte quadrangle. Another good, but thinner, section on Turkey Creek in southern part of quadrangle. Name derived from Board Cabin Draw, at southeastern foot of Diamond Butte.

Boardman Formation

Lower Ordovician (Canadian): West-central Vermont.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, p. 13, 24–27. Name proposed to include all rocks lying stratigraphically between underlying Clarendon Springs dolomite and overlying Bascom formation. Divided into (ascending) Sutherland Falls marble, Intermediate dolomite, and Columbian marble members. Subdivisions used as defined by Bain (1931), and names retained because of their economic importance in marble belt. Total thickness approximately 900 feet.

Type locality: On southwestern slope of Boardman Hill in Clarendon about 1¼ miles S. 50° W. on top of hill, Rutland County. Formation crops out in band that extends from northern to southern boundary of Castleton quadrangle from Pittsford Township through Proctor and Center Rutland to Clarendon Township.

Boarman Member (of Mifflin Formation)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., figs. 3, 10, 16. Limestone or dolomite about 4½ feet thick. Shown on columnar section as underlying Establishment member (new) and overlying Brickeys member (new).

In copy of guidebook used by compiler, a handwritten note states that Brickeys member overlies Boarman member. Thus, Boarman would be basal member of Mifflin formation and would overlie Oglesby member of Pecatonica formation. Since the compiler had no way to determine what changes, if any, had been made in other copies of guidebook, it was impossible to be certain of true stratigraphic relation.

Occurs in Dixon-Oregon area.

Bob Crystalline Limestone Member (of Brownsport Formation)[1]

Bob Formation (in Brownsport Group)

Middle Silurian: Western and central Tennessee.

Original reference: W. F. Pate and R. S. Bassler, 1908, U.S. Natl. Mus. Proc., v. 34, p. 410–432.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, Chart 3. Shown on correlation chart as formation in Brownsport group.

T. W. Amsden, 1949, Yale Univ., Peabody Mus. Nat. History Bull. 5, p. 25. In area of this report [western Tennessee], there does not appear to be any valid basis for subdividing the Brownsport into three members or formations. It is proposed that terms "Beech River," "Bob," and "Lobelville" be abandoned.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 262–264, figs. 2, 81. Bob formation included in Brownsport group. Typically a massive-bedded silt-free medium- to coarse-grained gray crystalline limestone with glassy appearance; locally contains red specks and green grains of gluconite [glauconite]; at some localities entire formation consists of limestone interbedded with shale. Thickness 5 to 30 feet average 25 feet. Throughout most of outcrop belt is a continuous blanket of limestone, but in some areas appears to pinch and swell, possibly to extent of being locally absent or represented only by an alternation of limestone and shale deposited contemporaneously with massive phase elsewhere. Bob limestone is conformable with both Beech

River and Lobelville formations; in several localities, grades into both by progressive interbedding. Where Lobelville is absent, the Bob is unconformably overlain either by Decatur limestone, a Devonian formation, or Chattanooga shale. Pate and Bassler (1908) named Bob limestone for bluff one-half mile below Bobs Landing along west bank of Tennessee River in Decatur County. Type section given by Pate and Bassler (p. 421), however, is composed of 20 feet of Dixon and 40 feet of Beech River, but no Bob limestone as recognized elsewhere by these writers nor as recognized and mapped by Miser, Jewell, and present writer. As shown in this report in section 3, *A'–A''*, figure 81, Bob limestone occurs on hill above the bluff, the Beech River being 80 feet thick and the Bob 5 to 25, increasing in thickness northward; the Bob is overlain by the Lobelville. Foerste (1903) named Gant limestone and Gant bed from exposures in Wayne County. Gant limestone included 30 feet of limestone and is equivalent to Bob limestone as recognized by Miser, Jewell, Wilson. and by Pate and Bassler at some localities. If name Bob had not become so well established, it would be recommended here that Bob limestone be dropped in preference to Gant.

Named for Bob Landing, Decatur County.

Bobcat Hill Conglomerate

Cretaceous or Tertiary: Southwestern New Mexico.

Elliot Gillerman, 1958, New Mexico Bur. Mines Mineral Resources Bull. 57, p. 55–58, table 1, pl. 1. Interbedded impure volcanic arkose sandstone and conglomerate. Conglomerate characterized by presence of fragments of limestone and volcanic rocks. Sandstones characteristically medium-bedded fine-grained light-grayish-green to yellowish-gray slightly calcareous. A 1-foot bed of limestone, which in places consists entirely of algal remains, occurs near base of formation in eastern part of outcrop area. Thickens from 724 feet in western part of area to 1,138 feet near North Star mines. Unconformably overlies unnamed volcanic rocks.

Named from exposures on north and west sides of Bobcat Hill, near corner common to secs. 25, 26, 35, and 36, T. 24 S., R. 21 W. Better exposed in S½ sec. 27, in vicinity of North Star mines, and extends east and west across southern parts of secs. 26, 27, and 28, T. 24 S., R. 21 W., central Peloncillo Mountains, Hidalgo County.

Bobs Ridge Member (of Huntersville Chert)

Lower Devonian (Onesquethaw): West Virginia.

J. M. Dennison, 1960, Dissert, Abs., v. 21, no. 3, p. 593. Glauconitic quartz sandstone. Accumulated over site of Browns Mountain anticline which was shoal during late Onesquethaw time.

Named for outcrops on Bobs Ridge, Greenbrier County.

Bobtail Quartz Latite Member (of Gem Hill Formation)

Miocene(?): Southern California.

T. W. Dibblee, Jr., 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 1, p. 137 (fig. 1), 138 (fig. 2), 140–141. Felsitic to porphyritic rock predominantly cream white in color, but locally tan, pink, brown, or pale green. Latite makes up several large volcanic plugs, a number of small plugs, pods, and dikes intrusive through pre-Tertiary granitic rocks into the Gem Hill; also occurs as several short lentils of flow breccia in the formation. Older than Fiss fanglomerate (new) which it does not intrude.

Type locality: Soledad Mountain, Rosamond quadrangle, secs. 6 and 7, T. 10 N., R. 12 W., San Bernardino Base and Meridian, Kern County. Name derived from Bobtail mines on west slope of Soledad Mountain. Many scattered buttes within 10 miles of Soledad Mountain are remnants of volcanic plugs made up of Bobtail quartz latite.

Bocas [Formation]

Pliocene: Panamá.

A. A. Olsson, 1942, 8th Am. Sci. Cong. Proc., v. 4, p. 234 (correlation chart). Name appears on correlation chart.

W. P. Woodring, 1960, *in* R. Hoffstetter and others, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 5–6. Underfined name for strata of Pliocene age.

On Bocas Island.

Bodega Diorite[1]

Pre-Tertiary: Northern California.

Original Reference: V. C. Osmont, 1904, California Univ. Pub., Dept. Geol. Bull., v. 4, p. 43.

C. C. Higgins, 1952, California Univ., Dept. Geol. Sci. Bull., v. 29, no. 5, p. 200, fig. 7. Described with pre-Tertiary rocks of area as being of ancient but unknown age. At Point Reyes, nonconformably overlain sands and shales of Miocene Monterey formation.

Exposures limited to Bodega Head and Point Reyes Peninsula, lower Russian River region.

Bodega Bay deposits[1]

Quaternary: Western California.

Original reference: V. C. Osmont, 1904, California Univ. Pub., Dept. Geol. Bull., v. 4, p. 76.

Bodega Bay, Marin County.

†Bodeville Series[1]

Precambrian (Llano Series): Central Texas.

Original reference: T. B. Comstock and E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept., p. lvi. 255–267, pl. 3.

Named for Bodeville, Mason County.

Bodine Sandstone

Ordovician: Oklahoma.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 99. Abandoned by Oklahoma Geological Survey. Eldridge (1901, U.S. Geol. Survey 22d Ann. Rept., pt. 1, p. 274) applied name of an asphaltic sandstone pit in Murray County to an asphaltic sandstone in Simpson group. Probably a bed in Bromide formation.

Bogachiel Formation[1]

Cretaceous(?): Northwestern Washington.

Original reference: A. B. Reagan, 1909, Kansas Acad. Sci. Trans., v. 22, p. 160.

Greatest development in Bogachiel Valley, near headwaters of that stream.

Boggs Member (of Pottsville Formation)[1]

Pennsylvanian (Pottsville Series): Southeastern Ohio.

Original reference: W. Stout, 1918, Ohio Geol. Survey, 4th ser., Bull. 21, p. 70.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 31, table 1. Included at top of Lower Mercer cyclothem in Perry County. Thickness about 1 foot. Overlies unnamed shale; underlies Flint Ridge shale and (or) sandstone.

Named because it is correlated with Boggs iron ore of Scioto County.

Boggs Mountain Flows (in Clear Lake Volcanic Series)

Quaternary: Northern California.

J. C. Brice, 1953, California Div. Mines Bull. 166, p. 12 (fig. 2), pl. 7. Dark-gray porphyritic andesitic lavas 100 to 500 feet thick. Shown on columnar section above Perini Hill flows (new) and below Cobb Mountain volcanics (new), but age relations of individual units of series are imperfectly known because some units are isolated and contacts of contiguous flows are commonly obscured by sliding.

Vicinity of Boggs Mountain, Lower Lake quadrangle, in Coast Range, about 70 miles north of San Francisco.

Boggy Shale[1] **or Formation** (in Krebs Group)

Pennsylvanian (Des Moines Series): Central southern and eastern Oklahoma and western Arkansas.

Original reference: J. A. Taff, 1889, U.S. Geol. Survey 19th Ann. Rept., pt. 3, p. 438.

C. W. Wilson, Jr., 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 4, p. 504, 510–511. Includes (ascending) shale, Crekola sandstone member (new), shale, Inola sandstone member, shale, Taft sandstone member (new).

C. W. Wilson, Jr., and N. D. Newell, 1937, Oklahoma Geol. Survey Bull. 57, p. 51–57. Includes Bluejacket sandstone member near base.

M. C. Oakes and M. M. Knechtel, 1948, Oklahoma Geol. Survey Bull. 67, p. 54–62. Maximum thickness more than 4,000 feet in Le Flore County; top eroded.

M. C. Oakes, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 6, p. 1523, 1524. Uppermost formation in Krebs group (new). Overlies Savanna formation; underlies Thurman sandstone.

E. W. Reed, S. L. Schoff, and C. C. Branson, 1955, Oklahoma Geol. Survey Bull. 72, p. 68. Formation, as defined by Oklahoma Geological Survey, comprises strata from base of Bluejacket sandstone member to unconformity at base of Cabaniss group.

J. V. A. Trumbull, 1957, U.S. Geol. Survey Bull. 1042–J, p. 333–335, pl. 16. In Oklahoma, exposed in wide arcuate belt from southeastern Pontotoc County and central and northern Coal County through Pittsburg, Haskell, and McIntosh Counties to northwestern Muskogee County. From there it has been mapped northward to Kansas line. Large outliers remain in Sansbois syncline in Haskell and Latimer Counties, where more than 2,000 feet of formation is present, and in Cavanal syncline in LeFlore County, where as much as 3,000 feet of rocks in formation make up much of Cavanal Mountain. Complete continuous section in Pittsburg County is about 2,850 feet thick. Overlies Savanna formation; underlies Thurman sandstone.

Named for exposures along North Boggy Creek, Pittsburg and Atoka Counties, Okla.

Bogota cyclothem (in McLeansboro Group)

Bogota cyclothem (in Mattoon Formation)

Pennsylvanian: Southeastern Illinois.

W. A. Newton and J. M. Weller, 1937, Illinois Geol. Survey Rept. Inv. 45, p. 9, 19–24. Lies above Cohn cyclothem (new) and below Newton cyclothem (new). Contains two cyclothems which are referred to as upper and lower Bogota. Includes Bogota limestone and Bogota shale.

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

Type locality: A few miles southwest of Bogota, Jasper County.

Bogota Limestone Member (of Mattoon Formation)

Bogota Limestone (in McLeansboro Group)

Pennsylvanian: Central and southeastern Illinois.

W. A. Newton and J. M. Weller, 1937, Illinois Geol. Survey Rept. Inv. 45, p. 19–24. Limestone in Bogota cyclothem in McLeansboro group.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 40, 41, 51 (table 1). Member of Mattoon formation (new). Occurs above Effingham limestone member and below Greenup limestone member. Thickness at type locality about 3½ feet. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type locality: NE¼NE¼ sec. 17, T. 5 N., R. 8 E., a few miles southwest of Bogota, Jasper County.

†Bogus Tongue (of Cutler Formation)[1]

Permian: Central eastern Utah.

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

A. A. Baker, 1946, U.S. Geol. Survey Bull. 951, p. 43. Name Bogus abandoned in favor of name Organ Rock tongue; it is evident that red beds formerly included in the Bogus are continuous with Organ Rock tongue at its type locality.

Crops out in Bogus pocket, SW cor. T. 30 S., R. 21 E., San Juan County.

Bohemia Conglomerate (in Portage Lake Lava Series)

Bohemia Conglomerate[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: L. L. Hubbard, 1898, Michigan Geol. Survey, v. 6, pt. 2, p. 3, 30, 52, 66, 72, 83, 99, pls. 4, 7.

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]. Included in Portage Lake lava series.

Named for the fact that it caps Bohemian Range, in Keweenaw County.

Bohemia Porphyrite[1] (in Bohemian Range Group)

Precambrian (Keweenawan): Northern Michigan.

Original reference: L. L. Hubbard, 1898, Michigan Geol. Survey, v. 6, pt. 2, p. 40, 72.

Named for the fact that it occurs north of Mount Bohemia, Keweenaw County.

Bohemian Range Group[1]

Precambrian (Keweenawan): Northern Michigan and probably northern Wisconsin.

Original reference: R. D. Irving, 1883, U.S. Geol. Survey Mon. 5, p. 179–187, pls. 17, 18.

W. S. White, H. R. Cornwall, and R. W. Swanson, 1953, U.S. Geol. Survey Geol. Quad. Map GQ-27. Name Portage Lake lava series (new) proposed to include Eagle River, Ashbed, Central Mine, and Bohemian Range groups of old reports. These subdivisions are quite arbitrary and depend on continuity of individual flows or conglomerate beds for validity. They are not useful for purpose of this report.

Named for the fact that its rocks compose Bohemian Range, Keweenaw County, Mich.

†Bohicket Marl 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, 21.

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

Bohío Formation

Bohío Conglomerate[1]

Oligocene, lower and upper: Panamá.

Original references (Bujio Formation): R. T. Hill, 1898, Harvard Coll. Bull. Mus. Comp. Zool., v. 28, no. 5, p. 183; (Bohío Formation): D. F. MacDonald, 1913, Geol. Soc. America Bull., v. 24, p. 708.

H. N. Coryell and J. R. Embich, 1937, Jour. Paleontology, v. 11, no. 4, p. 289–305. Ross and Reeves (1931, U.S. Geol. Survey Prof. Paper 821–B) gave name Bohío to entire group of sediments in Chagres Valley above Madden Dam, and referred them to the Oligocene. Samples of Foraminifera collected from Bohío show that it contains both an Eocene and Oligocene fauna. Bohío formation is restricted to include only Oligocene sediments. Eocene strata are herein named Tranquilla shale.

W. P. Woodring and T. F Thompson, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 2, p. 228–232, 246 (fig. 2). Formation consists of massive or poorly bedded conglomerate, tuffaceous sandstone, and tuffaceous siltstone. Estimated thickness as much as 1,000 feet. Overlies Gatuncillo formation; base of the Bohío not exposed along Panama Canal. Underlies Caimito formation. Grades laterally into Bas Obispo formation. Upper Eocene and lower Oligocene. Bohío was first named by Hill (1898) who used spelling Bujio.

W. P. Woodring, 1957, U.S. Geol. Survey Prof. Paper 306–A, p. 24–29. Basal part of Bohío in Quebrancha syncline contains smaller Foraminifera of early Oligocene age and upper part of formation in Pacific coastal and Gatún Lake areas, respectively, contains late Oligocene larger Foraminifera and mollusks. Whether formation represents so great a time span in each of areas where it crops out is not known at present. It represents, however, more than the early Oligocene age previously suggested (Woodring and Thompson, 1949). That it does not include all of the Oligocene is shown by late Oligocene age of overlying Caimito formation.

Type region: Bohío Peninsula. Bohío or Bohío Soldado, was a station on original line of Panamá Railroad, near southwest end of ridge forming present Bohío Peninsula. Many localities described by early writers, including French quarries at Bohío and excavation at near-by lock site, are covered by Gatún Lake.

Boice Shale (in Buckner Group)

Mississippian (Kinderhook Series): Subsurface in northeastern Kansas and southwestern Nebraska.

E. C. Reed, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 3, p. 348–349. Name applied to subsurface sequence previously referred to the Hannibal. Consists predominantly of shale with minor amounts of siltstone and sandstone near top; base is marked by zone of hematite concretions or oolites in part embedded in brick-red shale. Occurs between depths of 2,041 and 2,072 in type well and between depths of 2,225 and 2,283 feet in cotype locality. Underlies Chouteau limestone; overlies Fabius group. Placed in lower part of Buckner group of Kinderhook series, according to Marvin Weller's Mississippian correlation chart (Nat. Research Council, Apr. 10, 1945). [Compiler was unable to locate reference to Buckner group.]

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 111. Geographically extended into northeastern Kansas. Strata conformably underlie Compton limestone or occur disconformably beneath upper Sedalia and disconformably overlies deeply eroded Chattanooga. Maximum known thickness 110 feet near Nebraska border in Brown County.

Type locality: Pawnee Royalty Co. Boice well No. 1, located in center of NE¼NE¼ sec. 18, T. 1 N., R. 16 E., Richardson County, Nebr. Cotype locality: Pawnee Royalty Co. Meyers well No. 1, in center of NW¼NW¼ sec. 24, T. 1 N., R. 15 E.

Bois Blanc Formation

Bois Blanc Formation (in Detroit River Group)

Middle Devonian: 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), 80–109. Proposed for a Lower or Middle Devonian formation occupying position between Lower Devonian Garden Island formation (new), or Upper Silurian St. Ignace formation (new) where Garden Island is absent, and the Lower or Middle Devonian Detroit River group. Lower part consists of interbedded chert and dolomite; middle composed of limestone, dolomitic limestones, and a few beds of dolomite; strata range in color from light gray to light buff and contain nodules and irregular masses of chert, which is more abundant in some beds than others; upper part predominantly limestone. Total thickness probably not less than 325 or more than 400 feet. Numerous large blocks of the Bois Blanc occur in Mackinac breccia. Onesquethaw group.

K. K. Landes, 1951, U.S. Geol. Survey Circ. 133, p. 2 (fig. 2), 7. Stratigraphically restricted at top to exclude noncherty limestone and dolomite now included in base of Amherstburg.

W. N. Melhorn, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 4, p. 819 (fig. 1). Shown on generalized stratigraphic section of Middle Devonian as formation at base of Detroit River group.

Named for exposures on Bois Blanc Island situated in Lake Huron about 2½ miles southeast of Mackinac Island. Present on northern shore of Southern Peninsula between point on Lake Huron about 26 miles southeast of Mackinaw City and Waugoshance or Crane Island, 16 miles west of this city.

Bois d'Arc Limestone[1] (in Hunton Group)

Lower Devonian: Central southern Oklahoma.

Original reference: C. A. Reeds, 1911, Am. Jour. Sci., 4th, v. 32, p. 256–268.

R. A. Maxwell, 1936, Northwestern Univ. Summ. Doctoral Dissert., v. 4, p. 132, 134. Overlies Cravatt formation of Kite group (both new). Reeds considered Cravatt as basal part of Bois d'Arc.

T. W. Amsden, 1957, Oklahoma Geol. Survey Circ. 44, p. 6 (fig. 3), 7, 38–47. Subdivided to include Cravatt member below and Fittstown member (new) above. Thickness 45 to 200 feet with at least part of this variation caused by facies gradation from Bois d'Arc into Haragan formation. Underlies Frisco formation; overlies Haragan. Reeds (1926 Am. Mus. Nat. History Jour., v. 26) designated type locality as along Bois d'Arc Creek, sec. 4, T. 2 N., R. 6 E.; but this must be an error since Bois d'Arc Creek is not present in section 4; however, it is well exposed on north bank of this creek in sec. 11, T. 2 N., R. 6 E., and presumably this was location to which he referred. Type section designated.

T. W. Amsden, 1958, Oklahoma Geol. Survey Bull. 82, 110 p. Bois d'Arc formation consists of two members or lithofacies, lower cherty argillaceous calcilutite (Cravatt member) and upper calcarenite (Fittstown member). Both stratigraphic and faunal evidence indicate that these are facies of one another, and that entire formation is facies of Haragan formation. Brachiopod fauna described.

Type section: Sec. 4, T. 2 N., R. 6 E., starting at top of Cedar Hill and extending north along banks of Chimneyhill Creek. Named for exposures along Bois d'Arc Creek, Pontotoc County.

Boise Granite[1]

Jurassic or Cretaceous: Southwestern Idaho.

Original reference. I. C. Russell, 1902, U.S. Geol. Survey Bull. 199, p. 39.

In rugged mountains which lie to north and east of Boise, extends eastward from this area and occupies an extensive and exceedingly rugged region lying north of Mountain Home.

Boise Sandstone[1]

Pliocene(?): Southwestern Idaho.

Original reference: V. R. D. Kirkham, 1928, Idaho Bur. Mines and Geol. Pamph. 29, p. 1.

Bokchito Formation[1]

Lower Cretaceous (Comanche Series): Southeastern and central Oklahoma.

Original reference: J. A. Taff, 1902, U.S. Geol. Survey Geol. Atlas, Folio 79.

L. W. Stephenson and others, 1942, Geol. Soc. America Bull., v. 53, no. 3, chart 9. Overlies Caddo limestone; underlies Bennington limestone.

Named for Bokchito Creek, near Bokchito, Bryan County.

Bolander Group

Pennsylvanian (Des Moines Series): Central New Mexico.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Bull. 17, p. 27 (table 2), 51–55. Proposed for group of rocks of upper part of Des Moines series between top of Armendaris group (new) and base of Missouri series (above). At type section, composed largely of gray to light-gray fossiliferous limestone, several beds of fossiliferous gray shale, and one well-developed bed of conglomerate to highly conglomeratic sandstone about 70 feet below top of group. Thickness at type locality about 233 feet.

Type locality: Just west of large box canyon in central part of Whiskey Canyon in north portion of Mud Springs Mountains, in south-central part of sec. 1, T. 13 S., R. 5 W., Sierra County. Name derived from small deserted village of Bolander, about 8 miles northeast of Mud Springs Mountains.

Bolanos Pyroclastic Member (of Umatac Formation)

Bolanos (Balanos) (Baranos) Beds, Andesite, or Formation

Miocene, lower: Mariana Islands (Guam).

Risaburo Tayama, 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 48, 49 (fig. 37). table 4 [English translation in library of U.S. Geol. Survey, p. 57, 58]; S. Hanzawa in Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 25. At typical outcrop beds consist of (descending) massive, nonstratified agglomerate with some limestone fragments, andesite lava with columnar structure, tuff with abundant limestone fragments, and thick layer of andesite. Conformably underlie Nagas beds. Correlated with Marino agglomerate on Tinian Island, and Manila agglomerate on Rota Island.

U.S. Geological Survey currently classifies the Bolanos as a member of Umatac Formation and designates the age as lower Miocene on the basis of a study now in progress.

Typical outcrop: West side of Mount Bolanos, Guam.

Bolarian Series or Epoch

Middle Ordovician: Eastern North America.

Marshall Kay, 1947, (abs.), Geol. Soc. America Bull., v. 58, no. 12, pt. 2, p. 1198–1199; 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1401, 1402 (fig. 2), 1406–1411. Series comprises rocks younger than Lincolnshire, about late Chazyan, and older than Nealmont, early Trentonian, in the Virginias and Pennsylvania, and time equivalents. Includes Hatterian (lower Bolarian) and Hunterian (upper Bolarian) subseries. Mohawkian series divided into Bolarian and Trentonian series. Term Bolarian used in preference to term Black Riveran.

Marshall Kay, 1956, Geol. Soc. America Bull., v. 67, no. 1, p. 77–84, 100. Whether the Bolarian is a series, subseries, or stage depends on conception of each term, as well as on demand for categories in classification. Bolarian epoch has two stages, earlier (Hatterian) marked by relative southeasterly tilting and latter (Bennerian) by gradual northwesterly tilting. Bolarian rocks are in two groups. Lower has three limestone formations: Ward Cove, Peery, and Benbolt. Upper Bolarian has two limestones: McGlone and McGraw (both new).

Marshall Kay, 1958, Am. Jour. Sci., v. 256, no. 2, p. 65–96. Discussion of Ordovician Highgate Springs sequence of Vermont and Quebec and its bearing on the classification of stages and series in Ordovician System. "Porterfield" and pre-Trentonian part of "Wilderness" stage constitute type Bolarian. Black Riveran series seems to be contained in Bolarian series of Appalachians, but lowest Bolarian seems older and equivalent to upper Chazyan.

Named for Bolar Cove, Highland and Bath Counties, Va.

Boley Conglomerate Member (of Vamoosa Formation)

Pennsylvanian (Virgil Series): Central Oklahoma.

R. R. Ries, 1954, Oklahoma Geol. Survey Bull. 71, p. 82–83, pl. 1. Basal member of Vamoosa formation. Consists mostly of subangular to well-rounded white chert pebbles and cobbles, some which are as large as 6 inches in diameter. Upper limits of member are not always definite and locally grade into sandstone lenses of overlying undifferentiated beds. Overlies units of Tallant and Barnsdall formations. Thickness 50 to 60 feet.

Type locality: Sec. 20, T. 12 N., R. 8 E. Excellent exposure capping promontory in northeastern part of sec. 21, T. 12 N., R. 8 E. Named from town of Boley which is situated on the member in sec. 20.

Bolin Sandstone Member (of Roubidoux Formation)[1]

Lower Ordovician: 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 exposures on Bolin Creek, Miller County.

Bolinas Sandstone[1]

Jurassic(?): Western California.

Original reference: A. C. Lawson, 1902, Science, new ser., v. 15, p. 416 (table).

San Francisco region. Probably named for Bolinas Ridge.

Bolivar cyclothem

Pennsylvanian (Allegheny Series): Southeastern Ohio.

N. K. Flint, 1949, Ohio Acad. Sci. [Guidebook] 24th Ann. Field Conf., p. 17. Incidental mention in road log.

N. K. Flint, 1951, Ohio Geol. Survey, ser. 4, Bull. 48, p. 54–55, table 1, geol. map. Includes (ascending) Upper Freeport shale and (or) sandstone, 20 feet; Bolivar clay, 1 to 10 feet; and Bolivar coal. Occurs below Upper Freeport cyclothem and above Lower Freeport cyclothem. In area of this report [Perry County], 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), 84–88. Bolivar cyclothem in Athens County, includes (ascending) Bolivar shale and (or) sandstone, Shawnee limestone, Bolivar underclay, Bolivar coal members. In sequence, occurs above Lower Freeport cyclothem and below Upper Freeport cyclothem. In area of this report, Allegheny series is described on cyclothemic basis; 13 cyclothems are named. [For complete sequence see Brookville cyclothem.]

Probably named for Bolivar fire clay.

Bolivar Fire Clay (in Allegheny Group)

Bolivar Fire Clay (in Allegheny Formation)[1]

Bolivar underclay or clay member

Pennsylvanian: Western Pennsylvania, Maryland, eastern Ohio, and northern West Virginia.

Original reference: I. C. White, 1891, U.S. Geol. Survey Bull. 65, p. 159–160.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 75. Fire clay included in Allegheny group in report on Fayette County. In many older reports, name Bolivar fire clay has been so loosely used that much confusion has developed. Going back to original use of name, it becomes evident that Bolivar fire clay lies considerable distance below Upper Freeport coal, whereas clay immediately under coal should be called Upper Freeport fire clay. Bolivar fire clay horizon lies 20 to 50 feet below Upper Freeport coal.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 54–55, table 1. Clay member of Bolivar cyclothem in report on Perry County. Average thickness 5½ feet. Patchy distribution at most exposures; overlain by Upper Freeport limestone; locally sandstone lies above the clay. Bolivar coal not present above clay at any outcrop.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 48 (table 7), 87. Bolivar underclay member of Bolivar cyclothem, Allegheny series, is about 4 feet thick in Athens County [this report]. In Ohio, the Ortons (1884, Ohio Geol. Survey, v. 5, Economic Geology) seem to have applied name Bolivar to this underclay, but White (1891) is credited later with establishing name in geologic literature. Bolivar underclay and overlying thin and seldom present Bolivar coal have been traced in discontinuous distribution across eastern Ohio. Occurs above Shawnee limestone.

Named for occurrence near Bolivar, Westmoreland County, Pa.

Bolivar Sandstone[1]

Lower Ordovician (Beekmantown): Southwestern Missouri.

Original reference: E. M. Shepard, 1904, Bradley Geol. Field Sta. Drury Coll. Bull. 1, pt. 1, p. 42.

At and around Bolivar, Polk County.

Bolivar Sandstone (in Allegheny Formation)[1]

Bolivar shale and (or) sandstone member

Pennsylvanian: Western Pennsylvania and eastern Ohio.

Original reference: J. J. Stevenson, 1878, Pennsylvania 2d Geol. Survey Rept. K.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 48 (table 7), 84. In Ohio, shale and sandstone that occur in interval between Lower Freeport coal and Bolivar underclay are called Upper Freeport. However, there are two shale and sandstone members separated by Bolivar cyclothem in interval between Lower and Upper Freeport coals.

Wherever Bolivar members are absent, these two shale and sandstone members coalesce, and it is impossible to distinguish them as separate units. Where it is impossible to separate the two shale and sandstone members, Upper Freeport can and should be applied as a name, but where the two can be recognized the lower shale and sandstone are herein called Bolivar. This lower member may correlate with Butler sandstone in Pennsylvania. Exposures of Bolivar shale and sandstone member of Bolivar cyclothem in Athens County [this report] are confined almost entirely to Waterloo and York Townships. Average thickness of member about 12 feet. Occurs below horizon of Shawnee limestone member.

Probably named for occurrence near Bolivar, Westmoreland County, Pa.

Bollibokka Group

Permian: Northwestern California.

A. H. Coogan, 1960, California Univ. Pubs. Geol. Sci., v. 36, no. 5, p. 243–255. Name proposed to include basic pyroclastic rocks, basic flows, and sparsely fossiliferous interbedded sedimentary rocks which have been referred to separately as Nosoni and Dekkas formations. These names are retained for formational subdivisions of group to be used where recognizable. Where black shale of the Nosoni is not present it is not always possible to separate the two formations and term "Bollibokka group, undivided" is more appropriate than one formation name. Thickness more than 10,000 feet in type section. In Bollibokka area, group is conformable with underlying McCloud limestone and overlying Pit shale. Fossiliferous beds dated as early Guadalupian, middle Permian. Upper unfossiliferous part may be late Permian, Triassic, or both. Smith (1894) included these rocks in the "Carboniferous shales" of his Pitt formation. Diller (1906) who named the Dekkas and Nosoni stated that they were alike and separated the two formations on basis of occurrence of *Fusulina* (now *Parafusulina*) which he considered indicative of Nosoni formation. Occurrence of fossils is unsuitable criterion for recognition of formations and was not reliable even in 1906 because *Parafusulina* does occur near top of Dekkas andesite as mapped by Diller. Lithology is main criterion for subdivision and mapping of Bollibokka group.

Type section: Along Nosoni Creek, Redding quadrangle, Shasta County. Named for Bollibokka Mountain, Bollibokka Mountain quadrangle.

Bolsa Quartzite[1]

Middle Cambrian: Southeastern Arizona and southwestern New Mexico.

Original reference: F. L. Ransome, 1904, U.S. Geol. Survey Prof. Paper 21, p. 28–30.

J. R. Cooper, 1950, Arizona Bur. Mines Bull. 156, Geol. Ser. 18, p. 31, fig. 13. Deposited on surface of considerable relief on Apache group (Dripping Spring quartzite). Thickness varies abruptly from 335 to less than 50 feet in Johnson Camp area, Cochise County.

James Gilluly, 1956, U.S. Geol. Survey Prof. Paper 281, p. 14–15, pls. 5, 11, 12. In central Cochise County, rocks commonly crossbedded, and beds range from few inches to as much as 10 feet in thickness, average 2 to 4 feet. Rests on smooth surface carved across Precambrian rocks, largely Pinal schist. Underlies Abrigo limestone with transitional contact.

F. F. Sabins, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 3, p. 469–472, fig. 4. Transgresses upward through time (Lower Cambrian? to Upper Cambrian) in west to east section through Dos Cabezas and Chiricahua Mountains.

Elliot Gillerman, 1958, New Mexico Bur. Mines Mineral Resources Bull. 57, p. 18–21, tables 1, 2, pl. 1. Described from central Peloncillo Mountains of New Mexico. Arkosic and orthoquartzitic sandstone and conglomerate containing some glauconite and thin shale beds in middle part of unit. Thickness ranges from 60 to 400 feet. Underlies El Paso limestone. Of Middle and Upper Cambrian age.

Well exposed in Bolsa Canyon, on southwest side of Escabrosa Ridge, Bisbee quadrangle, Cochise County, Ariz.

†Bolton Gneiss[1]

Late Carboniferous or post-Carboniferous: Eastern Massachusetts.

Original reference: B. K. Emerson and J. H. Perry, 1903, Geology of Worcester, p. 79, map.

Named for town of Bolton, which it extends through.

Bolton Igneous Series[1] or Group

Upper Ordovician or post-Ordovician: Southeastern Quebec, Canada, and northeastern Vermont.

T. H. Clark, 1934, Geol. Soc. America Bull., v. 45, no. 1, p. 11, 12. Bolton igneous series consists of large masses of gray finely crystalline metabasalt, metagabbro, and metaperidotite. Contains pillow structures and breccias; flow structure identified. Younger than Magog slates; metaperidotite intrudes Sutton schists. Upper Ordovician or post-Ordovician.

C. G. Doll, 1951, Vermont Geol. Survey Bull. 3, p. 38–41, pl. 1. Geographically extended into Vermont where it is referred to as igneous group. Consists of fine- to medium-grained metadiorites and related rocks in area west of Lake Memphremagog. Devonian or younger.

Occurs in vicinity of Bolton, southeastern Quebec.

Bolton Schist[1]

Bolton Formation or Group

Mississippian(?) or older: Central Connecticut.

Original reference: J. G. Percival, 1842, Connecticut Geol. Survey Rept., p. 229–333, map.

H. M. Mikami and R. Digman, 1950, (abs.) Geol. Soc. America Bull., v. 61, no. 12, pt. 2, p. 1487. In Branford-Killingworth area, Connecticut, pre-Triassic Bolton formation lies stratigraphically above Middletown gneiss and consists of schist and quartzites. Contact between formations conformable.

E. N. Cameron and others, 1954, U.S. Geol. Survey Prof. Paper 255, p. 20, 21. Age considered probably older than Upper Devonian; designated Paleozoic(?) in geologic map legend.

Frederick Stugard, Jr., 1958, U.S. Geol. Survey Bull. 1042–Q, p. 619, 620–624, pl. 56. Pegmatites in Middletown area cut metasediments of Bolton schist of pre-Mississippian(?) age and, in ascending order of sequence, mafic gneisses, Glastonbury granite gneiss, Maromas granite gneiss, and Monson gneiss. Position of formations in stratigraphic column cannot be determined with accuracy; maximum age is indicated by their relation to the pegmatites, which have been dated by uranium-and thorium-lead ratios as about 260 million years old, presumably Mississippian. Predominantly mica-schist with interbedded layers of quartzite and amphibolite-bearing gneiss. Estimated thickness 1,400 to 4,300 feet. Intruded by Maromas granite gneiss. Crops out as narrow band in northern part of Middletown area, and near the Straits in Connecticut River; divides into two broader bands that enclose northern end of Killingworth dome. West boundary of unit is westward-dipping normal fault of Triassic age. Band of schist extending northward from Collins Hill to village of South Glastonbury is cut on north by a Triassic fault. These two areas of schist are separated by narrow belt of mafic gneiss; easternmost body of schist can be followed northward beyond mapped area to type locality at Bolton Notch.

R. M. Gates and J. L. Rosenfeld, 1959, Connecticut Geol. Nat. History Survey Bull. 84, p. 21–24, fig. 3. Recent study in Middle Haddam quadrangle east of Middletown has resulted in major revision of interpretation of pre-Triassic rocks of area. Some features from maps of Percival (1842) and Westgate (1899, ms.), such as Percival's distinction between schist at and northeast of Great Hill and that to south and west, and Westgate's mapping of Maromas gneiss and its environs. Common mapping practice has been to lump all schist together as Bolton. This was done on Connecticut map of 1956. The Bolton is herein raised to group rank and geographically restricted to schist in Great Hill-Bolton Notch belt. Remaining schist is named Collins Hill formation. Group as herein defined consists of three units. Lower unit, which is Lower or Middle Ordovician, is well-banded quartzite and quartz-sericite above and conglomeratic quartzite below. Middle unit, which is Middle Silurian, is laminated calcareous biotite gneiss, granulite, and schist, showing deep pits and weathered surfaces due to solution of masses of calcite marble. Upper unit, which is Lower Devonian, is gray nonrusty graphitic garnet-staurolite two-mica schist and some platy quartz-serite schist. Unconformably overlies Collins Hill formation.

Named for exposures in western part of town of Bolton, Tolland County.

Bommer 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. Predominantly thick-bedded coarse-grained sandstone and grit which contains thin lenticular pebble beds. Thin beds of fine- to medium-grained sandstone commonly separate coarse-grained sandstone beds in middle and upper parts of member. Maximum thickness about 2,000 feet. Conformably underlies Los Trancos member (new); overlies Vaqueros formation; contact gradational where exposed in Moro Canyon.

Type area: In large fault block extending from upper Moro Canyon to mouth of Bommer Canyon, Orange County. Named for Bommer Canyon, which joins Sand Canyon Wash at north margin of San Joaquin Hills.

Bomoseen Greywacke or Grit Member (of Bull Formation)

Bomoseen Grit[1]

Bomoseen Grit Member (of Schodack Formation)

Lower Cambrian: Southwestern Vermont and eastern New York.

Original reference: R. Ruedemann, 1914, New York State Mus. Bull. 169, p. 67–70, map.

Rudolf Ruedemann, J. H. Cook, and D. H. Newland 1942, New York State Mus. Bull. 331, p. 64–65; Winifred Goldring, 1943, New York State Mus. Bull. 332, p. 65–68. Considered member of Schodack formation.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, p. 46–47, pl. 2. Bomoseen grit crops out along western part of Castleton quadrangle in irregular-shaped pattern from Hampton, N.Y., at south to point of Pines on western shore of Lake Bomoseen. Kaiser (1945, Geol. Soc. America Bull., v. 56, no. 12, pt. 1) mapped Bomoseen in outcrop 1 mile west of West Castleton. This outcrop, which is type locality, extends westward into Whitehall quadrangle. Minimum thickness about 200 feet. Underlies Mettawee slate; in many places, gradational contact between the two requires arbitrary definition. Base not exposed, presumably overlies Nassau formation.

D. W. Fisher, 1956, Internat. Geol. Cong., 20th, Mexico, Cambrian Symposium, pt. 2, p. 329–330. First distinguished by Dale (1889, U.S. Geol. Survey Ann. Rept., v. 19, pt. 3B) as "Olive grit," and assigned to base of Cambrian in Washington County, unit was named by Ruedemann (1914) from type exposures near Lake Bomoseen, Vt. Here it consists of medium-grained angular quartz grains, with subordinate amount of feldspar set in sericitic, somewhat calcareous, matrix and characterized by abundant specks of hematite and graphite; locally intercalated green and red slates. There is suggestion of cyclical bedding. Some beds of medium- to coarse-textured calcareous orthoquartzite, flecked with hematite, limonite, and graphite are present. These beds are seldom more than 1 inch thick, but some are as much as 55 feet. Weathers brick red. Thickness probably 500 feet. Here interpreted as facies of Nassau formation farther south. Kaiser (1945) suggested that Bomoseen may be equivalent of Rensselaer grit whose age has long been in dispute.

E–an Zen, 1959, New England Intercollegiate Geol. Conf. Guidebook 51st Ann. Mtg., p. 1. Referred to as greywacke member of Bull formation. West of Lake Bomoseen is lowest exposed unit and underlies Mettawee member; east of Lake Bomoseen and north of Pine Pond thrust, it is demonstrably within Mettawee member. Bomoseen graywacke west of Lake Bomoseen conceivably belongs to lower horizon, stratigraphically replacing Biddie Knob formation (new); on other hand, it may merely be part of a thickened section of Bull formation, still underlain by the (unexposed) Mettawee member. Underlies Zion Hill member.

George Theokritoff, 1959, New England Intercollegiate Geol. Conf. Guidebook 51st Ann. Mtg., p. 53–54. Referred to as grit member of Bull formation. Is lowest rock unit exposed in Taconic sequence in Washington County, N.Y.

Type locality: West side of Lake Bomoseen, Castleton quadrangle, Rutland County, Vt.

†Bon Air measures[1]

Pennsylvanian: Southeastern Tennessee.

Original reference: J. M. Safford and J. B. Killebrew, 1900, Elements of geology of Tennessee, p. 104, 148–151, 167, 168.

Named for mines in White County.

Bonair Sandstone (in Lee Group)[1]

Lower Pennsylvanian: Eastern Tennessee and northern Georgia.

Original reference: M. R. Campbell, 1899, U.S. Geol. Survey Geol. Atlas, Folio 53, p. 3.

V. H. Johnson, 1946, Coal deposits of Sand and Lookout Mountains, Dade and Walker Counties, Georgia: U.S. Survey Prelim. map. Geographically extended into northern Georgia where it is 150 to 200 feet thick. Underlies Vandever shale; overlies 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. Sandstone that has been called "Bon Air" at Bon Air, White County, is equivalent to Sewanee conglomerate; because name Sewanee has priority, name Bon Air is discontinued.

Named for Bon Air, White County, Tenn. [Board on Geographic Names gives Bon Air as correct spelling.]

Bonanza Latite[1]

Tertiary: Southern Colorado.

Original reference: H. B. Patton, 1916, Colorado Geol. Survey Bull. 9, p. 21–63.

J. W. Gabelman, 1953, Econ. Geology, v. 48, no. 3, p. 195, 196. In Greater Bonanza district, the volcanics in order of succession are Rawley andesite, Bonanza latite, Squirrel Gulch latite, Porphyry Peak rhyolite, and Bremer [Brewer] Creek latite. In South Bonanza district, the volcanic sequence is roughly the same except Porphyry Peak rhyolite is missing and Bonanza atite is replaced by Hayden Peak latite.

Bonanza district, Saguache County.

Bonanza King Formation[1] or **Dolomite**

Middle and Upper Cambrian: Southeastern California and southeastern Nevada.

Original reference: J. C. Hazzard and J. F. Mason, 1936, Geol. Soc. America Bull., v. 47, no. 2, p. 229–240.

J. C. Hazzard, 1937, California Jour. Mines and Geology, v. 33, no. 4, p. 277 (fig. 3c), 316–318. Extended into Nopah and Resting Springs area, Inyo County, Calif. Thickness 1,515 feet. Underlies Cornfield Springs formation: overlies Cadiz formation.

J. C. Hazzard and J. Mason, 1953, Am. Jour. Sci., v. 251, no. 9, p. 643–655. Geographically extended into Goodsprings area, Nevada, where it lies within Goodsprings dolomite of Hewett (1931).

A. R. Palmer and J. C. Hazzard, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 10, p. 2494–2499. On basis of paleontological data, age of Bonanza King formation at its type locality is designated as Middle and Upper Cambrian. On basis of this evidence, names Cornfield Springs and Bonanza King were misapplied in Nopah Range area. Here units so designated should now be considered as unnamed upper and lower divisions, respectively, of Bonanza King formation. Hence, in Nopah area, Bonanza King underlies Nopah formation.

First described in Providence and Marble Mountains, San Bernardino County, Calif. Named for Bonanza King mine, east side of Providence Mountains.

Bonaparte Marble[1]

Mississippian: Southeastern Iowa.

Original reference: C. H. Gordon, 1895, Iowa Geol. Survey, v. 4, p. 211.

Appears at Des Moines River level on south side, about half way between Bentonsport and Bonaparte, Van Buren County.

Bond Formation (in McLeansboro Group)

Pennsylvanian: Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 8 (fig. 1), 26 (fig. 4), 27, 38–39, 50, pl. 1, geol. sections. Proposed for strata extending from base of Shoal Creek limestone member to top of Millersville limestone member. Characterized in area of typical development by thick limestones. Thickness in type area nearly 300 feet; east of La Salle anticline 75 feet or less. Overlies Modesto formation and underlies Mattoon formation (both new). Members—central and southwestern Illinois (ascending): Shoal Creek limestone, McWain sandstone, Sorento limestone (new) Bunje limestone (new), Flat Creek coal (new), Witt coal (new), Coffeen limestone (new), and Millersville limestone; southeastern and eastern—Shoal Creek limestone, Mount Carmel sandstone, Flannigan coal, Reel limestone, Livingston limestone, and Millersville limestone; northern Illinois—Hall limestone and La Salle limestone. Presentation of new rock-stratigraphic classification for Pennsylvanian of Illinois. Cyclical classification is retained but is independent of rock-stratigraphic classification.

Type section: Composite of seven exposures (geol. section 8) in Bond, Montgomery, and Christian Counties. Named for Bond County. Reference section: Core from drill hole 59, Peabody Coal Co. NW¼NE¼ NW¼ sec. 33, T. 11 N., R. 1 E., Pana quadrangle, Christian County.

†Bone Canyon Member[1] or Limestone[1]

Permian: Western Texas.

Original reference: P. B. King and R. E. King, 1929, Am. Assoc. Petroleum Geologists Bull., v. 13, p. 921, 922, 925.

In Bone Canyon, on west side of Guadalupe Mountains.

†Bone Lake Crystalline Schists[1]

Precambrian (middle Huronian): Northwestern Michigan.

Original reference: J. M. Clements, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 3, p. 60.

Best developed in northern part of Crystal Falls district, in vicinity of Bone Lake.

Bone Spring Limestone[1]

Permian (Leonard Series): Western Texas and southeastern New Mexico.

Original reference: W. G. Blanchard, Jr., and M. J. Davis, 1929, Am. Assoc. Petroleum Geologists Bull., v. 13, p. 962, pls. 10, 11.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 566–575, pl. 2; 1948, U.S. Geol. Survey Prof. Paper 215, p. 13–27, pls. Consists largely of limestones of varied types complexly interbedded and interfingered. Those laid down on shelf area outside Delaware basin, now exposed on Guadalupe Mountains and Sierra Diablo, are of different facies from those laid down within basin, now exposed in Delaware Mountains. Underlies Delaware Mountain group; overlies Hueco limestone and in some areas Wolfcamp series, undifferentiated. In Delaware Mountains, and as far north as Bone Canyon, exposed parts of formation are black cherty limestone in thin beds, with partings and a few members of shaly limestone and silic shale north of Bone Canyon; in Guadalupe Mountains, upper part of black limestone is replaced by thick-bedded gray limestone, Victorio Peak gray member, which forms capping stratum of Sierra Diablo. At top is Cutoff shaly member (new). Thickness several thousand feet.

D. W. Boyd, 1958, New Mexico Bur. Mines Mineral Resources Bull. 49, p. 3 (table 1), 12–14, pl. 1. Victorio Peak and Cutoff members mapped in Otero County, N. Mex.

Named for Bone Springs Canyon, which opens in sec. 2, Block 66, northwestern part of Culberson County, Tex.

Bone Valley Gravel[1] or Formation

Pliocene, middle: Southern central Florida.

Original reference: G. C. Matson and F. G. Clapp, 1909, Florida Geol. Survey 2d Ann. Rept., p. 138–141, table.

C. W. Cooke, 1945, Florida Geol. Survey Bull. 29, p. 18 (table), 203–208. Gravel makes up only small fraction of deposit; hence unit is here termed formation. Thickness about 50 feet. In type area, Bone Valley lies unconformably on limestone bedrock that is supposed to represent Hawthorn formation; farther north it presumably lies on Tampa and Suwannee limestones. Unconformably overlain by Pleistocene terrace deposits ranging in age from Sunderland to Pamlico. Probably merges southward into Caloosahatchee formation, but there are no known exposures in supposed transition area.

M. H. Bergendahl, 1956, U.S. Geol. Survey Bull. 1030–B, p. 70 (fig. 7), 79–84. Formation described in De Soto and Hardee Counties. Thickness as much as 35 feet. Generally, formation is considered to be Pliocene in age, but, until Miocene-Pliocene boundary is reestablished, age of formation cannot be categorically stated.

K. B. Kitner and L. J. McGreevy, 1959, U.S. Geol. Survey Bull. 1074–C, p. 65. Hawthorn formation of this report [area between Hernando and Hardee Counties, Fla.] includes (1) Hawthorn formation as redefined by Cooke (1945), (2) middle Miocene rocks in hard-rock phosphate belt including those generally assigned to Alachua formation, and (3) middle Miocene rocks in land-pebble phosphate district including noncalcareous rocks which have not always been distinguished from Bone Valley formation.

Named for exposures at town of Bone Valley, west of Bartow, Polk County.

Bonham Marl[1]

Bonham Clay (in Austin Group)

Upper Cretaceous (Gulf Series): Northeastern Texas.

Original reference: L. W. Stephenson, 1927, Am. Assoc. Petroleum Geologists Bull., v. 11, p. 8.

L. W. Stephenson and others, 1942, Geol. Soc. America Bull., v. 53, no. 3, chart 9. Chart shows Bonham marl below the Gober tongue of Austin chalk and above the Ector tongue.

D. L. Frizzell, 1954, Texas Univ. Bur. Econ. Geology Rept. Inv. 22, p. 35. Foraminifera described. Bonham clay listed in Austin group.

Name for exposures a short distance north of town of Bonham, Fannin County, and for fact that town is located on the clay.

Bonita Beds (in Gila Conglomerate)

Pliocene(?) : Southeastern Arizona.

P. A. Wood, 1959, Arizona Geol. Soc. Guidebook 2, p. 60. Massive conglomerate characterized by basaltic and rhyolitic fragments. Range in thickness from about 400 to 800 feet. Disconformably underlie Solomonsville beds. At least pre-Blancan, probably Pliocene age. Name credited to W. L. Van Horn and L. A. Heindl (unpub. theses).

In eastern part of Safford Valley [Graham County].

Bonita Sandstone Member (of Franciscan Formation)

Bonita Sandstone (in Franciscan Group)[1]

Jurassic and Cretaceous: Northern California.

Original reference: A. C. Lawson, 1902, Science, new ser., v. 15, p. 416 (table).

U.S. Geological Survey currently classifies the Bonita Sandstone as a member of the Franciscan Formation on the basis of a study now in progress.

Named for exposures at Point Bonita, on north shore of Golden Gate.

Bonita Park Formation.

Cenozoic: Southeastern Arizona.

H. E. Enlows, 1955, Geol. Soc. America Bull., v. 66, no. 10, p. 1216 (table 1), pl. 1. Discussion of sequence of rocks in Chiricahua National Monument. Chiricahua limestone is succeeded by thick section of Lower Cretaceous Bisbee group with recognizable Glance conglomerate at base, and in turn, by section of what appears to be Morita formation. This sequence of Lower Cretaceous rocks is apparently similar to Outlaw formation (Raydon, unpub. thesis) described from area east of Paradise. Above Bisbee group is a 300-foot sequence of red beds and associated tuff named Bonita Park formation (Waller, unpub. thesis). May be equivalent to some of volcanic sediments of Raydon's Blacktail formation. The Bonita Park unconformably underlies Faraway Rock formation in Hands Pass region, just east of the Monument.

Mapped at Bonita Park, Chiricahua National Monument, Cochise County.

Bonnellian series[1]

Lower Cretaceous: Texas.

Original reference: C. R. Keyes, 1935, Pan-Am. Geologist, v. 64, no. 2, p. 138–139.

Named for Mount Bonnell, near Austin, Travis County.

Bonner 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. Pink crossbedded feldspathic quartzite; forms blocky rubble; outcrops relatively rare. Underlies McNamara argillite; overlies Miller Peak argillite.

Mapped in Bonner quadrangle. Type locality and derivation of name not given.

Bonner Springs Shale[1] or **Formation** (in Kansas City Group)

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

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. 2031 (fig. 4); 1949, Kansas Geol. Survey Bull. 83, p. 111. In Kansas City group. Underlies Merriam limestone member of Plattsburg formation; overlies Farley limestone member of Wyandotte formation. This is classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 34. Thickness in Nebraska 8 to 10 feet

T. L. Welp, L. A. Thomas, and H. R. Dixon, 1957, Iowa Acad. Sci. Proc., v. 64, p. 418 (fig. 1), 420. In Schildberg quarry, NW¼SE¼ sec. 5, T. 75 N., R. 29 W., Madison County, consists of 4 feet of olive to dark-gray shale with a thin coallike layer near top; lower 3 feet contains numerous limestone nodules.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 24–25, fig. 5. Uppermost formation in Kansas City group. Consists of gray to black shale overlain by maroon shale that commonly contains limestone nodules Thickness commonly 10 feet. Overlies Wyandotte limestone; underlies Plattsburg limestone.

Type locality: Cement plant northeast of Bonner Springs, Wyandotte County, Kans.

Bonneterre Dolomite[1]

Upper Cambrian: Southeastern Missouri.

Original reference: F. L. Nason, 1901, Am. Jour. Sci., 4th, v. 12, p. 358–361.

Josiah Bridge, 1936, U.S. Geol. Survey Prof. Paper 186–L, p. 234 (table 1). Underlies Davis formation of Elvins group.

G. F. Brightman, 1937, (abs.) Missouri Acad. Sci. Proc., v. 3, no. 4, p. 120; 1938, Jour. Geology, v. 46, no. 3, pt. 1 p. 248–267. Includes Tom Sauk limestone member (new) at base.

Christina Lochman, 1940, Jour. Paleontology, v. 14, no. 1, p. 1–53. Formation varies in thickness throughout area, for it overlaps Lamotte sandstone and is to a certain degree still affected by irregularities in Precambrian surface. Average thickness 375 feet; maximum thickness 448 feet of Delassus on Bonneterre plain. Thickness decreases regularly southward with average of 200 feet in Madison County and minimum of 50 feet where unit lies directly on rhyolite porphyry. Twofold lithic division recognized: basal 50 feet, which is intricate sequence of interbedded and intergrading glauconitic sandstones, fine gray and yellow shales, fossiliferous crystalline limestone, and barren white or pink dolomites; and a 200- to 300-foot upper part, which is essentially a massive-bedded barren crystalline dolomite. Basal 50 feet carries late *Cedaria* fauna of more than 61 species. Upper Cambrian.

Named for exposures at Bonneterre, St. Francois County.

Bonnetian Age and Stage

Middle Cambrian: North America.

B. F. Howell and J. F. Mason, 1938, Jour. Paleontology, v. 12, no. 3, p. 297. Lower *Paradoxides bennetti* fauna, with *Dawsonia* and *Ehmania*, together with faunas which are correlated with them, are assigned a new age and stage name, Bonnetian.

Term taken from original name for Highland Range of Nevada.

†Bonneville Beds[1]

†Bonneville Group[1]

See **Lake Bonneville Beds.**

Bonneville Formation (in Lake Bonneville Group)

Pleistocene: West-central Utah.

C. K. Bullock, 1951, Utah Geol. and Mineralog. Survey Bull. 41, p. 21. Includes those deposits that accumulated in Lake Bonneville at its highest stage. Consists of gravel containing some cobbles and boulders in sandy matrix. Younger than Alpine formation and older than Provo formation (both new). 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, 20–21, pl. 1. Includes those deposits that accumulated during what Gilbert (1890, U.S. Geol. Survey Mon. 1) referred to as Bonneville stage. Thickness about 20 feet except at Point of the Mountains where formation was deposited in spit 300 feet high and extending 1 mile west from end of Traverse Mountains. Overlies Alpine or older formations. Included in Lake Bonneville group.

Forms thin and discontinuous beach deposit along old Lake Bonneville shore line. Deposits encircle Lake Mountain.

Bonpas 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), 82, pl. 1. Proposed to replace name Calhoun limestone, in order to restrict name Calhoun to underlying coal. Stratigraphically below Omega limestone member. Medium gray, weathers with reddish cast; dense to finely crystalline, thick bedded; tends to be shaly in lower part. Thickness 3 feet. Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification is retained but is entirely independent of rock-stratigraphic classification.

Type locality: NE¼NE¼NE¼ sec. 6, T. 2 N., R. 14 W., Richland County. Named from Bonpas Creek, about 1½ miles east of type outcrop.

Bonsall Tonalite

Upper Cretaceous: Southern California.

C. S. Hurlbut, Jr., 1935, Am. Mineralogist, v. 20, no. 9, p. 611–613. Medium-grained plutonic rock presenting in outcrop a color of varying shades of gray which distinguishes it in the field from other intrusives. Characterized by dark inclusions. Shows marginal assimilation at contact with San Marcos Mountain gabbro which it intrudes.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, table facing p. 630. In Late Mesozoic plutonic sequence in central and northwestern San Diego County, Bonsall tonalite is listed as older than Lakeview tonalite and younger than Green Valley tonalite.

E. S. Larsen, Jr., 1948, Geol. Soc. America Mem. 29, p. 58–62, pl. 1. In this report, name Bonsall tonalite replaces name Perris quartz diorite as used by Dudley (1935) and Val Verde tonalite used by Osborn (1939). Intruded by Woodson Mountain granodiorite and Indian Mountain granodiorite. Considered younger than Lakeview Mountain tonalite. Upper Cretaceous.

Richard Merriam, 1958, California Div. Mines Bull., 177, p. 14, 16 (fig. 2), Described and mapped in Santa Ysabel quadrangle. Younger than Green Valley tonalite. Cretaceous.

Name derived from village of Bonsall located slightly west of central portion of San Luis Rey quadrangle. Tonalite underlies approximately 100 square miles in San Luis Rey quadrangle; also present in Elsinore and Ramona quadrangles.

Bonta Formation

Miocene, upper(?): Northeastern California.

Cordell Durrell, 1957, Pacific Petroleum Geologist, v. 11, no. 3, p. 3. Hornblende and pyroxene andesite, volcanic conglomerate and mudflow breccia. Thickness about 750 feet. Unconformable below Penman formation (new); rests unconformably on Delleker formation (new) and all older rocks; unconformities marked by faulting.

Cordell Durrell, 1959, California Univ. Pub. Geol. Sci., v. 34, no. 3, p. 165 (fig. 1), 172–174. Predominantly andesite mudflow breccia, volcanic conglomerate, and volcanic fanglomerate. Thickness 100 to 750 feet. Underlies Penman formation. Rests in various places on granitic and metamorphic rocks and on Lovejoy, Ingalls (new), and Delleker formations. In many areas, lies across faults between two of older formations; in other areas has been faulted showing renewed movements on the faults. Upper Miocene on basis of fossil flora.

Named for Bonta Creek in south-central part of Blairsden quadrangle, Most representative area is in secs. 28 and 33, T. 23 N., R. 13 E.

Bony Falls Member (of Black River Formation)

Middle Ordovician: Northern Michigan.

R. C. Hussey, 1952, Michigan Dept. Conserv. Geol. Survey Div. Pub. 46, Geol. Ser. 39, p. 13, 14, 16, 17–22. Section at Bony Falls consists of about 40 feet of limestone, some of which is argillaceous and some finely crystalline dolomitic; a 2-inch layer of bentonite occurs about middle of section, and this may mark top of Black River. Evidence of subaerial erosion appears at several levels throughout section, and a very obvious disconformity near middle of section may represent a time break of considerable duration. Underlies Chandler Falls member (new) of Trenton formation. Separation of Black River rocks from Trenton above presents difficult problem; rocks of the two formations are commonly distinguished on basis of faunal changes that are not always very significant; deposition was practically continuous at some localities from Black River to Trenton time, and dividing line between the two formations becomes an arbitrary one.

Type locality: Sec 1, T. 41 N., R. 24 W., at Bony Falls on Escanaba River, Delta County.

Boone Formation[1]

Boone Limestone[1] or Chert

Lower and Upper Mississippian: Northern Arkansas, southwestern Missouri, and eastern Oklahoma.

Original reference: J. C. Branner and F. W. Simonds, 1891, Arkansas Geol. Survey Ann. Rept. 1888, v. 4, p. xiii, 27–37.

L. M. Cline, 1934, Am. Assoc. Petroleum Geologists Bull., v. 18, no. 9, p. 1132. St. Joe limestone, formerly considered member of Boone, here raised to formation rank. Term Boone should be suppressed as synonym of term Osage.

J. A. Straczek and D. M. Kinney, 1950, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–1. Boone chert mapped in Batesville manganese district. Includes St. Joe limestone member, locally, at base.

E. B. Brewster and N. F. Williams, 1951, Guidebook to the Paleozoic rocks of northwest Arkansas: Arkansas Resources Devel. Comm., p. 13, 14. Formation consists of limestone and chert which vary in relative proportions both horizontally and vertically. Thickness 300 to 350 feet in most of northern Arkansas. Includes Short Creek oolite member in upper part and St. Joe limestone member in basal part. In Yellville quadrangle, basal member of Boone lies at some place on every one of formations preceding it in stratigraphic section except the Joachim, Cotter, and Jefferson City. In northwestern Arkansas overlain by Batesville sandstone, Hindsville limestone, or Fayetteville shale.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Formation mapped in Oklahoma. In Ottawa County, includes at top some beds equivalent in part at least to Moorefield formation of several counties farther south and in northeastern part of state.

E. E. Glick, S. E. Frezon, B. R. Haley, 1956, Kansas Geol. Soc. Guidebook 20th Field Conf., cross section. Lower and Upper Mississippian.

R. G. Huffman and others, 1958, Oklahoma Geol. Survey Bull. 77, p. 1, 14 (fig. 2), 40–41. Osagean series, frequently referred to as "Boone chert," includes St. Joe, Reeds Spring, and Keokuk formations.

C. H. Behre, Jr., and A. V. Heyl, Jr., 1959, Deutsche Geol. Gesell. Zeitschr., v. 110, pt. 3, p. 517 (fig. 2). Chart shows Boone formation comprises (ascending) Reeds Spring, Grand Falls, and Short Creek members. Overlies Northview shale; underlies Carterville formation.

Named for extensive development in Boone County, Ark.

Boone Creek Limestone Member (of Palo Pinto Limestone)[1]

Pennsylvanian: Central northern Texas.

Original reference: J. M. Armstrong, 1929, Texas Bur. Econ. Geology, geol. map of Jack County.

Jack and Wise Counties, Brazos River region.

Boone Gap facies (of New Providence Formation)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 77, 119–121. Predominantly shale with minor amounts of limestone, siltstone, and clay. Thickness ranges from about 125 feet in Rockcastle County to nearly 275 feet in northeastern Estill County. Merges with Dicks River facies (new) on west and with Stanton facies (new) on east.

Underlies Conway Cut siltstone member of Brodhead formation, Irvine facies (all new); overlies New Albany shale.

Name derived from Boone Gap, at line between Rockcastle and Madison Counties, where there are excellent exposures in deep cuts on both sides of tunnel of Louisville and Nashville Railroad, and along U.S. Highway 25. Base of formation, in contact with New Albany shale, is exposed less than 1 mile north of tunnel, and top is exposed at roadcut a few feet above highway level at gap.

Booneville Stage[1]

Pennsylvanian: Western Arkansas and central eastern Oklahoma.

Original reference: A. Winslow and H. M. Chance, 1896, New York Acad. Sci. Trans., v. 15, p. 51–52

Probably named for Booneville, Logan County, Ark.

Bootlegger Member (of Blackleaf Formation)

Lower Cretaceous: Northwestern Montana.

W. A. Cobban and others, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2791–2793; 1959, Billings Geol. Soc. [Guidebook] 10th Ann. Field Conf., p. 89 (fig. 1), 90. Predominantly interbedded medium-gray sandstone, gray siltstone, and dark-gray shale; massive sandstone at base. A few thin layers of chert-pebble conglomerate present. Beds of bentonite common in upper half of member and one bed attains thickness of 10 feet. Widespread thin sandstone at top, in which finely fragmented fish bones are very abundant, is diagnostic feature. Thickness 330 feet in composite type section. Overlies Vaughn bentonitic member (new); underlies Floweree member (new) of Marias River shale (new).

Composite type section: Begins near place where Bootlegger Trail crosses outcrop of member at NE cor. sec. 1, T. 21 N., R. 3 E., Cascade County, and extends westward for about 15 miles toward Muddy Creek along upper part of a south-facing escarpment. Bootlegger Trail, from which member is named, is a secondary road extending from Great Falls north toward Canada.

Bootlegger Cove Clay

Pleistocene: Alaska.

R. D. Miller and Ernest Dobrovolny, 1959, U.S. Geol. Survey Bull. 1093, p. 12 (table 1), 14–15, 35–48, pls. 1, 3, 5, 6, 9. Extensive blue-gray clay of lacustrine or estuarine origin. Thickness 14 to 126 feet. Separates the Knik from overlying Naptowne glacial deposits. Shows interglacial weathering. Pre-Wisconsin.

Typical sections are in SW¼NE¼ sec. 23, T. 14 N., R. 4 W., near Bootlegger Cove, Anchorage area. Exposed almost continuously from point about three-fourths mile southeast of Point Woronzof northward to point about one-half mile southwest of Eagle River Flats; north of the Flats exposed discontinuously in bluffs.

Boott Member (of Littleton Formation)

Lower Devonian: North-central New Hampshire.

M. P. Billings and others, 1945, Geologic map and structure sections of the Mount Washington quadrangle (1:62,500): New Hampshire State Plan. Devel. Comm. and Highway Dept. Consists of diopside granulite, diopside-actinolite granulite, actinolite granulite, actinolite-biotite schist, biotite schist and biotite-pyrite schist. Occurs near middle of Littleton formation.

M. P. Billings and others, 1946, Geol. Soc. America Bull., v. 57, no. 3, p. 264–266. Maximum thickness 65 feet. Type locality cited.

Named from Boott Spur 1.2 miles south-southeast of summit of Mount Washington, Coos County. Exposed in narrow belt extending north-northeast from Boott Spur Trail to within a few hundred feet of Cutler River in Tuckerman ravine.

Bopesta Formation[1]

Miocene, upper: 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. 148. Consists of tan and white fine and coarse quartzose sandstones containing some ash and volcanic debris, a few conglomerate beds, and some gray sandy shale beds. Thickness probably not less than 3,500 feet. Beds moderately deformed, with dips as much as 30°. Probably conformable on Kinnick formation; overlain by basic lavas, probably unconformably. Type section designated; derivation of name given.

Type section: From confluence of Cache Creek and its East Fork (which heads on south side of Cache Peak) in NW¼ sec. 1, T. 32 S., R. 34 E., to north side of Cache Peak, which is in sec. 20, T. 31 S., R. 35 E. Named from Bopesta Ridge, southwest of Cache Peak, Kern County.

Boquillas Flags[1]

Boquillas Formation

Upper Cretaceous: Western Texas.

Original reference: J. A. Udden, 1907, Texas Univ. Bull. 93, p. 17, 29–33.

S. S. Goldich and M. A. Elms, 1949, Geol. Soc. America Bull., v. 60, no. 7, p. 1141–1143, pl. 1. Formation described in Buck Hill quadrangle. Overlies Buda limestone; underlies Buck Hill volcanics (Pruett formation). How much of Boquillas is Eagle Ford and how much Austin equivalent not determined.

C. G. Moon, 1953, Geol. Soc. America Bull., v. 64, no. 2, p. 157–170, pl. 1. Boquillas-Terlingua problem discussed. A 50-foot rock unit, herein named Fizzle Flat lentil, occurs in middle of Boquillas-Terlingua sequence in Agua Fria quadrangle.

R. G. Yates and G. A. Thompson, 1959, U.S. Geol. Survey Prof. Paper 312, p. 10–12, pl. 1. Boquillas flags described in Terlingua district. Thickness about 1,000 feet. Divided into upper and lower member, plane of division being top of thin sandy limestone bed that represents faunal zone characterized by ammonite (*Crioceras*), found nowhere else in formation. This division of Boquillas into members is not a subdivision of Adkins' (Sellards, Adkins, and Plummer, 1933, Texas Univ. Bull. 3232) Boquillas flags, which includes only lower member; instead it is an extension of his and Udden's definition of formation to include rocks considered by them as more properly belonging to an overlying formation. Beds mapped as Boquillas flags therefore include lower part of what Adkins called Terlingua formation (restricted). Overlies Buda limestone; underlies Terlingua clay.

Named for Boquillas, Brewster County, on Tormillo Creek, Chisos Mountains quadrangle.

Boracho Limestone (in Sixshooter Group)

Cretaceous (Comanche Series): Western Texas.

Hugh Hay-Roe, 1957, Texas Univ. Bur. Econ. Geology Geol. Quad. Map 21. Name applied to strata lying between Finlay limestone below and Buda limestone above in Sixshooter group (new). Name credited to J. P. Brand and R. K. DeFord (in press). Described in area of this report (Wylie Mountains and vicinity) as hard pale-yellowish-brown fine-micrograined fossiliferous limestone with thin bands of marl. Approximate thickness 180 to 330 feet.

J. P. Brand and R. K. DeFord, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 2, p. 374 (fig. 2), 379-385. Described in Kent quadrangle where it comprises (ascending) Levinson limestone and San Martine members (both new). Middle formation in Sixshooter group. Overlies Finlay limestone; underlies Buda limestone. Deviation of name.

Name derived from Boracho Station on Texas and Pacific Railroad about 10½ miles west of Kent, Culberson County.

Boracho Sandstone

Cretaceous (Comanche Series): Western Texas.

W. E. Tipton, 1951, *in* West Texas Geol. Soc. Guidebook Fall Field Trip, Oct. 26–27, p. 29 (geol. map) Named on map legend.

Culberson County.

Borden Group[1] or Formation

Lower and Upper Mississippian: Indiana and Kentucky.

Original reference: E. R. Cumings, 1922, Handb. Indiana Geology, pt. 4, p. 408, 470 (footnote), 487–490, 492, 531, chart.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 1–248. In Kentucky, comprises (ascending) New Providence formation, Brodhead formation (embracing Locust Point and Carwood divisions of Indiana classification), Floyds Knob formation, and Muldraugh formation (embracing Lower Harrodsburg division and Edwardsville division of Indiana classification). Underlies Harrodsburg (restricted) of Warsaw age, Salem formation, St. Louis limestone, or Ste. Genevieve limestone; overlies Rockford limestone (in Indiana), New Albany shale, Bedford, or Sunbury shale. Age given as Osage. Report deals specifically with 225-mile belt in Kentucky, immediately bordering Lexington Plain and also discusses Lower Mississippian as a whole in east-central interior.

D. J. McGregor, 1958, Indiana Geol. Survey Bull. 15, p. 40 (table 7), 44. In southern Indiana, group comprises five formations (ascending): New Providence shale, Locust Point, Carwood, Floyds Knob, and Edwardsville. Group undifferentiated in northern Indiana. Overlies Rockford limestone: underlies Harrodsburg limestone. Osage series.

Well exposed near village of Borden, Clark County, Ind.

Borden Sandstone (in Monongahela Formation)[1]

Pennsylvanian: Western Maryland.

Original reference: C. K. Swartz, 1922, Maryland Geol. Survey, v. 11, pl. 7.

Lies a short distance above Borden coal in Georges Creek basin.

†Border Conglomerate (in Newark Group)[1]

Upper Triassic: Eastern Virginia.

Original reference: J. K. Roberts, 1923, Pan-Am. Geologist, v. 39, p. 185–200.

Extends in a broken manner from Potomac River at Point of Rocks to Carolina line.

Boring Agglomerate

Pliocene, upper, or Pleistocene, lower: Northwestern Oregon.

R. C. Treasher, 1942, Oregon Dept. Geology and Mineral Industries G. M. I. Short Paper 7, p. 10, geol. map. Structureless mass with tuffaceous matrix containing cobbles and fragments of lava and pieces of wood that are so unaltered that they may be burned.

R. C. Treasher, 1942, Geologic map of the Portland area, Oregon (1:96,000): Oregon Dept. Geology and Mineral Resources. Thickness as much as 100 feet. Lies immediately above Troutdale formation on ridges and hillslopes except where it is intracanyon; lies immediately below Boring lava and represents an opening phase of Boring lava volcanism.

Occurs in Portland area.

Boring Lava

Pliocene, upper, to Pleistocene, lower(?): Northwestern Oregon.

R. C. Treasher, 1942, Oregon Dept. Geology and Mineral Industries G. M. I. Short Paper 7, p. 10, geol. map. Name applied to series of lava flows that spread from number of vents over long period of time.

R. C. Treasher, 1942, Geologic map of the Portland area, Oregon (1:96,000): Oregon Dept. Geology and Mineral Resources. Described as gray basalts containing abundant olivine phenocrysts. Thickness as much as 100 feet. Overlies Troutdale formation and Boring agglomerate; older than terrace gravels and glacial outwash.

W. D. Lowry and E. M. Baldwin, 1952, Geol. Soc. America Bull., v. 63, no. 1, p. 10, 12, pl. 2. Interbedded with Troutdale formation; at its type locality, lava underlies Portland Hills silt member of Troutdale; at Crown Point, a 30-foot flow of Boring lava is referred to as Crown Point member of the Troutdale; in southern part of area, the lava overlies Molalla formation. Age restricted to upper Pliocene.

D. E. Trimble, 1957, U.S. Geol. Survey Geol. Quad. Map GQ-104. Described in Portland quadrangle. Younger than lower Pliocene Troutdale formation; in Sandy River area overlain by deposits thought to be early or middle Pleistocene. Lavas therefore may be wholly Pliocene in age or they may be in part early Pleistocene.

Named for occurrence on Boring Hills southeast of Portland. Caps Troutdale Hills, east of Willamette River; caps Portland Hills and covers Oswego Lake depression; also intracanyon in three canyons in Portland Hills.

Borrego Formation

Pliocene, upper, or (?)Pleistocene, lower: Southern California.

L. A. Tarbet and W. H. Holman, 1944, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 28, no. 12, p. 1782. Nonmarine mudstone, siltstone, sandstones, and conglomerates probably unconformably overlying all older rocks. Thickness as much as 7,600 feet.

J. W. Durham, 1950, Geol. Soc. America Mem. 43, table facing p. 20. Upper Pliocene.

L. A. Tarbet, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 2, p. 261 (fig. 40), 262. Lower Pleistocene(?). Thickness 8,600 feet. Shown on columnar section as overlying Palm Spring formation and underlying alluvium lake deposits.

T. W. Dibblee, Jr., 1954, California Div. Mines Bull. 170, chap. 2, p. 23 (fig. 2), 24, pl. 2. Mapped as lacustrine facies of Palm Spring formation. In type section, Borrego lake beds grade downward into terrestrial beds of Palm Spring facies and are overlain by Ocotillo conglomerate (new). Formation reaches maximum thickness of 6,000 feet in Borrego Badlands, and thins eastward to 2,000 feet.

Type section: Borrego Badlands, Imperial Valley.

Boscabel Boulder Beds[1]

Upper Triassic: Eastern Virginia.

Original reference: N. S. Shaler and J. B. Woodworth, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 2, p. 424–425.

Well exposed at Boscabel Ferry, Richmond Basin.

Boskydell Sandstone (in Tradewater Group)

Boskydell marine horizon (in Pottsville Formation)

Pennsylvanian: Southwestern Illinois.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 34, 76. Boskydell marine horizon—a calcareous marine sandstone in upper Pottsville, between Finnie sandstone above and Willis coal.

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. 17 (fig. 3), 20. Listed as sandstone in Tradewater group.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 31. Name dropped from formal usage.

Exposed 1 mile southwest of Boskydell, Jackson County.

†Bosque division[1]

Lower Cretaceous (Comanche Series): Oklahoma and Texas.

Original reference: J. A. Taff, 1892, Texas Geol. Survey 3d Ann. Rept., p. 272–273, 281–325.

Named for Bosque River.

Bossardville Limestone (in Cayuga Group)[1]

Silurian: Northeastern Pennsylvania and northern New Jersey.

Original reference: I. C. White, 1882, Pennsylvania 2d Geol. Survey Rept. G_6, p. 77, 141–145.

C. K. Swartz, 1941, Geol. Soc. America Bull., v. 52, no. 8, p. 1183, measured sections. Keyser limestone and its correlates are underlain in area [southeastern Pennsylvania] in descending order by Bossardville limestone, Poxono Island shale, and Bloomsburg red beds. Where typically developed in vicinity of Delaware Water Gap, the Bossardville consists of three parts. Major (central) beds are blue-black dense limestone. Underlying these beds, at many places, are thin-bedded gray finely straticulate and somewhat shaly limestones. Overlying central beds, locally, is a few feet of thick-bedded impure limestone, weathering yellowish. White (1882) describes green shales, the Deckers Ferry "shale" which present writers have not seen, as lying at top of formation. Poxono Island shale and Bossardville limestone are similar to, and homotaxial with, Wills Creek shale and Tonoloway limestone, respectively, of central Pennsylvania and Maryland but lie in a different province; the corresponding formations differ in their time limits; both are believed to be later than Wills Creek shale.

H. P. Woodward, 1941, West Virginia Geol. Survey, v. 14, p. 253. Bossardville limestone of previous West Virginia reports is replaced by Tonoloway limestone.

Named for Bossardville, Monroe County, Pa.

Bossier Formation (in Cotton Valley Group)

Upper Jurassic: Subsurface in western Louisiana, southern Arkansas, and eastern Texas.

F. M. Swain. 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 5, p. 582–594. Includes the marine dark-gray to black shale and sandstone and shoreward equivalents of these rocks beneath Schuler formation and above Buckner formation or its basinward equivalent. In type well, occurs between depths of 6,515 and 8,140 feet. Thickness varies from knife edge where it is overlapped by Schuler formation to almost 2,000 feet on flank of North Lisbon field in east-central Claiborne Parish, La. Relationship to underlying Buckner formation not clear; in some areas the Bossier rests directly on Smackover limestone.

Type well: Phillips Petroleum Co. Kendrick No. 1, C., NE¼SW¼ sec. 22, T. 19 N., R. 11 W., Bossier Parish, La., Bellevue Field Deep Test.

†Boston Conglomerate[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: A. R. Marvine, 1873, Michigan Geol. Survey, v. 1, pt. 2, p. 53–57, 61, 81, 84, 86, chart.

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

Boston Glacial Substage

Pleistocene (Wisconsin): Northeastern Massachusetts.

S. S. Judson, Jr., 1949, Peabody Foundation for Archeology Papers, v. 4, no. 1, p. 12–23. Name proposed for substage which includes genetically related deposits of till, clay, sand, and gravel. Older than Lexington glacial substage (new). Relation to glacial sequences in other areas of North America unknown.

Named for good exposures in Boston area. No type locality designated because of temporary nature of artificial exposures.

†Boston Group[1]

Mississippian and Pennsylvanian: Northwestern Arkansas and northeastern Oklahoma.

Original reference: J. C. Branner, 1891, Arkansas Geol. Survey Ann. Rept. 1888, v. 4, p. xii.

Named for Boston Mountains, Washington County, Ark.

Boston Basin Series[1]

Devonian or Carboniferous: Eastern Massachusetts.

Original reference: W. E. Hobbs, 1899, Am. Geologist, v. 23, p. 109–113.

East of west rim of Boston Basin.

Boston Bay Group[1]

Devonian or Carboniferous: Eastern Massachusetts.

Original reference: W. E. Hobbs, 1899, Am. Geol., v. 23, p. 109–113.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6, column 5a. Age shown as Pennsylvanian but is uncertain; may include Devonian, Mississippian, and Permian.

Occurs in Boston Basin which borders Boston Bay.

Boston Neck Granite[1]

Upper Carboniferous or post-Carboniferous: Southern Rhode Island.

Original reference: F. H. Lahee, 1912, Am. Jour. Sci., 4th, v. 33, p. 365, 449, 454–469.

Occurs at various places along west coast of Narragansett Bay from Watson's pier southward, and inland on Little Neck, Boston Neck, and Tower Hill.

Bostwick Conglomerate or Beds (in Lake Murray Formation)

Bostwick Limestone (in Dornick Hills Group)

Bostwick Member (of Dornick Hills Formation)[1]

Pennsylvanian: Central southern Oklahoma.

Original reference: C. W. Tomlinson, 1928, Oklahoma Geol. Survey Bull. 40Z, p. 14.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 37). Shown on correlation chart as Bostwick limestone in Dornick Hills group. Lampasas 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. 140, 141 (fig. 3) Rank reduced to member status in Lake Murray formation (new). Underlies Griffin sandstone member (new).

Lynn Jacobsen, 1959, Oklahoma Geol. Survey Bull. 79, p. 32–33. Bostwick conglomerate at base of Lake Murray formation is most prominent exposed unit in Ardmore basin. Consists of limestone and chert conglomerate, sandstone, limestone, and shale. Maximum thickness 500 feet.

Type locality: On Bostwick dairy farm, in W½NE¼ sec. 11, T. 5 S., R. 1 E., Carter County.

Botetourt Formation

Botetourt Limestone Member (of Edinburg Formation)

Middle Ordovician: Western Virginia and eastern Tennessee.

B. N. Cooper and G. A. Cooper, 1946, Geol. Soc. America Bull., v. 57, no. 1, p. 80, 103, 106. Botetourt limestone member proposed for brown-weathering granular limestone above Lincolnshire formation and below beds of Liberty Hall type. Thickness 15 to 75 feet (type section).

G. A. Cooper, 1956 Smithsonian Misc. Colln., v. 127, pt. 1, p. 49–50. Rank raised to formation. In Catawba Valley northeast of Blacksburg, underlies or interfingers with calcarenites of Effna formation. At Edinburg dam section about 1 mile below Edinburg and at Tumbling Run 1½ miles southwest of Strasburg, Va., dark thin-bedded limestone occurs between granular beds thought to be Botetourt and the cherty Lincolnshire; these beds are here placed in Botetourt formation. Can be recognized in parts of Tennessee as at type section of the Whitesburg of Ulrich; at this place its overlies the Lenoir and occurs at the base of Ulrich's Whitesburg formation.

Type section: In Botetourt County, Va., on deeply gullied hillsides about 0.25 miles south of Dunkard Church and 6.0 miles S. 80° W. of Natural Bridge.

Botijas Limestone Member (of Coamo 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. 149–150. Rudistid-bearing limestone that occurs locally in lower red part of formation in north-central Puerto Rico. Name credited to Briggs and Gelabert (in preparation).

North-central part of island.

Bouchard Formation (in Missoula Group)

Precambrian (Belt Series): Northwestern Montana.

A. B. Campbell, 1960, U.S. Geol. Survey Bull. 1082-I, p. 567–568, pl. 28. Olive-gray, olive-brown thin- to medium-bedded sericitic quartzite and interbedded dark-olive-gray to olive-black argillite more abundant near bottom and top of section. A few beds of vitreous white quartzite and dark-gray fissile shale. Weathers rusty brown to olive drab. Thickness about 4,000 feet. Conformably overlies Sloway formation (new); unconformably underlies vitreous quartzite of Middle Cambrian age.

Type section: In secs. 24 and 25, T. 16 N., R. 26 W. Named for exposures near Bouchard Lake in sec. 23, T. 17 N., R. 27 W., St. Regis-Superior area, Mineral County.

Boucher Formation

Middle Cambrian: Northwestern Vermont.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, pl. 1. Name used only on correlation chart. Underlies St. Albans shale; overlies Parker slate. Name credited to Shaw (unpub. thesis).

Boucher 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, 101–102. Composed of thin beds of rusty-brown dolomite. On fresh surface, dolomite appears steely gray and typically even grained, with crystals averaging 0.25 or 0.30 mm. In places, grades into brownish siltstone. Younger than Parashant tongue (new).

Extends southeastward from vicinity of Garnet Canyon at least as far as Cottonwood Canyon, a distance of 25 miles. Grand Canyon area.

Boulder Creek Granite or **Granodiorite**

Boulder Creek Granite (in Pikes Peak Group)

Boulder Creek Granite Gneiss[1]

Precambrian: Central northern Colorado.

Original reference: M. F. Boos and C. M. Boos, 1934, Geol. Soc. America Bull., v. 45, no. 2, p. 305–306.

J. M. Bray, 1942, Geol. Soc. America Bull., v. 53, no. 5, p. 768 (fig. 1), 769–770. In this report, Pikes Peak group includes (ascending) Boulder

Creek granite and Overland Mountain granite (new). Younger than Swandyke hornblende gneiss.

T. S. Lovering and E. N. Goddard, 1950, U.S. Geol. Survey Prof. Paper 223, p. 25–27, pl. 1. Commonly dark-gray faintly banded rock that ranges from quartz monzonite to sodic granite. Chiefly coarse-grained primary gneiss, which is locally porphyritic. Near centers of large masses, gneissic structure is not prominent, and rarely color changes to pinkish gray or pink becoming indistinguishable from facies of Pikes Peak granite.

Crops out widely on Boulder Creek, on east flank of Front Range, west and southwest of Boulder, Boulder County.

†Boulder Pass Formation[1]

Precambrian (Belt Series): Northwestern Montana, and southwestern Alberta, Canada.

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. 1900. Term Missoula antedates and reduces to synonymy the Boulder Pass formation.

Section made up from near Boulder Pass, south of Ahern Pass, Glacier National Park, Mont., and in Waterton Lakes National Park, Alberta.

Boulder River Sandstone Member (of Colorado Shale)

Lower Cretaceous: Southwestern Montana.

P. W. Richards, 1957, U.S. Geol. Survey Bull. 1021–L, p. 415–416, pl. 34. Discussion of area east and southeast of Livingston, Mont. Here Colorado shale is divided into 10 units, and these are compared, where possible, with Black Hills and central Montana or Bighorn Basin formations. Unit 7, a thick-bedded or massive sandstone about 100 feet thick, is herein named Boulder River sandstone member. Forms cliffs and ridges between less resistant shale sequence below and thin-bedded sandstone above. On south slope of a hill west of West Boulder River in NE¼ (unsurveyed) sec. 26, T. 3 S., R. 11 E., Park County, member is about 65 feet thick and consists of gray to yellowish-brown mostly fine-grained sandstone. Above it, and below crest of hill, are 145 feet of thin-bedded, in part shaly, sandstone.

Section measured in SE¼ sec. 11, T. 3 S., R. 12 E., in McLeod Basin quadrangle along west side of Boulder River valley. Member forms almost continuous ridge from Boulder River westward to Yellowstone River south of Livingston.

Boulder Wash Group

Precambrian(?) or Tertiary(?): Southeastern Nevada.

C. R. Longwell, 1936, Geol. Soc. America Bull., v. 47, p. 1407–1409. Stratified series, lower part of which is dark-gray compact heavy dolomite that weathers rusty yellow brown, and is interrupted by thin layers of greenish compact shale 3 or 4 feet above base of unit; maximum thickness 200 feet. Above dolomite and separated from it by highly irregular surface of erosion is coarse breccia which fills valleys in the dolomite; thickness several hundred feet and probably exceeds 1,000 feet. Total thickness possibly exceeds 2,000 feet. Unconformably overlies Precambrian schist. Precambrian(?).

F. A. Nickell, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 12, p. 1804 (fig. 2). Breccia, dolomite, andesite, rhyolite, and intrusives. Tertiary(?).

North of Colorado River Canyon and west of Boulder Wash, Clark County.

Bouldin Member (of Lake Waco Formation)

Cretaceous (Gulf Series): Central Texas.

W. S. Adkins and F. E. Lozo *in* F. E. Lozo, 1951, Fondren Sci. Ser., no. 4, p. 120–121, 139 (fig. 17), 141 (fig. 18). Proposed for upper member of formation. Composed of interbedded grayish-white to brownish silty limestone and silty shales with bentonites. Thickness at type locality about 9 feet. Northward from Travis County, a flagstone member near to or identical with stratigraphic position of type Bouldin flags occurs at scattered localities across Williamson, Bell, and McLennan Counties; as exposed in Blue Cut north of Moody, this limestone flag unit is approximately 14 feet thick. Overlies Cloice member (new); underlies emended South Bosque formation.

Type locality and section: Bouldin Creek and diversion cut near the Missouri Pacific-Missouri, Kansas and Texas Railroad, between Milton Street and Barton Springs Road, Austin, Travis County.

Boundary Argillite[1] (in Stevens Series)

Cambrian: Northeastern Washington.

Original reference: C. E. Weaver, 1920, Washington Geol. Survey Bull. 20, p. 81, map.

C. D. Campbell, 1947, Geol. Soc. America Bull., v. 58, no. 7, p. 611. Remapping of northeastern Stevens County and discovery of Cambrian and Ordovician fossils are thought to justify adoption there of formation names established by Park and Cannon (1943) for Metaline quadrangle. Part of Boundary argillite is considered correlative to Metaline limestone, part correlative to Maitlen phyllite, and part correlative with Gypsum quartzite.

Probably named for its occurrence near international boundary, Stevens County.

Boundary Granodiorite[1] (in Coast Range Intrusives)

Jurassic or Cretaceous: Southeastern Alaska.

Original reference: A. F. Buddington, 1929, U.S. Geol. Survey Bull. 807, p. 32–33, 55–59, maps.

F. M. Byers, Jr., and C. L. Sainsbury, 1956, U.S. Geol. Survey Bull. 1024–F, p. 126. Mentioned in report on tungsten deposits of Hyder district. In upper part of Coast Range intrusives.

Named for exposures along both sides and at head of Boundary Glacier from about 1 mile above its foot; Hyder district.

Boundary Shale

Eocene, upper: Western Washington.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 123, 124, 125, 126. Mentioned in discussion of stratigraphy in Lyre River area. In measured stratigraphic section of Crescent, Lyre, and Lincoln formations in canyon of Lyre River, Clallam County, the Lyre formation is said to rest conformably upon Boundary shale, which forms uppermost part of middle Eocene Crescent formation.

W. S. Drugg, 1958, (abs.) Geol. Soc. America Bull., v. 69, no. 12, pt. 2, p. 1682. Boundary shale, in Hoko River area, is in fault contact with Crescent beds. Siltstones of Boundary shale grade upward into Lyre conglomerate.

Derivation of name not stated.

Boundary Peak 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 [Pelliser and Boundary Peak] are probably equivalent in age to the Sierra Batholith—middle or upper Mesozoic. Derivation of name given.

Composes Montgomery Peak and Boundary Peak, at extreme end of Inyo Range.

Bouquet Canon Breccia[1]

Miocene(?) : Southern California

Original reference: A. O. Woodford, 1925, California Univ. Pub., Dept. Geol. Sci. Bull., v. 15, no. 7, p. 212.

Lower Bouquet Canon, 30 miles north of Los Angeles and 5 miles northeast of Saugus.

Bourbon Group or Formation[1]

Pennsylvanian: Eastern Kansas and southeastern Nebraska.

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. 6th Ann. Field Conf., Guidebook, p. 90, 97.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2028. Suppressed in favor of Pleasonton group.

Named for Bourbon County, Kans.

Bourbon series[1]

Middle Ordovician: Kentucky.

Original reference: C. R. Keyes, 1931, Pan-Am. Geologist, v. 55, p. 231.

Named for Bourbon County.

Bow Formation or Group[1]

[Upper Cretaceous] : Southern Wyoming.

Original references: A. C. Veatch, 1907, Jour. Geology, v. 15, p. 548; 1907, Am. Jour. Sci., 4th, v. 24, p. 18–22; C. F. Bowen, 1918, U.S. Geol. Survey Prof. Paper 108, p. 229.

Medicine Bow River.

Bowen 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. 840–841, 876–877, 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 Bowen formation is applied to zones 20 and 21; lower zone is brown-weathering calcareous sandstone and upper is red mudrock tongue; these are 14 feet and 60 feet thick, respectively. The sandstone pinches out 8 miles northeast of Russell-Tazewell County line; beyond this point and northeastward to Burkes Garden, Marys Chapel, and Five Oaks, the Bowen is represented only by tongue of red mudrock. Where both zones of the Bowen occur, there is evidence of disconformity between sandstones of Bowen and underlying buff shales of Wardell formation (new); in middle part of Tazewell County, the hiatus between the buff shales and overlying red mudrocks is indicated by absence of zone of brown mudstone; east of meridian of Tazewell, the hiatus includes part of red mudrock which pinches out entirely a few miles northeast; contact with overlying limestones of Witten limestone (new) are conformable. Throughout its extent in Virginia, southwest of Bluefield, beds herein named Bowen formation have been classified by Butts as lower part of the Lowville-Moccasin.

C. E. Prouty, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 7, p. 1171–1172. Southwest from Tazewell, Va., the Bowen is traced in both Copper Creek and St. Paul belts into Tennessee. Sandstone, ordinarily less than 15 feet thick in Virginia, thickens gradually into Tennessee. Mudrock phase varies from about 40 to 100 feet in thickness, locally attains thickness of about 175 feet at Thorn Hill. At Heiskell, Tenn., both sandstone and claystone phases are present between underlying Wardell and overlying Witten limestone. In Knoxville belt, allochthonous to Saltville thrust, the Bowen is present in several places between Knoxville and Lenoir City, and thickness may be as much as 200 feet in places. The sandstone occurs at top of the Sevier and is separated from maroon Moccasin claystone by a few feet of limestone probably of Witten age.

Type section: Along State Highway 91, one-half mile south of intersection with County Road 604, Tazewell County, Va. Name derived from Bowen Cove at northwest base of Short Mountain and along County Road 609, west of Maiden Spring.

Bowes Member (of Piper Formation)

Middle Jurassic: Central and eastern Montana (subsurface and surface).

J. W. Nordquist, 1955, Billings Geol. Soc. Guidebook 6th Ann. Field Conf., p. 97, 102–103. Displays varying lithologies, being represented in Williston basin by red to varicolored shale facies which grade westward into sandstone and sandy oolitic limestone on east flank of Sweetgrass arch. In type section, consists of (descending) 18 feet of light-brown finely crystalline to fragmental limestone, very sandy to argillaceous in part with few thin stringers of light-gray calcareous sandstone; 7 feet of light-gray fine- to coarse-grained very calcareous sandstone; 20 feet of light-gray oolitic to sandy limestone with thin beds of calcareous sandstone; and 12 feet of light-brown fine-grained calcareous sandstone grading downward into light-gray sandy and partly oolitic limestone. Becomes increasingly sandy and somewhat variable in thickness west of type well; eastward becomes interbedded with shale and eventually grades into varicolored shale, thickness uniform. Conformably overlies Firemoon limestone member (new) in Williston basin and most of north-central Montana; southward it overlaps Firemoon member and unconformably overlies Madison limestone. Underlies Rierdon formation.

Type section: The interval 3,360 to 3,417 feet in Northern Ordnance No. 1 Guertzgen well, SW¼NW¼NE¼ sec. 2, T. 31 N., R. 19 E., Blaine County, Montana.

Bowhan Sandstone Member (of Vamoosa Formation)

Bowhan Sandstone Member (of Nelagoney Formation)[1]

Pennsylvanian (Virgil Series) : Northeastern Oklahoma and southeastern Kansas.

Original reference: M. I. Goldman and H. M. Robinson, 1920, U.S. Geol. Survey Bull. 686–Y, p. 361–362, pl. 51.

W. F. Tanner, 1956, Oklahoma Geol. Survey Circ. 40, p. 12 (fig. 1), 48, pl. 1. Reallocated to Vamoosa formation. Occurs 110 to 140 feet above Cheshewalla sandstone member. Together with overlying Jonesburg sandstone member, the Bowhan extends northward across State line into Kansas.

Named for exposures at Bowhan Point, sec. 16, T. 28 N., R. 11 E., Osage County, Okla.

Bowie 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), 322.

E. C. Dapples, 1939, Econ. Geology, v. 34, no. 4, p. 371. Strata near village of Baldwin previously identified as Bowie herein named Baldwin sandstone member of Mesaverde formation.

J. D. Fisher, C. E. Erdmann, and J. B. Reeside, Jr., 1960, U.S. Geol. Survey Prof. Paper 332, p. 19. Resting on Rollins sandstone member of Mesaverde of Lee (1912, U.S. Geol. Survey Bull. 510) in Grand Mesa field lie (ascending) Bowie shale member, Paonia shale member, and undifferentiated upper Mesaverde. Lee distinguished Bowie shale as of marine and brackish-water origin and the Paonia as fresh-water origin. Paonia member rests, according to Lee, on Rollins sandstone member in western part of Grand Mesa area, but toward the east, Bowie member appears and gradually thickens eastward. According to Boyer (written commun.) Lee misidentified his units in western part of Grand Mesa area. Upper member of Sego sandstone of present report was mistaken for the Rollins, and strata between upper Sego and Rollins were referred to Bowie shale member.

Typically exposed at Bowie, Delta County.

Bowknot Bed (in Church Rock Member of Chinle Formation)

Upper Triassic: Southeastern Utah.

J. H. Stewart, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 3, p. 447 (fig. 3), 459; J. H. Stewart and others, 1959, U.S. Geol. Survey Bull. 1046–Q, p. 503 (fig. 73), 518, 519, 520 (fig. 79). Prominent sandstone unit in middle part of Church Rock member.

Present near junction of Green and Colorado Rivers.

Bowler Formation[1]

Permian and Triassic: Central southern Montana.

Original reference: J. P. Rowe, 1906, Montana Univ. Bull. 37, geol. ser. No. 2, p. 81.

Type locality not stated, but judging from list of occurrences on page 16 it is town of Bowler, Carbon County.

Bowling Green Limestone Member (of Edgewood Limestone)[1]

Lower Silurian: Northeastern Missouri and southwestern Illinois.

Original reference: C. R. Keyes, 1898, Iowa Acad. Sci. Proc., v. 5, p. 59, 62.

T. J. Laswell, 1957, Missouri Geol. Survey and Water Resources Rept. Inv. 22, p. 16, 19, 20, 21. In Bowling Green quadrangle, typically a brown to dusky-yellow dolomite or dolomitic limestone that is normally gray-blue-green on fresh exposure. Thickness 2 to 40 feet. Underlies Cyrene member; overlies Maquoketa formation; in some areas relationship is uncomformable.

M. G. Mehl, 1960, Denison Univ. Jour. Sci. Lab., v. 45, art. 5, p. 99. In some areas, underlies Cuivre shale (new).

Named for exposures near Bowling Green, Pike County, Mo.

Bowman Limestone[1]

Middle Cambrian: Central northern Utah.

Original reference: J. Gilluly, 1932, U.S. Survey Prof. Paper 173.

J. K. Rigby, 1958, Utah Geol. Soc. Guidebook 13, p. 20. Term Bowman extended into Stansbury Range where it is used to include a series of olive-drab shale and interbedded limestone between Herkimer formation below and Bluebird formation above. Thickness approximately 435 feet; apparently wedges out completely to south. Well exposed in headwaters of Timpie Valley and southward into Muskrat Canyon.

Named for exposures in Bowman Gulch northwest of Ophir, Oquirrh region, Tooele County.

Bowmanstown Chert (in Onondaga Group)

Bowmanstown Chert Member (of Onondaga Formation)

Lower or Middle Devonian: Eastern Pennsylvania.

F. M. Swartz, 1939, *in* Bradford Willard, F. M. Swartz, and A. B. Cleaves, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 52, fig. 17. Chert about 60 feet thick; underlies Palmerton sandstone; overlies Oriskany conglomerate. Onondaga group. Middle Devonian.

C. K. Swartz and F. M. Swartz, 1941, Geol. Soc. America Bull., v. 52, no. 7, p. 1145–1146, 1147, 1150, 1151, 1153, 1157. Detailed descriptions of several sections given. Thickness varies from 13 to 111 feet.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Correlation chart gives age 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 Bowmanstown chert member in Lehigh Gap area.

Type locality not stated, but unit described near Bowmanstown, Carbon County.

Bowmanville Interglacial Substage

Pleistocene (Wisconsin): North-central United States.

M. M. Leighton, 1960, Jour. Geology, v. 68, no. 5, p. 529, 549, 550. Name introduced for the Cary-Mankato intraglacial substage. Name was used by Baker (1920, Illinois Univ. Bull., v. 17, no. 41) for low-water stage of Lake Chicago which occurred when Cary glacier receded to north and cleared the Straits of Mackinac. Presentation of classification of Wisconsin glacial stage. Report also gives consideration to other classifications, including one proposed by Frye and Willman (1960, Illinois Geol. Survey Circ. 285).

Bowring Limestone Member (of Vamoosa Formation)

Pennsylvanian (Virgil Series): Northeastern Oklahoma.

W. F. Tanner, 1956, Oklahoma Geol. Survey Circ. 40, p. 43–44, pl. 1. Name applied to limestone unit occurring above Cheshewalla sandstone member in Lake Hulah area. Thickness 1 to 2 feet.

Type section: In NE¼ sec. 10, T. 28 N., R. 11 E., Osage County. Named for village of Bowring.

Bowser Formation (in Tuxedni Group)

Bowser Member (of Tuxedni Formation)

Middle(?) and 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]. Consists of thick-bedded to massive sandstone and conglomerate units 100 to 300 feet thick, interbedded with siltstone units 100 to 600 feet thick. Cliff-forming sandstone unit, 500 to 800 feet thick, forms top of member. Siltstone is dark gray, or light gray where calcareous, and weathers light brown. Sandstone partly light gray, partly very dark gray to black. Thickness of member about 2,600 feet. Underlies Tonnie siltstone member; overlies Cynthia Falls sandstone member.

U.S. Geological Survey currently classifies the Bowser as a formation in Tuxedni Group and designates its age as Middle(?) and Upper Jurassic on the basis of a study now in progress.

Crops out over large area of Iniskin Peninsula and is well exposed in valley of Bowser Creek.

Box Member (of Percha Shale)

Upper Devonian or Lower Mississippian: Southwestern 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. 95. Commonly composed of gray to green calcareous shales with intercalated lenses and nodules of limestone. Upper part of Percha shale. Overlies Ready Pay member (new) with gradational contact.

F. V. Stevenson, 1945, Jour Geology, v. 53, no. 4, p. 241, 243, figs. 2, 13. Upper Devonian age. Becomes progressively more calcareous to the west of Hillsboro; on Bear Mountain, northwest of Silver City, interbedded in shale are many massive beds of limestone, one attaining maximum of 16 feet. Total thickness 46½ feet. Unconformably underlies Lake Valley limestone. Derivation of name given.

M. A. Stainbrook, 1947. Jour. Paleontology, v. 21, no. 4, p. 298. Upper, lighter shales of Percha termed Bella by Keyes (1908). There is little doubt that Bella and Box were proposed for identical division of Percha, and there is little reason to replace earlier name. Percha of early Mississippian age.

L. R. Laudon and A. L. Bowsher, 1949, Geol. Soc. America Bull., v. 60, no. 1, p. 59 (fig. 28), 79 (fig. 39). Underlies Caballero formation and Andrecito member (new) of Lake Valley formation in parts of southwestern New Mexico.

Named for "The Box," the narrow canyon in Mimbres Mountains through which Percha Creek flows eastward into Rio Grande.

Box Butte Member (of Sheep Creek Formation)

Miocene: Northwestern Nebraska.

R. C. Cady, 1940, Am. Jour. Sci., v. 238, no. 9, p. 663–667. Proposed for member in uppermost part of formation. At type section, consists of three parts: lower, 30 to 40 feet, red and green clay with white concretions, limy sandy silt containing thin beds of brown blocky sandstone, and lumpy brown sandstone that weathers into a honeycomb ledge;

middle, 25 feet, lumpy and blocky brown sandstone in beds less than 2 feet thick containing two honeycomb limy ledges; and upper, 40 feet, partly covered, predominantly green clay with limy white concretions. Exposures showing middle sandstone zone are limited to northern part of Box Butte County, where Niobrara Valley cuts it; elsewhere member consists wholly of clay. Sheep Creek formation, exclusive of Box Butte member, fills narrow channels in top of Marsland formation. Top of Marsland is a white limy slabby caprock as much as 5 feet thick; in most exposures the Box Butte rests upon this cap rock. Sheep Creek channel was filled with brick-red silt and sand; at top of channel fill, the silt was cemented with lime; red clay of lower zone of Box Butte member rests upon this cemented zone. Unit occupies position in geologic column of area between earliest recognized Pliocene (Ogallala) beds and latest known Miocene (Sheep Creek) beds.

M. K. Elias, 1942, Geol. Soc. America Spec. Paper 41, p. 131–132. Uppermost member of formation. No direct contact between the Box Butte and the Sand Canyon member (new) was observed. Topographically higher outcrops of Box Butte clays north of outcrops of Sand Canyon member at its type locality are considered as indicating higher stratigraphic position of the former.

Type section: In sec. 27, T. 28 N., R. 49 W., Box Butte County.

Box Canyon Member (of Mutual Quartzite)

Precambrian: Northeastern Utah.

N. C. Williams, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 12, p. 2737 (fig. 2), 2738. Sequence of buff quartzitic sandstones and brown micaceous shales at top of Mutual quartzite. Intertongues in places with purple beds. Thickness 820 feet at Box Canyon. Underlies Red Pine shale (new).

Top of member exposed precisely at mouth of Box Canyon, a tributary to Red Pine Creek near forks in Smith and Morehouse Canyon of western Uinta Mountains. Member exposed upstream from mouth of Box Canyon.

Box Canyon Rhyolite Tuff

Tertiary: Southwestern New Mexico.

W. E. Elston, 1957, New Mexico Bur. Mines Mineral Resources Bull. 38, p. 17 (table 1), 29–30, pl. 1. Described as a typical ignimbrite or welded tuff. Structure is massive; color is cream, gray, or pink. Throughout its occurrence, it forms a plate 40 to 75 feet thick. Lies conformably on Mimbres Peak rhyolite, except in its northernmost exposures, where it lies on Kneeling Nun rhyolite.

Found only in upper 4 miles of Box Canyon, Dwyer quadrangle. Largest outcrop is on southeast slope of Mimbres Peak, where its thickness is about 75 feet.

Box Elder Limestone[1]

Lower Ordovician: Northeastern Utah.

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

Northern Wasatch Mountains.

Box Springs Complex

Precambrian(?): Southern California.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 477. Metadiorite-granite complex. The complex dips 50° to 70° into the mountainside so that the exposed thickness is at least 1,500 feet. In northern part of mountains, a granite stock, nearly 2 miles across, cuts the complex, and Perris quartz diorite cuts it on southwest. Tentatively regarded as early Precambrian, but may be much younger.

Well exposed in Perris block in steep southwestern face of Box Springs Mountains, east of Riverside, Riverside County.

Boyer glaciation

Boyer till[1]

Pleistocene: Iowa.

Original reference: C. R. Keyes, 1931, Pan-Am. Geologist, v. 55, p. 284.

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

Boyle Limestone[1]

Middle Devonian: Central Kentucky.

Original reference: A. F. Foerste, 1906, Kentucky Geol. Survey Bull. 7, p. 10, 92.

A. C. McFarlan and W. H. White, 1952, Kentucky Geol. Survey, ser. 9, Bull. 10, p. 5–16. Discussion of Doyle-Duffin-Ohio shale relationships. In Kentucky outcrop overlap is by Jeffersonville limestone in west and Boyle limestone in south and east. Locally rests on Waynesville or Estill.

Named for Boyle County.

Boyles Sandstone Member (of Pottsville Formation)[1]

Pennsylvanian: Northern central Alabama.

Original reference: Charles Butts, 1910, U.S. Geol. Survey Geol. Atlas, Folio 175.

T. N. McVay and L. D. Toulmin, 1945, Alabama Geol. Survey Bull. 55, p. 27. In Warrier field, the thick basal sand of the Pottsville is called Boyles sandstone member.

Named for exposure at Boyles Gap, north of Birmingham, Jefferson County.

Boylston Schist[1]

Carboniferous: Massachusetts.

Original reference: B. K. Emerson, 1917, U.S. Geol. Survey Bull. 597, p. 61, 67–68, map.

Eastern part of Worcester County.

Boysen Formation

Upper Cambrian: North-central and northwestern Wyoming.

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1092–1096, 1101 (fig. 3), 1104. Replaces name Gallatin formation. Consists of Upper Cambrian rocks in Wind River Canyon which lie between the Depass (Middle Cambrian) and Big Horn (Ordovician) formations. Rocks are massive limestones, intraformational conglomerates, and shales in basal 182 feet (Maurice member); shales, thin limestones, and thick-bedded intraformational conglomerates in overlying 308 feet (Snowy Range member); maroon and buff dolomitic shales, mudstones, and edgewise conglomerates in upper 40 feet (Grove Creek member).

Helen Foster, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 9, p. 1539 (strat. column), 1541, 1543, 1544, 1546 (fig. 2), 1547. Described in Teton County where it is 102 to 181 feet thick; overlies Gros Ventre formation and underlies Bighorn dolomite. Not subdivided in this area.

Type locality: East of Smith's cabin, approximately 2 miles north of Boysen Dam, Fremont County, Wyo.

Bozeman Lake Beds[1]

Oligocene, lower, to Pleistocene: Central southern and southwestern Montana.

Original reference: A. C. Peale, 1893, U.S. Geol. Survey Bull. 110, pl. 1.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 15. Loose term for entire middle and late Cenozoic section northwest of Yellowstone Park in Gallatin and Broadwater Counties, Mont., including beds ranging in age from early Chadronian to Pleistocene and devoid of lacustrine deposits (except the *Leuciscus turneri* lake beds).

Named for exposures in vicinity of Bozeman, Gallatin County.

Brackett Member (of Stowe Formation)

Lower Cambrian(?): West-central Vermont.

P. H. Osberg, 1952, Vermont Geol. Survey Bull. 5, p. 66, pl. 1. Dark-green albite-epidote-calcite-chlorite schist.

Named for exposures in Brackett Brook. Occurs along eastern border of Rochester-East Middlebury area.

Bracks Rhyolite (in Vieja Group)

Tertiary: Southwestern Texas.

R. K. DeFord, 1958, Texas Jour. Sci., v. 10, no. 1, p. 13, 15 (fig. 3), 25–26. Name proposed for rhyolite overlying Chambers tuff (new). Rhyolite is characteristically light olive gray to greenish black; locally dark reddish brown. Maximum thickness about 300 feet (in vicinity of San Carlos); lenses out on the northwest, north, and south; eastward, dips underground. Underlies Capote Mountain tuff (new).

Type locality: Vicinity of San Carlos, on Vieja Rim east of basin, Presidio County. Name derived from Bracks Canyon which cuts through rhyolite outcrop just west of San Carlos.

Brad Formation (in Canyon Group)[1]

Brad Group

Upper Pennsylvanian: Central and central northern Texas.

Original reference: F. B. Plummer and R. C. Moore, 1922, Jour. Geology, v. 30, p. 24–31, 35.

C. O. Nickell, 1938, Texas Univ. Bur. Econ. Geology Pub. 3801, p. 108–115. As redefined herein, formation consists only of shale member at base and overlying Ranger limestone member (Drake's Home Creek of the type locality). 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) are included in typical Graford formation of Brazos River basin. Beds included in "shale member" represent upper part of Placid shale of Plummer and Moore, some sandstone, and the Cherty limestone of Drake. Underlies Caddo Creek formation.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 88 Rank raised to group. Includes Ranger limestone and Placid shale. Underlies Caddo Creek group; overlies Graford group.

D. H. Eargle, 1958, San Angelo Geol. Soc. Guidebook, Apr. 17–19, p. 51. Shown on composite section of Brown and Coleman Counties as Brad formation in Canyon group. Thickness about 125 feet. Includes Ranger limestone and Placid shale members. Underlies Caddo Creek formation; overlies Winchell limestone.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 66–67, pl. 27. In Brown and Coleman Counties, comprises (ascending) Placid shale member and Ranger limestone member. Overlies Winchell limestone; underlies Caddo Creek formation. Thickness about 130 feet in southwestern Brown County; about 105 feet in central Brown County; not completely exposed northeast of Pecan Bayou.

Named for Brad, Palo Pinto County, Brazos River region.

†Braddyville Limestone (in Shawnee Formation)[1]

Pennsylvanian: Southwestern Iowa and northwestern Missouri.

Original reference: G. L. Smith, 1909, Iowa Geol. Survey, v. 19, p. 617, 618, 623, 629, 632.

Named for exposures at Braddyville, Page County, Iowa.

Bradford Group[1]

Devonian: New York.

Original reference: C. Schuchert and C. O. Dunbar, 1933, A textbook of geology, pt. 2, Historical geology: New York, John Wiley and Sons, Inc., p. 199, 203, 204.

†Bradford Schist[1]

Ordovician: Northeastern Vermont.

Original reference: C. H. Richardson, 1898, Am. Assoc. Adv. Sci. Proc., v. 47, p. 295–296.

Named for Bradford, Orange County.

†Bradfordian[1] Series

Upper Devonian: Southwestern New York and northwestern Pennsylvania.

Original reference: G. H. Girty, 1904, Science, new ser., v. 19, p. 24.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 12, pt. 1, chart 4. Bradfordian series (part) shown on correlation chart. Includes Conewango stage. Follows Chautauquan series.

Winifred Goldring, 1943, New York State Mus. Bull. 332, p. 148. Report discusses geology of Coxsackie quadrangle, New York. Above "Portage" (Naples) beds in western New York occur marine Chemung and post-Chemung beds (Chautauquan, Bradfordian) which reach their maximum thickness in Pennsylvania (3,500 feet in central part) and thin greatly westward.

Bradley Granodiorite

Upper Jurassic: Southern California.

W. J. Miller, 1944, California Jour. Mines and Geology, v. 40, no. 1, p. 12, 52–59. Varies in composition from quartz diorite to quartz monzonite; varies in texture and structure from granulated, sheared, and strongly foliated to granitoid and little foliated. Cut by small dikes and sills genetically related to San Jacinto batholith. Cuts Palm Canyon complex (new) usually in form of sills. Probably correlative with Fargo Canyon diorite (new).

Named for exposures in Bradley Canyon, south of Cathedral City, in Palm Springs-Indio area, Riverside County.

†Bradshaw Granite[1]

Precambrian: Central Arizona.

Original reference: T. A. Jagger, Jr., and C. Palache, 1905, U.S. Geol. Survey Geol. Atlas, Folio 126.

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

Named for Bradshaw Mountains in which it is well displayed, Yavapai County.

Bradshaw Limestone (in Bluefield Formation)[1]

Mississippian: Southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 299, 397.

Well exposed in Talcott district, Summers County, in bluff south of Greenbrier River, just west of Stony Creek and 0.3 mile southwest of Bargers Springs. Named for association with Bradshaw sandstone.

Bradshaw Sandstone (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. 299, 394.

Type locality: In vicinity of Indian Mills and along Bradshaw Creek, there being a cliff on the road which ascends the mountain immediately north of Indian Mills and the mouth of Bradshaw Creek, Summers County, W. Va. Also observed in Mercer and Monroe Counties, and in Tazewell County, Va.

Bradshaw 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. 299, 398.

Type locality: On mountain road immediately north of Indian Mills, Summers County, W. Va. Also in Mercer, Monroe Counties, and in Tazewell County, Va.

Bradshaw Mountain Complex

Age not given: Southwestern Utah.

K. C. Condie, 1959, The Compass, v. 36, no. 3, p. 185, 186, 191–192. Composed of tonalite, granodiorite, and adamellite; gneisses and schists are also locally abundant. Large limestone and marble inclusions found within the complex. Basic projection of Mineral Range pluton.

Outcrops in Bradshaw mining district immediately southwest of Pass Canyon; in Mineral Range located in Beaver and Millard Counties.

Brady Soil

Pleistocene (Wisconsin): Central Nebraska.

C. B. Schultz and T. M. Stout, 1948, Geol. Soc. America Bull., v. 59, no. 6, p. 568 (fig. 2), 570. Proposed for the 1.5-foot buried soil at top of Peorian loess and below Bignell loess.

Type locality: Same as for Bignell loess, that is, Bignell Hill section, southeast of North Platte, 1.7 miles south of Bignell, in E½E½ sec. 3, T. 12 N., R. 29 W., Lincoln County.

Bradyan Interglacial Substage or Subage

Pleistocene (Wisconsin): Midcontinent.

A. B. Leonard, 1951, Jour. Geology, v. 59, no. 4, p. 325. Interval during which Brady soil was formed. This was likely a post-Tazewellian-pre-Caryan (or pre-Mankatoan) interval.

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 132–135. Bradyan substage (subage) is interglacial interval of relatively short duration characterized by stable soil-forming conditions. It divides Wisconsinan into two unequal parts.

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. Provincial classification of post-Sangamonian into Scandian, Bradyan, and Almenan subages is proposed for use in Midcontinent.

Brady soil was named from exposures in loess bluffs south of Platte River valley south of Bignell, sec. 3, T. 12 N. R,. 29 W., Lincoln County, Nebr.

Bragdon Formation[1]

Mississippian: Northwestern California.

Original reference: O. H. Hershey, 1901, Am. Geologist, v. 27, p. 236, 238.

A. R. Kinkel, Jr., W. E. Hall, and J. P. Albers, 1956, U.S. Geol. Survey Prof. Paper 285, p. 1, 38–41, pl. 1. Composed of interstratified shale, siltstone, sandstone, grit, conglomerate, a small amount of rhyolite tuff, and a small flow of mafic lava. Beds of shale make up more than 75 percent of formation. Thickness 3,500 feet in mapped area; only lower part of formation present. Overlies Kennett formation, but, where Kennett was either not deposited or was locally eroded, the Bragdon rests upon either Balaklala rhyolite or Copley greenstone.

Named from community of Bragdon on Trinity River 8 miles south of Trinity Center, Weaverville quadrangle. Formation occurs as an arcuate band 17 miles long and as much as 4 miles wide at north end of West Shasta district, Shasta County.

Brainard Member (of Maquoketa Shale)

Brainard Shale (in Maquoketa Group)[1]

Upper Ordovician: Northeastern Iowa, northwestern Illinois, and western Wisconsin.

Original reference: S. Calvin, 1906, Iowa Geol. Survey, v. 16, p. 60, 97.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2 (column 50). Shown on correlation chart as member of Maquoketa formation. Underlies Neda shale member; overlies Fort Atkinson limestone member.

C. E. Brown and J. W. Whitlow, 1960, U.S. Geol. Survey Bull. 1123–A, p. 27–28, pl. 3. Described in Dubuque South quadrangle, Iowa-Illinois, where it is rank reduced to member status in Maquoketa shale. Consists of grayish-green and pale-blue soft dolomitic shale. Thickness as much as 135 feet. Underlies Neda member; overlies brown shaly unit in lower part of the Maquoketa.

Named for exposures near Brainard, Fayette County, Iowa.

Brainerd Quartz Monzonite[1]

Eocene: Central northern Colorado.

Original reference: P. G. Worcester, 1921, Colorado Geol. Survey Bull. 21, p. 32.

North side of valley near mouth of Brainerd Tunnel, on Lefthand Creek about a mile east of Ward and farther north in Tuscarora Gulch, Ward district, Boulder County.

Braintree Argillite

Braintree Slate[1]

Middle Cambrian: Eastern Massachusetts.

Original reference: N. S. Shaler, 1871, Boston Soc. Nat. History Proc., v. 13, p. 173, 175.

N. E. Chute, 1950, Bedrock geology of the Brockton quadrangle, Massachusetts: U.S. Geol. Survey Geol. Quad. Map [GQ–5]. Referred to as argillite.

Named for occurrence in Braintree, Norfolk County.

Brallier Shale (in Susquehanna Group)

Brallier Shale (in Portage Group)[1]

Brallier Member (of Fort Littleton Formation)

Upper Devonian: Central Pennsylvania, Virginia and West Virginia.

Original reference: C. Butts, 1918, Am. Jour. Sci., 4th ser., v. 46, p. 523, 531, 536.

Bradford Willard, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 210, 216–217. Member of Fort Littleton formation. Overlies Harrell member; underlies Losh Run member.

B. N. Cooper, 1939, Virginia Geol. Survey Bull. 55, p. 44–46, pl. 3. Formation described in Draper Mountain area, where it is 1,500 feet thick and consists of olive-drab siliceous shale and even-bedded siltstone and sandstone. Underlies Chemung; overlies Millboro shale (new).

H. P. Woodward, 1943, West Virginia Geol. Survey, v. 15, p. 412–445. Geographically extended into West Virginia where it replaces "Portage shales" or "Portage series" of previous reports. Overlies Harrell shale; underlies Chemung. Thickness as much as 2,900 feet (Randolph County).

R. R. Conlin and others, 1957, Geol. Soc. America Guidebook Atlantic City Mtg., p. 274, 276. Includes Stone Creek member (new).

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

Named for railway station 6 miles northeast of Everett, Bedford County, Pa.

Branch Canyon Formation

Miocene, 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), 2991–2993. On south side of Cuyama Valley and on northeast flank of Caliente Range, Monterey shale grades laterally eastward into marine sandstone which in turn grades eastward into continental Caliente formation; this marine sandstone is herein designated Branch Canyon formation; as transitional facies includes minor fingers of marine shales and continental claystones and sandstones. At type section, comprises units mapped by Eaton and others (1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 2) as (descending) lower "Neroly," "Cierbo," "Briones," "Temblor," and "Vaqueros;" section is 3,000 feet thick. Southeast of type locality, between Branch and Salisbury Canyons, formation is divisible into two units separated by a 750-foot interval of Monterey shale that contains Relizian microfauna; lower unit (mapped as Vaqueros by English, 1916, U.S. Geol. Survey Bull. 621–M) consists of about 1,200 feet of medium- to coarse-grained thick-bedded sandstone containing a *Turritella ocoyana* fauna and lies directly on Cretaceous sandstone; upper unit consists of about 1,400 feet of medium-grained sandstone that conformably underlies basal shale of Santa Margarita formation; on northeast flank of Caliente Range formation consists of about 1,500 feet of sandstone that contains three amygdaloidal basalt flows up to 50 feet thick (triple basalt flows of Eaton) which serve as key beds. Formation at its type locality is Relizian and possibly Luisian (middle Miocene), and upper 100 feet may be as young as upper Miocene (Eaton's lower "Neroly"). Preoccupied term Bitter Creek has been used for unit herein designated as Branch Canyon.

Type section: Near Branch Canyon on south side of Cuyama Valley near south Cuyama oil field, Cuyama Ranch quadrangle.

Branch Pond Gneiss[1] or Formation

Cambrian: Central southern Maine.

Original reference: E. H. Perkins and E. S. C. Smith, 1925, Am. Jour. Sci., 5th, v. 9, p. 204–228.

L. W. Fisher, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 110, 140, table 1. Mentioned in report on Lewiston, Maine, region. Quartz-feldspar-biotite gneiss of Cambrian Pejepscot formation is in part at least equivalent to Branch Pond formation of Perkins.

Named for exposures near Branch Pond in West Palermo, Waldo County.

Branchtown Clay[1]

Pliocene(?): Southeastern Pennsylvania.

Original reference: H. C. Lewis, 1881, Philadelphia Acad. Nat. Sci. Proc., v. 32, p. 258–272, 296–309.

In village of Branchtown [a suburb of Philadelphia].

Brandon Lignite or (residual) Formation[1]

Tertiary, lower: West-central Vermont.

Original reference: Edward Hitchcock, 1861, Rept. Geol. Vermont, v. 1.

Alfred Traverse and E. S. Barghoorn, 1953, Jour. Paleontology, v. 27, no. 2, p. 289–293. Lower Tertiary (probably Oligocene) age assigned to lignite.

Well exposed around town of Brandon, northern Rutland County.

Brandt Sandstone (in Kingsley member of Wellsburg monothem)

Upper Devonian (Chautauquan): Northeastern Pennsylvania.

K. E. Caster, 1938, Jour. Paleontology, v. 12, no. 1, p. 45 (fig. 7), 46–47. Somewhat massive sandstone, which splits along low-angled crossbedding diastems and shale partings into commercial flagstones; marine fauna. Thickness about 30 feet. Occurs in lower part of member above Starrucca sandstone member of Cayuta monothem.

Composite section described is near Lanesboro, Susquehanna County.

Brandy Run Sandstone (in Chester Group)[1]

Mississippian: Southwestern Indiana and northern Kentucky.

Original reference: C. A. Malott, 1919, Indiana Univ. Studies, v. 6, no. 40, p. 7–20.

Well developed in region of Marengo on Brandy Run Creek, Ind.

Brandywine Formation[1] or Gravel

Pliocene(?): Atlantic Coastal Plain from Delaware to Georgia.

Original reference: W. B. Clark, 1915, Am. Jour. Sci., 4th, v. 40, p. 499, 506.

C. W. Cooke, 1952, Maryland Dept. Geology, Mines and Mineral Resources Bull. 10, p. 39–42. Described in Prince Georges County, Md., and District of Columbia. Gravel is predominant component in this area, therefore term gravel is preferred rather than formation; gravel is commonly overlain by silt. Thickness about 40 feet. Main body lies unconformably on Chesapeake group; outliers in District of Columbia overlap the Miocene and lie on Patuxent formation and crystalline rocks. Because Brandywine lies on Chesapeake group, it must be younger than Miocene, unless, possibly it was deposited during concluding part of that epoch. Because it is highest extensive sheet of river gravel in which present Potomac Valley has been cut, it presumably antedates the Pleistocene era; no fossils have been found to verify age assignment; unit is here referred to as Pliocene.

J. T. Hack, 1955, U.S. Geol. Survey Prof. Paper 267–A, p. 10–17, pl. 1. Described in Brandywine area where it forms surface of the uplands and consists of lower gravel member 10 to 50 feet thick and upper loam member that averages 15 feet in thickness. Overlies North Keys sand (new) which had been mapped as part of the Brandywine by some workers and as part of the Sunderland by others. Base of formation is defined by lowest gravel or coarse sand in the section, even though beds of fine sand identical with the North Keys occur in many places interbedded with the gravel; although formation as here defined may contain a disconformity and hiatus above the base, it is believed that this definition is only one practical for areal mapping and conforms closely to original definition. No basis is found for separating the Brandywine from the Sunderland; both formations at their type localities are underlain by North Keys sand of Miocene(?) age. Age given as Pliocene(?) although field evidence justifies only statement that it may be Miocene, Pliocene, or Pleistocene.

Typically developed in vicinity of Brandywine, Prince Georges County, Md.

Branford Granite Gneiss[1]

Branford Quartz Monzonite

Precambrian: South-central Connecticut.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 114, 146, map.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Redescribed as a granitic gneiss. Fine- to medium-grained well-foliated gray gneiss. Part of East Haven granitic body, a structural unit. Pre-Triassic.

H. M. Mikami and R. E. Digman, 1957, Connecticut Geol. Nat. History Survey Bull. 86, p. 13–14, 24–25, 50–51, pl. 1. Discussion of Branford-Stony Creek massif, an igneous body composed of Stony Creek granite and Branford quartz monzonite; a facies of the latter is designated Lighthouse quartz monzonite.

Extensive outcrops in Branford Township, New Haven County.

Brannon Limestone Member (of Cynthiana Formation)

Brannon Cherty Member (of Flanagan Limestone)[1]

Brannon Limestone (in Lexington Limestone)

Middle Ordovician: North-central Kentucky.

Original reference: A. M. Miller, 1913, Kentucky Geol. Survey, 4th ser., v. 1, pt. 1, p. 324.

D. K. Hamilton, 1948, Econ. Geology, v. 43, p. 41 (fig. 2), 42. Referred to as Brannon limestone; consists of finely crystalline siliceous limestone which weathers to very cherty residue. Thickness about 15 feet. Overlies Benson limestone; underlies Woodburn limestone.

A. C. McFarlan and W. H. White, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1636–1637. Forms middle part of Lexington limestone. Fine-grained siliceous gnarly limestone with much shale in lower part. On weathering, gives rise to conspicuous zone of chert drift and forms greater part of Campbell's (1898) Flanagan chert. Thickness 15 to 20 feet; in some places 30 feet. Includes Woodburn phosphatic member. On the north in Bourbon, Harrison, Franklin, and Fayette Counties, the Brannon fades in a short distance as a useful lithologic unit. Woodburn also thins. Recognition of these beds becomes difficult as Brannon wedges out (lithologic change), but horizon is still well marked wherever *Stromatocerium* and its associates of upper Benson are presented. 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 lithologic and paleontologic units heretofore defined as Brannon, Woodburn, Greendale, Millersburg, Nicholas, Rogers Gap, Bromley, and Gratz.

Named for exposures at Brannon Station, Jessamine County.

Brannon Limestone Member (in Millsap Lake Formation)[1]

Pennsylvanian: North-central Texas.

Original reference: E. H. Sellards, 1933, Texas Univ. Bull. 3232, p. 106, 107.

Type locality not stated.

Brannon Bridge Limestone Member (of Lazy Bend Formation)

Brannon Bridge Limestone (in Millsap Lake Formation)[1]

Pennsylvanian: Central northern Texas.

Original reference: F. B. Plummer and J. Hornberger, Jr., 1936, Texas Univ. Bull. 3534, p. 16.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Reallocated to member status in Lazy Bend formation. Occurs below "Buck Creek sandstone" in Grindstone Creek formation and above Dennis Bridge limestone member of Lazy Bend.

Leo Hendricks, 1957, Texas Univ. Bur. Econ. Geology Pub. 5724, p. 17–18, fig. 3, pl. 4. Composed of two limestones separated by shale and discontinuous sand bodies. Lower limestone is 15 feet thick and shale is 22 feet thick (measured at Steussy Scarp where ranch road crosses scarp approximately 1½ miles west of Brazos River); a lensing sandstone in upper part of shale has maximum thickness of 4 feet in exposures in drainage immediately south of Meek Bend; upper limestone is 17 feet thick (in quarry on top of cliffs south of Brazos River at Meek Bend). Overlies Steussy shale member; underlies sandstone and shales of Grindstone Creek formation. Type section established.

Type section: Succession of beds exposed in Steussy Scarp, a prominent feature northwest of Rocky Creek west of Brazos River. Name derived from former highway bridge on Brazos River at a point three-fourths mile south of present Highway 80 bridge, Parker County. Outcrop of member extends south of U.S. Highway 80 along west side of meander of Brazos River forming Meek Bend; on west side of Brazos River outcrops are in bluffs along west and south sides of Meek Bend; southeast edge of outcrop forms Steussy Scarp which begins near river and extends southwestward across county line.

Bransford Sandstone Bed (in Gassaway Member of Chattanooga Formation)

Bransford Sandstone Member (of Gassaway Formation)

Upper Devonian: Central Tennessee.

Guy Campbell, 1946, Geol. Soc. America Bull., v. 57, no. 9, p. 884, pl. 1. Layer of sandstone 2 to 4 inches thick at base of the Gassaway (new). Overlies Dowelltown shale (new); from Nashville extends southward with the Gassaway but without the underlying Dowelltown.

W. H. Hass, 1956, U.S. Geol. Survey Prof. Paper 286, p. 11. Name Bransford sandstone not used in present report [Chattanooga shale and Maury formation]; bed so designated by Campbell is not named.

U.S. Geological Survey currently classifies the Bransford Sandstone as a bed in the Gassaway Member of the Chattanooga Formation on the basis of a study now in progress.

Type section: At bridge and along a small stream northwest of bridge, along Highway 31E, 2 miles north of Bransford, Sumner County.

Brassfield Limestone[1] **or Dolomite**

Lower Silurian: Central Kentucky, central northern Arkansas, southern Indiana, southwestern Ohio, and southern Tennessee.

Original references: A. F. Foerste, 1905, Kentucky Geol. Survey Bull. 6, p. 156; 1906, Kentucky Geol. Survey Bull. 7, p. 10, 27.

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

Wilber Stout, Karl Ver Steeg, and G. F. Lamb, 1943, Ohio Geol. Survey, 4th ser., Bull. 44, p. 116–117, chart facing p. 108. Present at surface in extended area in southwestern Ohio. Trend of outcrop is northeastward from Indiana-Ohio line near Fairhaven across Preble and Montgomery Counties into central Miami County, thence southeastward across Clark, Greene, Clinton, Highland, and Adams Counties to Ohio River near Rome. Thickness 20 to 60 feet; average 20 feet. Underlies Dayton formation, Niagara group.

A. C. McFarlan, 1943, Geology of Kentucky: Lexington, Ky., Kentucky Univ., p. 34, 35–36. Thickness 20 feet at type section. Thickens northward to 40 or even 50 feet in Adams and Highland Counties, Ohio, and then thins westward into Indiana. In southern Blue Grass, the Brassfield thins westward and is eliminated from sections near Stanford, where the Devonian overlaps on Ordovician. Underlies Plum Creek shale.

E. B. Branson and C. C. Branson, 1947, Jour. Paleontology, v. 21, no. 6, p. 549–556. Brassfield herein considered to consist of lower dolomitic limestone, including *Whitfieldella* bed, and Plum Creek clay member above. Underlies Oldham limestone. Conodonts described. Lower Silurian.

C. W. Wilson, Jr., 1948, Geol. Soc. America Bull., v. 59, no. 8, p. 752, 755, 756. Discussion of channel-filling sediments, south-central Tennessee. Brassfield limestone was deposited as blanket over south-central Tennessee, resting unconformably upon sandstone member of Mannie shale, or where sandstone member is absent, upon underlying Mannie shale. Locally the Brassfield rests on Fernvale limestone in regional stratigraphic succession but not within limits of Pulaski channel. Overlies the Richmond throughout practically entire length of Pulaski channel. Consists of thinly bedded blue-gray finely crystalline limestone containing many species of corals. Maximum thickness 45 feet along Pulaski channel. Underlies Mississippian Medinan series.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 239–244. Northwestward across central Tennessee, the Brassfield becomes dolomitic and in Perry County and vicinity develops basal zone of coarse-grained limestone. Commonly cherty and glauconitic. Lies between overlying Osgood formation or Chattanooga shale, and underlying Mannie or Fernvale formations, or Leipers formation where the Richmond formations are absent as in parts of Columbia quadrangle. Thickness 20 to 50 feet.

H. A. Lowenstam, 1949. Illinois Geol. Survey Rept. Inv. 145, p. 20–21. Niagaran in Illinois is underlain by late Alexandrian formations equivalent to Brassfield limestone of Kentucky and Indiana. These are Sexton Creek limestone in southern half of State and its dolomitic equivalent, Kankakee dolomite in northern part of State.

J. B. Patton, T. G. Perry, and W. J. Wayne, 1953, Indiana Geol. Survey Feld Conf., Guidebook 6, p. 14, pl. 1. Shown on generalized stratigraphic column of Ordovician and Silurian rocks exposed in Jefferson and Switzerland Counties. Thickness 0 to 11 feet. Underlies Osgood formation; overlies Whitewater formation.

Named for exposures along Louisville and Atlantic Railroad between Brassfield and Panola, Madison County, Ky.

Brasstown Schist[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 bedding, so that on stratigraphic evidence available they are not readily divisible. In this report, the 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; 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 the Brasstown formation.

J. L. Stuckey and S. G. Conrad, 1958, North Carodina Div. Mineral Resources Bull. 71, p. 31–32; J. L. Stuckey, 1958, Geologic map of North Carolina (1:500,000): North Carolina Div. Mineral Resources. Lower Cambrian(?).

Named for exposures on Brasstown Creek, Clay County, N.C. In Mineral Bluff quadrangle, Ga., crops out in two belts, one on each limb of Murphy syncline.

Brattleboro Phyllite[1]

Ordovician: Southeastern Vermont.

Original reference: C. H: Richardson, 1929, Vermont State Geologist 16th Rept., p. 232.

Named because Brattleboro Township is practically all covered with a fine-grained graphitic phyllite schist.

Bratton Sandstone (in Bluestone Formation)[1]

Bratton Sandstone Member (of Bluestone Formation)

Mississippian (Chesterian): Southeastern West Virginia and southern Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 293, 317.

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 185, pl. 15. Geographically extended into Virginia and redefined as member of Bluestone formation. Thickness about 10 feet. Overlies Belcher member; underlies Bent Mountain member (new). Consists of greenish-gray micaceous silty sandstone.

Type locality: Near extreme head of Bratton Branch of Brush Creek, Mercer County, W. Va.

Bratton Shale (in Bluestone Formation)[1]

Mississippian: Southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 294, 318.

Type locality: Near extreme head of Bratton Branch of Brush Creek, Mercer County, W. Va.

Brave Boat Harbor Biotite Granite[1]

Carboniferous(?): Southwestern Maine.

Original reference: A. Wandke, 1922, Am. Jour. Sci., 5th, v. 4, p. 148, 149, 154.

Occurs on northeast side of Brave Boat Harbor, Kittery Township, York County.

Brawley Formation

Pleistocene: Southern California.

T. W. Dibblee, Jr., 1954, California Div. Mines Bull. 170, p. 23 (fig. 2), 24, 25, pl. 2. Defined as the lacustrine and continental basinward facies of Ocotillo conglomerate (new); at type section about 2,000 feet of light-gray claystone and thin interbeds of buff sandstone are exposed; in Superstition Hills, composed of lacustrine and terrestrial clays, sands, and pebble gravels, and base is not exposed. Around Superstition Mountain, Brawley formation, basal part of which is Ocotillo conglomerate facies, unconformably overlaps Imperial formation, Alverson lava (new), and Split Mountain formation onto diorite; southeastward and adjacent to Superstition Mountain fault, Ocotillo-Brawley series lies unconformably on Borrego clays, and an angular discordance of as much as 60° is exposed north of fault.

Type section: West of U.S. Highway 99 and west of the south end of the Salton Sea, Imperial County.

Braxton Formation[1]

Pennsylvanian: Northern West Virginia.

Original reference: J. A. Taff and A. H. Brooks, 1896, U.S. Geol. Survey Geol. Atlas, Folio 34.

In greater part of Braxton County.

Brayman Shale[1]

Silurian: Eastern New York.

Original reference: A. W. Grabau, 1906, New York State Mus. Bull. 92, p. 101.

Theodore Arnow, 1949, New York State Water Power and Control Comm. Bull. GW-20, p. 9 (table 7), 13. Thickness 9 feet in Albany County. Overlies Indian Ladder formation; underlies Cobleskill limestone. Silurian.

J. M. Berdan, 1950, New York State Water Power and Control Comm. Bull. GW-22, p. 10 (table 2), 14-15. In Shoharie County, gradationally overlies Schenectady formation and underlies Cobleskill limestone. Thickness 20 to 40 feet. Upper Ordovician(?).

D. W. Fisher and L. V. Rickard, 1953, New York State Mus. Circ. 36, p. 3-14. Brayman is here regarded as eastern extension of Bertie and upper Camillus formations. Discontinuation of name "Brayman" as an Ordovician residual soil is advocated. Proposed here that name Brayman be applied to undifferentiated strata of Camillus and Bertie age in area from Vanhornesville, Herkimer County, to Gallupville, Schoharie County. 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 section beneath the Cobleskill. Thickness about 135 feet at Vanhornesville; 80 feet at Sharon Springs; 17 feet at Gallupville; only a few feet of uppermost Brayman exposed at type section. Thins eastward; diminution due to loss of strata from base so that Brayman includes more time stratigraphically in its western exposures. Everywhere conformably underlies Cobleskill. Upper Silurian.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. Shown on correlation chart as Upper Silurian.

Type locality: Along County road one-half mile west of Howes Cave. Named for Braymanville, Cobleskill County.

Brazer Limestone[1] or **Dolomite**

Mississippian: Northeastern Utah. eastern and south-central Idaho, and southwestern Wyoming.

Original reference: G. B. Richardson, 1913, Am. Jour. Sci., 4th, v. 36, p. 407, 413.

G. B. Richardson, 1941, U.S. Geol. Survey Bull. 923, p. 22–24, pls. 1, 6. Brazer limestone, in Randolph quadrangle, Utah-Wyoming, consists of massive gray siliceous limestone and sandstone; cherty in places; lower part thin-bedded and shaly, locally phosphatic. Thickness 1,100 feet. Overlies Madison limestone; underlies Wells formation.

J. S. Williams, 1943, Geol. Soc. America Bull., v. 54, no. 4, 610–612, measured sections. Brazer formation at type locality (herein considered to be Brazer Canyon) is 500 feet thick; neither top nor bottom of formation exposed. Overlies Madison formation; underlies Morgan or Wells formation. Traced eastward nearly to Colorado State line; thickness varies greatly over compartively short distances.

J. S. Williams and J. S. Yolton, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 8, p. 1143–1155. Thickness 3,700 feet in section at Dry Lake, Logan quadrangle, Utah. Five units or faunal zones described. Formation at Dry Lake section includes rocks of Iowan and Chesterian age, extending probably from an equivalent of the Warsaw to latest Chester. Underlies Wells formation.

L. L. Sloss and C. A. Moritz, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 10, p. 2161–2162. Beds exposed in southwestern Montana appear to be correlative with those described by Ross (1934, Geol. Soc. America Bull., v. 45, no. 5) in Idaho and are here tentatively assigned to the Brazer. However, neither the southwestern Montana nor the Idaho beds bear much resemblance to type Brazer; a new term seems to be required. Thickness 1,718 feet in Beaverhead County, Mont.

W. L. Stokes, 1953, Intermountain Assoc. Petroleum Geologists [Guidebook] 4th Ann. Field Conf., p. 16. Westernmost exposures of formation are near Rockland, Idaho. Thickness at least 4,000 feet in east-central Idaho; thinner in Wyoming where the Sacajawea may represent a featheredge. Upper Mississippian.

J. W. Strickland, 1956, Wyoming Geol. Assoc. Guidebook 11th Ann. Field Conf., p. 51–57. In southeastern Idaho, the Brazer should be classed as a formation and placed in Madison group containing, in addition to the Brazer, the Mission Canyon and Lodgepole formations. In northern Utah, Upper Mississippian strata formerly included in the Brazer are subdivided into a Chester and a Meramec series on basis of regional correlation and faunal suites. The Brazer should be restricted to rocks of Meramec age and to a facies consisting predominantly of partially dolomitized limestone, siliceous limestone, and calcareous sandstone. Brazer facies is an intermediate stage between dominantly sandstone Humbug formation of north-central Utah and upper Madison limestone of Wyoming. Section of rocks of Chester age formerly included with the Brazer (Williams, 1943; Williams and Yolton, 1945) are raised to group rank, consisting of (ascending) unit 3, Long Trail formation; unit 4, unnamed thin- to medium-bedded cherty limestone sequence; unit 5, Manning Canyon formation. Units 1 and 2 are classed as members of the Brazer as defined in this paper.

W. J. Sando, J. T. Dutro, Jr., and W. C. Gere, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2741–2769. Brazer dolomite in its type area consists of about 850 feet of dolomite with a few beds of quartz sandstone and limestone near top. Divided into three members (unnamed) in Crawford Mountains, Utah. Member 1 consists mainly of thin-bedded cherty fine-grained dolomite weathering dark-yellowish brown; member 2, thick-bedded medium- to coarse-crystalline crinoidal cherty dolomite weathering mostly yellowish gray: member 3 consists of several distinct rock types that are interbedded, most common type being thin-bedded fine-grained dolomite weathering dark yellowish brown. Overlies Lodgepole limestone. Underlies sandstones and carbonate rocks that are referred to Wells formation as used by McKelvey and others (1956). Lower two-thirds of formation has yielded fauna of Early Mississippian age that suggests correlation with Mission Canyon limestone of type Madison group; upper third of formation contains fauna of uncertain affinities, interpreted as Late Mississippian in age. Inasmuch as Brazer cannot be recognized on lithologic or faunal basis outside type area, it is herein recommended that name be restricted to Mississippian dolomite sequence in Crawford Mountains. New nomenclature should be devised for Upper Mississippian limestone-sandstone facies, perviously called Brazer, in northern Cordilleran region. Richardson (1913, 1941) did not indicate precise type locality nor give detailed section in either of his papers on Randolph quadrangle. Recent interpretations of type Brazer have been based on Williams statement (1943) that type section is at mouth of Brazer Canyon where the formation is incomplete because of faulting. Reasons presented for regarding this interpretation as incorrect and site for type section suggested.

M. R. Thomasson, 1959, Dissert, Abs., v. 20, no. 3, p. 999. Discussion of Late Paleozoic stratigraphy and paleotectonics of central and eastern Idaho. Milligen, Muldoon (new), Wood River, and Lemhi (new) formation recognized. Lemhi formation replaces term Brazer.

C. P. Ross, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B232. Discussion of interfingering Carboniferous strata in Mackay quadrangle, Idaho. Rocks commonly called Brazer limestone are widespread from interrupted zone trending nearly north through middle of quadrangle well to north and eastward into Montana. In Mackay quadrangle, their thickness exceeds 8,000 feet. They consist mainly of limestone but include some quartzite and conglomerate of Mississippian age. As originally used in central Idaho (Ross, 1934, Geol. Soc. America Bull., v. 45, no. 5), the Brazer limestone is of Late Mississippian age, but, in localities far to northeast of Mackay quadrangle, limestone that has not yet been mapped separately from the Brazer limestone has yielded fossils of Pennsylvanian and Permian age. In that part of Idaho, the Brazer limestone together with these younger associated beds may have an aggregate thickness of more than 10,000 feet. In Mackay quadrangle, rocks that were mapped as Brazer are now known on basis of paleontologic evidence to be largely of Early to Late Mississippian age, and in several outcrops they even include rocks of Pennsylvanian age; the Pennsylvanian limestone, however, cannot be distinguished in mapping from limestone of Mississippian age without far more refined work than has been practicable so far.

Type section (Sando, Dutro, and Gere): NW¼ sec. 20, T. 11 N., R. 8 E., Rich County, Utah. Named for exposures in Brazer Canyon, Rich County, Utah.

Brazil Formation[1]

Brazil Group

Middle Pennsylvanian: Southwestern Indiana.

Original reference: M. L. Fuller and G. H. Ashley, 1902, U.S. Geol. Survey Geol. Atlas, Folio 84.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 96. Includes Minshall limestone (new).

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (Column 25). Shown on correlation chart as Brazil formation. Includes strata from base of Connellton coal to a little above top of Minshall limestone. Underlies Staunton formation; overlies Mansfield formation.

D. W. Franklin, 1944, Illinois Acad. Sci. Trans., v. 37, p. 89, 90. Referred to as Brazil group. Contains Grandview limestone (new) near top.

F. E. Kottlowski, 1959, U.S. Geol. Survey Coal Inv. Map C–28. As defined by Cumings (1922, Indiana Dept. Conserv. Spec. Pub. 21, pt. 4) formation includes rocks between base of Lower Black coal and unconformity at top of Coal II. In type area, formation is about 75 feet thick and includes four principal named coals (ascending): Lower Block, Upper Block, Minshall, and Coal II. Between Minshall coal and Coal II is Minshall limestone. In strictest sense, unconformity at top of Brazil is not at top of Coal II but at base of prominent sandstone that lies a few feet below Coal III. In Coal City quadrangle, this sandstone, which is basal member of overlying Staunton formation, generally rests on Minshall limestone member, on the gray or black shale beneath the limestone, or on Minshall coal. Hence, thickness of formation in Coal City quadrangle ranges from 35 to 94 feet. Overlies Mansfield formation.

H. C. Hutchinson, 1960, Indiana Geol. Survey Bull. 16, p. 12–21, pl. 1. Formation described in Brazil quadrangle where it ranges from 40 to 90 feet in thickness and includes commercially mined coals, the Minshall and Coal II, and Perth limestone member (new) which closely overlies Minshall coal. Overlies Mansfield formation and underlies Staunton formation.

Named for Brazil, Clay County.

Brazil Limestone[1]

Pennsylvanian: Central western Indiana.

Original reference: F. C. Greene, 1911, Indiana Acad. Sci. Proc. 1910, p. 169–171.

Named for Brazil, Clay County.

Brazil Branch Breccia[1]

Cretaceous: Central northern Arkansas.

Original references: C. Croneis and M. Billings, 1929, Jour. Geology, v. 37, p. 543, 554; 1930, Arkansas Geol. Survey Bull. 3, p. 158–160.

Crops out in W½SE¼ sec. 29, T. 4 N., R. 17 W., about 3 miles south by west of Perryville, in valley of Brazil Branch, a perennial tributary of Fourche la Fave River, on land owned by J. R. Myers, Perry County.

†Brazos Sandstone[1]

Pennsylvanian: Central northern Texas.

Original reference: F. B. Plummer, 1919, Am. Assoc. Petroleum Geologists Bull., v. 3, p. 138.

Named for widely distributed exposures along Brazos River, especially the high cliff at Inspiration Point, 8 miles due south of Mineral Wells.

†Brazos Series[1]

Upper Permian and Triassic: Texas, southern Kansas, eastern New Mexico, and Oklahoma.

Original reference: R. T. Hill, 1901, U.S. Geol. Survey 21st Ann. Rept., pt. 7, p. 100–103.

Named for Brazos River, central northern Texas.

Brazos River Conglomerate Member (of Garner Formation)[1]

Brazos River Sandstone Member (of Garner Formation)

Middle Pennsylvanian: Central northern Texas.

Original reference: F. B. Plummer, 1919, Am. Assoc. Petroleum Geologists Bull., v. 3, p. 138.

R. J. Cordell and others, 1954, Abilene Geol. Soc. Guidebook Nov. 19–20, fig. 2. Faunal break occurs in Brazos River sandstone and conglomerate. Part of unit is assigned to East Mountain shale and part retained in Garner formation.

Leo Hendricks, 1957, Texas Univ. Bur. Econ. Geology Pub. 5724, p. 21–22, fig. 3, pl. 1. Referred to as sandstone member of Garner in report on Parker County. Essentially massive and crossbedded with lenses and beds of coarse conglomerate and minor shale beds; in some areas, conglomerate is missing. Thickness uniformly 25 to 30 feet. Overlies Mingus shale member; underlies East Mountain formation.

Named for exposures along Brazos River, especially cliff at Inspiration Point, 8 miles south of Mineral Wells, Palo Pinto County.

Breakwater Quartzite[1]

Precambrian (upper Huronian): Northeastern Wisconsin.

Original reference: C. K. Keith, R. J. Lund, and A. Leith, 1935, U.S. Geol. Survey Prof. Paper 184, p. 4.

Named for its location near Breakwater Falls on Pine River, Florence County.

Breathitt Formation or **Group**

Breathitt Formation (in Pottsville Group)[1]

Middle Pennsylvanian: Southeastern Kentucky.

Original reference: M. R. Campbell, 1898, U.S. Geol. Survey Geol. Atlas, Folio 47.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 82, 88, 94. Magoffin shale and limestone, Kendrick shale, and Elkins Fork shale are listed in Breathitt formation.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 22). Correlation chart shows Lost Creek limestone and Flint

Ridge flint in upper part of Breathitt formation in Kentucky River valley.

H. R. Wanless, 1946, Geol. Soc. America Mem. 13, p. 64, 65, 76, 136, 153. Includes Whetstone Creek shale member (new) in Whitley County area. In Letcher County, includes Bee Tree shale.

R. E. Hauser, 1953, Kentucky Geol. Survey, ser. 9, Bull. 13, p. 11 (fig. 2), 13–28. In Paintsville quadrangle, named units, not including coals are (ascending) Quakertown shale, Campbell Creek limestone, Elkins Fork shale, Kendrick shale, and Magoffin limestone.

J. A. Baker, 1955, U.S. Geol. Survey Water-Supply Paper 1257, p. 32–36. At type locality, the Breathitt includes rocks of Pottsville age only. However, no upper boundary has been defined, and formation includes rocks of Allegheny age in other localities. In Paintsville area, all consolidated rocks above massive sandstones of Lee formation are included in the Breathitt.

Named from exposures in Breathitt County.

†Breckenridge Formation (in Cisco Group)[1]

Pennsylvanian: Central northern Texas.

Original reference: F. C. Plummer, 1919, Am. Assoc. Petroleum Geologists Bull., v. 3, p. 133–145.

Near east end of Breckenridge oil field.

Breckenridge Limestone Member (of Thrifty Formation)[1]

Breckenridge Formation (in Thrifty Group)

Upper Pennsylvanian: Central northern Texas.

Original references: F. B. Plummer and R. C. Moore, 1921, Texas Univ. Bull. 2132, p. 152, 154, 155, 160; 1922, Jour. Geology, v. 30, p. 24.

Wallace Lee, 1938, Texas Univ. Bur. Econ. Geology Pub. 3801, p. 54, 61. Upper part of Thrifty formation, in Brazos River area, contains several beds of limestone, including Ivan and Blach Ranch members and, at top. Breckenridge limestone member. Thickness of Breckenridge varies from 5 feet near Crystal Falls to 1½ feet near McCann Bridge. Underlies Harpersville formation.

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 Chaffin formation; overlies Speck Mountain formation.

D. A. Myers, 1958, Jour. Paleontology, v. 32, no. 4, p. 678 (fig. 1). Shown on stratigraphic column as member of Thrifty formation. Occurs below Chaffin member and above Speck Mountain member.

L. F. Brown, Jr., 1960, Texas Univ. Bur. Econ. Geology Rept. Inv. 41, p. 7 (fig. 2), 8 (fig. 3), 18–20, pls. 1, 2. Plummer (1919) applied name "Breckenridge formation" to a section containing three persistent limestone beds and one local limestone, thick shale beds, and lenticular sandstones above his "Gunsight" limestone. The three limestone beds which "form escarpments around east end of Breckenridge oil field" (idem) are the Breckenridge, Blach Ranch, and Ivan limestones of Plummer and Moore's (1921) classification. Breckenridge limestone member was defined by Plummer and Moore as upper limestone of Thrifty formation. It was described as gray, massive, and resistant, from 3 to 4 feet thick, and lying 25 to 45 feet above Blach Ranch member. Plummer and Moore did not include measured section of Breckenridge limestone in its type area, and nearest sections to it were measured at type Blach Ranch area, 10½ miles northeast of Breckenridge and "in escarpment 2 miles northeast of Harpersville" (idem, p. 156), about 8 or 9 miles south of Breckenridge. Line labeled "Breckenridge limestone" on Plummer and Moore's plate 1 is not outcrop of Breckenridge limestone according to their type description but is the outcrop of Blach Ranch limestone. Bradish (1937, Geologic map of Brown County) and Plummer and others (1949, Texas Univ. Bur. Econ. Geology Pub. 4915, pl. 4) traced outcrop of type Breckenridge limestone in type area and Lee (1938) traced Breckenridge limestone in northern Stephens County. Mapping for present report shows that the limestone which Plummer and Moore labeled "Breckenridge" in each of their measured sections in Stephens and Young Counties correlates with their type Breckenridge. Hence, the inconsistency between type description of Breckenridge limestone and outcrop map is interpreted as mislabeling and not an error in type description. Type reference section herein described. Breckenridge outcrop is prominent escarpment throughout most of area. The resistant massive mottled bed of Breckenridge member that caps this escarpment and many outliers is of uniform lithology and thickness. This limestone bed averages 1.8 feet and weathers into angular irregular fragments, usually mottled gray to orange or reddish brown. About 1 foot of nodular or irregularly bedded limestone occurs above and below the massive mottled bed except near Breckenridge, where these limestone units thicken to 3 or 4 feet. Overlies unnamed shale member; underlies Quinn clay member of Harpersville formation.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 72–73, pl. 27. Breckenridge limestone member was named by Plummer and Moore (1921) for a gray massive resistant limestone, 3 or 4 feet thick, forming prominent escarpment in and about Breckenridge in Stephens County. They considered it easily traceable to northeast and south and possibly identifiable with upper Chaffin bed of Drake (1893) in Colorado River valley. Bullard and Cuyler (1935, Texas Univ. Bull. 3501) followed Plummer and Moore's correlations, and the bed they mapped as Breckenridge through northern McCulloch County is the Chaffin limestone of Drake (1893). Cheney and Eargle (1951, Geologic map of Brown County) mapped the Breckenridge and showed it in the interval between their Chaffin and Speck Mountain limestones. Breckenridge was mapped for present report as far southwest as Home Creek and was found to be correlative with the bed Drake considered the lower Chaffin limestone. From vicinity of Home Creek southwest to Colorado River in southeastern Coleman County, this limestone and shale immediately above and below it is removed by channel erosion and channel filled by Parks Mountain sandstone member. Breckenridge not recognized south of Colorado River. Breckenridge is 20 to 40 feet above Speck Mountain limestone member. Beds that intervene between Breckenridge and Chaffin members in Brown County and north of Home Creek in eastern Coleman County are red clay. Plummer and Bradley (1949) named this Quinn clay for exposures in Eastland County.

Type reference section (Brown): On Harris Veale property, near south city limits of Breckenridge, west of U.S. Highway 183, Stephens County. Lower part of section measured from base of Blach Ranch limestone at road level on west side U.S. Highway 183 westward to pond excavated in Breckenridge limestone at top of prominent escarpment (fig. 5, beds

1A–5A). Upper part of section offset westward along outcrop of massive mottled bed of Breckenridge (fig. 5, bed 5A); upper interval measured from base of bioclastic limestone bed of Breckenridge, exposed in gully 1, northwest 20 yards, then southwest to sandstone above Crystal Falls limestone at top of isolated hill (fig. 5, beds 5B–12). All three units of Breckenridge (beds 5A, B, and C) are partly exposed in gullies 2 and 3, beds 5B and 5C are best exposed in gully 1. Makes prominent escarpment in and about town of Breckenridge, Stephens County.

Brecksville Shale (in Orangeville Shale Member of Cuyahoga Formation)

†Brecksville Shale Member (of Orangeville Shale)[1]

Mississippian: Northeastern Ohio.

Original reference: C. S. Prosser, 1912, Ohio Geol. Survey, 4th ser., Bull. 15, p. 69, 98, 127.

Wilber Stout, Karl Ver Steeg, and G. F. Lamb, 1943, Ohio Geol. Survey, 4th ser., Bull. 44, p. 137. Noted as Brecksville shale in Orangeville member of Cuyahoga.

Named for Brecksville, Cuyahoga County.

Breezy Hill cyclothem

See **Breezy Hill Limestone Member** (of Cabaniss Formation)

Breezy Hill Limestone Member (of Cabaniss Formation)

Breezy Hill Limestone Member (of Senora Formation)

Breezy Hill Limestone Member (of Cherokee Shale)

Breezy Hill Limestone Member (of Mulky Formation)

Pennsylvanian (Des Moines Series): Kansas, Missouri, and Oklahoma.

W. G. Pierce and W. H. Courtier, 1937, Kansas Geol. Soc. Guidebook 11th Ann. Field Conf., p. 17; 1938, Kansas Geol. Survey Bull. 24, p. 33–35. Breezy Hill limestone member is about 5 feet below top of the Cherokee; in most places it consists of 6 inches to 2 feet of gray impure concretionary to nodular limestone but may exhibit considerable variation in thickness and character of material. In most places it is from 1 to 3 feet below Fort Scott coal; where coal is absent, Breezy Hill maintains its same stratigraphic position and is from 4 to 8 feet below top of the Cherokee. Underlain by Squirrel sand of drillers.

W. B. Howe. 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 9, p. 2091–2092. Member of Cherokee formation. Geographically extended into northern Oklahoma where it is essentially a single massive bed about 3 feet thick. Overlies Kinnison shale member (new); underlies covered interval to base of lower limestone member of Fort Scott formation (Blackjack Creek). Has been identified as lower Fort Scott in northern Oklahoma.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 99. Included in Breezy Hill cyclothem.

C. C. Branson, 1954, Oklahoma Geol. Survey Guide Book 2, p. 5. Shown as Breezy Hill limestone in Mulky coal cycle of Senora formation in Oklahoma. Occurs above Kinnison shale. Mulky coal and underclay not present in Oklahoma.

W. B. Howe, 1956, Kansas Geol. Survey Bull. 123, p. 84–87, measured sections. Reallocated to member status in Mulky formation. Occurs below underclay of Mulky coal, where latter is present, and above Lagonda ("Squirrel") sandstone in southeastern Kansas or above Kinnison shale in northern Oklahoma. Known in western and northern Missouri only from scattered exposures.

J. V. A. Trumbull, 1957, U.S. Geol. Survey Bull. 1042–J. pl. 16. Member of Senora formation in Oklahoma.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. Shown on chart as member of Cabaniss formation.

Named for exposures at Breezy Hill, southwest of Mulberry, Crawford County, Kans.

Breien Member (of Hell Creek Formation)

Upper Cretaceous: Southwestern North Dakota.

W. M. Laird and R. H. Mitchell, 1942, North Dakota Geol. Survey Bull. 14, p. 14–15. Consists of two beds of gray sand separated by gray bentonite. Maximum thickness 31 feet. Interfingers with basal part of formation; base occurs about 20 feet above base of Hell Creek.

Named for occurrence near village of Breien in T. 134, N., R. 82 W., Morton County.

Breitenbush Series or Tuffs

Oligocene to Miocene: Northwestern Oregon.

T. P. Thayer, 1936, Jour. Geology, v. 44, no. 6, p. 704, 705, 709 (fig. 2), 713 (fig. 3). Dominantly tuffaceous; basal exposed part consists of rhyolitic lavas and pyroclastics. Thickness about 7,500 feet. Along Breitenbush River, underlies Sardine series (new); contact gradational. In some areas unconformably underlies Outerson basalts (new).

T. P. Thayer, 1939, Oregon Dept. Geology and Mineral Industries Bull. 15, p. 9–10, fig. 1 (geol. map). Referred to as tuffs; about 7,500 feet of water-worked, land-laid tuffs, breccias, and conglomerates, interlayered with lava flows. Although upper beds are Miocene in part, most of tuffs are probably Oligocene, and some may be as old as Eocene. Mapped as Oligocene-Miocene. Type section stated.

Type section: Along Breitenbush River between French and Fox Creeks which are 1 and 5½ miles, respectively, east of Detroit, Marion County.

Bremen Sandstone Member (of Pottsville Formation)[1]

Pennsylvanian: Northern central Alabama.

Original reference: C. Butts, 1910, U.S. Geol. Survey Geol. Atlas, Folio 175.

Named for exposures in Bremen northwest corner of Birmingham quadrangle, Cullman County.

Bremo Quartzite

Silurian or younger: Central Virginia.

G. W. Stose and A. J. Stose, 1948, Am. Jour. Sci., v. 246, no. 7, p. 397–401, 408. Quartzite, about 400 feet thick, that overlies Arvonia slate. Consists of three units: upper and lower, each about 150 feet thick, of thin-bedded quartzite and interbedded knotted slate closely folded and a middle unit of massive quartzite, about 100 feet thick, with a few shale partings; vertical. Structure interpreted as isoclinal syncline.

Named for occurrence at Bremo Bluff, a prominent cliff of quartzite which rises 150 feet above floor of James River at point just east of bridge over river on U.S. Highway 15, Fluvanna County.

Brentwood Limestone Member (of Bloyd Shale)[1]

Lower Pennsylvanian (Morrow Series): Northwestern Arkansas and northeastern Oklahoma.

Original reference: G. I. Adams and E. O. Ulrich, 1904, U.S. Geol. Survey Prof. Paper 24, p. 28, 109.

C. A. Moore, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 3, p. 427–430. Geographically extended into Adair County, Okla., where it is defined to include shale and limestone members of the Bloyd between top of Hale formation and base of Kessler member of the Bloyd. Here consists of blue-black fissile clay shale with thin discontinuous limestone beds. On Bugger Mountain, exposed part of Brentwood is 65 feet thick.

C. A. Moore, 1947, Oklahoma Geol. Survey Bull. 66, p. 39. The Brentwood loses its identity in Oklahoma and becomes indistinguishable in a sequence of alternating, thin, discontinuous limestones and interbedded shale of the lower Bloyd.

L. G. Henbest, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 8, p. 1942–1943. Further described in area of type locality where it is recognizable largely by its position between Prairie Grove member (new) of Hale formation below and terrestrial sediments above that comprise newly defined Woolsey member of the Bloyd.

Named from exposures in vicinity of Brentwood Station, Washington County, Ark.

Brereton cyclothem (in Carbondale Formation)

Brereton cyclothem[1] (in Carbondale Group)

Pennsylvanian: Illinois.

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

J. M. Weller, 1942, Illinois Acad. Sci. Trans., v. 35, no. 2, p. 145 (table 1). In list of Upper Pennsylvanian cyclothems, occurs below Jamestown cyclothem (new).

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 60–61, 103–113, pl. 5. Described in Beardstown, Glasford, Havana, and Vermont quadrangles, where it includes (ascending) Cuba sandstone, Big Creek shale, Herrin (No. 6) coal, Brereton limestone, and Sheffield shale. Underlies Pokeberry cyclothem believed to be equivalent to Jamestown cyclothem. Derivation of name and type locality given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 52 (table 2), pl. 1. In Carbondale formation (redefined). Above St. David cyclothem and below Jamestown cyclothem. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification independent of rock-stratigraphic classification.

Type section: Along Middle Branch of Copperas Creek, 2 miles northeast of Brereton, in NE¼SE¼NE¼ sec. 1, T. 7 N., R. 4 E., Glasford quadrangle, Fulton County.

Brereton Limestone Member (of Carbondale Formation)

Brereton Limestone (in McLeansboro Formation)[1]

Brereton Limestone (in McLeansboro Group)

Brereton Limestone (in Petersburg Formation)

Pennsylvanian: Central western Illinois and southwestern Indiana.

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

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 25). Shown on correlation chart as limestone in Petersburg formation in Indiana.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 111–112. Included in Brereton cyclothem, McLeansboro group. Overlain and underlain by unnamed shale units. Stratigraphically below Sheffield shale (new).

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 34, 35, 48 (table 1), 65, pl. 1. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois. Carbondale redefined as formation and includes Brereton limestone member. Name Brereton is extended to caprock of No. 6 coal in southern Illinois to replace name Herrin, now restricted to Herrin (No. 6) coal member. Underlies Jamestown coal member in southern Illinois and Lawson shale member (new) in western and northern Illinois. Thickness 3½ feet.

Type locality: East bank Middle Copperas Creek, SE¼NE¼ sec. 1, T. 7 N., R. 4 E., Fulton County, Ill.

Brevard Schist[1]

Brevard Series

Lower Cambrian: Western North Carolina, northwestern Georgia, and northwestern South Carolina.

Original reference: A. Keith, 1905, U.S. Geol. Survey Geol. Atlas, Folio 124, p. 5.

G. W. Crickmay, 1952, Georgia Geol. Survey Bull. 58, p. 23–27. 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). Brevard series occupies belt averaging about 2 miles in width and extending from Habersham County southwestward across state into Alabama. Series includes biotite gneiss, mica schist, quartzite, chlorite schist, and marble. Brevard schist was mapped as Cambrian by Keith (1907, U.S. Geol. Survey Geol. Atlas, Folio 147) but is similar to schists in Carolina series. Brevard schist traced southwestward into Alabama where it is included in Ashland and Wedowee formations. Keith believed Brevard schist rested unconformably on Carolina gneiss and old granites, but no evidence of this unconformity is to be found in Georgia. Henderson granite gneiss in North Carolina and Lithonia granite gneiss in Georgia are instrusive into Brevard schist. Name Brevard is retained, but author [Crickmay] believes that Brevard series is essentially part of Carolina series and is Precambrian.

J. L. Stuckey and S. G. Conrad, 1958, North Carolina Div. Mineral Resources Bull. 71, p. 31; J. L. Stuckey, 1958, Geologic map of North Carolina (1:500,000); North Carolina Div. Mineral Resources. Fine-grained black and dark schist with lenses of limestone varying from a few hundred feet to more than 1 mile in length and up to 250 feet in thickness. Lower Cambrian(?).

Named for exposures near Brevard, Transylvania County, N.C.

Brewer Phyllite

Brewer Phyllite Member (of Talladega Slate)[1]

Precambrian or Paleozoic: Northeastern Alabama.

Original reference: Charles Butts, 1926, Alabama Geol. Survey Spec. Rept. 14, p. 52, map.

Charles Butts, 1940, U.S. Geol. Survey Geol. Atlas, Folio 226. Rank raised to formation. Overlies Waxahatchee slate; underlies Wash Creek slate (new). Thickness 200 to 500 feet.

T. N. McVay and L. D. Toulmin, 1945, Alabama Geol. Survey Bull. 55, p. 20, 21. Overlies Waxahatchee slate. Underlies Wash Creek slate. Thickness 200 to 500 feet. In Talladega series.

Named for exposures at Brewer School, in Columbiana quadrangle, Chilton County.

Brewer Creek 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, volcanic sequence is roughly the same except Porphyry Peak rhyolite is missing and Bonanza latite is replaced by Hayden Peak latite.

Exposed north of and westward along Brewer Creek, Saguache County.

Brewer Dock Limestone (in Clinton Group)

Brewer Dock Member[1] (of Reynales Limestone)

Middle Silurian: West-central New York.

Original reference: H. E. Alling and J. E. Hoffmeister, 1932, 16th Int. Geol. Cong. Guidebook 4, p. 106, 107, 108, chart opposite p. 6.

D. W. Fisher, 1953, Buffalo Soc. Nat. Sci. Bull., v. 21, no. 2, p. 27 (fig. 1), 31–32. Argillaceous limestone with many shale partings. Shale is greenish gray in contrast to bright-green shale of underlying Maplewood. Thickness 3 feet in Genesee Gorge; thins eastward to 2½ feet at Glen Edythe; not identified outside Rochester area. Fauna is similar to the Lower Reynales (Reynales limestone of Niagara Gorge) with which it is correlated as being a more argillaceous near-shore phase. Middle Silurian.

Tracy Gillette, 1947, New York State Mus. Bull. 341, p. 47. Suggested that Brewer Dock, defined by Sanford (1935, Jour. Geology, v. 43, no. 2) as member of Reynales, be retained for discussing local geology of Rochester and vicinity. In that area, Brewer Dock is separated from rest of Reynales by the Furnaceville. In other parts of western New York where that condition does not exist, use of Brewer Dock is not justified.

D. W. Fisher, 1959, New York State Mus. Sci. Service Map and Chart Ser., no. 1. Included in Clinton group. Middle Silurian.

Typically exposed in Genesee Gorge near Brewer Dock, vicinity of Rochester, Monroe County.

Brewerton Shale[1]

Silurian: Central New York.

Original reference: G. H. Chadwick, 1918, Geol. Soc. America Bull., v. 29, p. 327–368.

Tracy Gillette, 1940, New York State Mus. Bull. 320, p. 28 (table 3). Listed on correlation chart showing development of Niagaran nomenclature.

Exposed at Brewerton, Onondaga County.

†Brewerville Sandstone (in Chester Group)[1]

Mississippian: Southwestern Illinois and southeastern Missouri.

Original reference: S. Weller, 1913, Illinois Acad. Sci. Trans., v. 6, p. 120, 121.

Named for Brewerville Township, Randolph County, Ill., where it is well exposed in Mississippi River bluffs.

†Brewster Formation[1]

Middle Ordovician: Southwestern Texas.

Original reference: J. A. Udden, C. L. Baker, and E. Bose, 1916, Texas Univ. Bur. Econ. Geology and Tech. Bull. 44, p. 35, 37.

Named for exposures in Brewster County.

Brezee Phyllite[1]

Lower Cambrian: Southwestern Vermont.

Original reference: A. Keith, 1932, Washington Acad. Sci. Jour., v. 22, p. 360, 399.

Named for Brezee Mill Creek, which flows out of northeast end of Taconic Range, 3 miles south-southwest of Brandon, Rutland County.

Brian Head Formation

Miocene(?): Southwestern Utah.

H. E. Gregory, 1944, Am. Jour. Sci., v. 242, no. 11, p. 591–597, 599, 601, 602. Series of white, calcareous, and siliceous shalelike beds overlain by gray igneous agglomerates which in places form surface of plateaus and in other places extend upward to capping sheets of black lava. Thickness about 80 feet in Antimony Canyon; 520 feet in Horse Creek Canyon; 968 feet in North Branch of Limekiln Gulch. Overlies Wasatch formation.

H. E. Gregory, 1949, Geol. Soc. America Bull., v. 60, no. 6, p. 983–986, 987–988, 989. Forms almost entire surface of Markagunt Plateau. Along westward-facing cliffs of Sevier Plateau, where entire formation is exposed, stratified calcareous and tuffaceous rocks are separated from overlying dark-gray coarse agglomerate by erosional unconformity believed to be regional in extent. Because of this persistent time break, it has been suggested that Brian Head be restricted to stratified beds and agglomerate correlated with Bullion Canyon volcanics of Tushar and northern Sevier Plateaus.

R. L. Threet, 1952, (abs.) Geol. Soc. America Bull., v. 63, no. 12, pt. 2, p. 1386. At type locality, formation includes about 500 feet of interbedded volcanic ash and chalcedony, dacite lava, andesite breccia, and sheeted rhyolitic vitrophyre and tuff. The sheeted vitrophyre at top of type section is a glassy basal zone of the rhyolitic welded tuff caprock of Brian Head Peak. The andesite breccia and dacite lava immediately beneath the sheeted vitrophyre are a local agglomeratic phase of massive andesite lavas which constitute basal formation in group of Tertiary flows and welded tuffs which cap southern High Plateaus. Inasmuch as type Brian Head includes considerable thickness of rocks which are part of overlying group of flows and welded tuffs, it is suggested that term Brian Head formation be restricted, redefined, or abandoned.

Name derived from Brian Head, prominent projection of Markagunt Plateau near Cedar Breaks National Monument.

Briarcliff Dolomite

Upper Cambrian: Southeastern New York.

E. B. Knopf, 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1212; 1956, (abs.) Geol. Soc. America Bull., v. 67, no. 12, pt. 2, p. 1817. Dominantly light dolomites with some dark beds. Fossils indicate a horizon not earlier than middle Franconian nor later than middle Trempealeauian state, probably early Trempealeauian. Thickness 700 to 1,000 feet. Occurs below Halcyon Lake calc-dolomite (new) and above White Plains formation (new).

Described in area of Stissing Mountain, Dutchess County.

Briar Hill Coal Member (of Carbondale Formation)

Pennsylvanian: Western Kentucky and southern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 34, 47 (table 1), pl. 1. Assigned member status in Carbondale formation (redefined). Occurs above St. David limestone member and below Vermilionville sandstone member. Coal named by Glenn (1912, Kentucky Geol. Survey Bull. 17). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: In mines at DeKoven, Shawneetown quadrangle, Union County, Ky.

Briar Hill cyclothem (in Carbondale Formation)

Pennsylvanian: Southwestern and southeastern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 43, 52 (table 2), pl. 1. Proposed for unit formerly termed Crab Orchard cyclothem. Contains Briar Hill (No. 5) coal member. Occurs above St. David cyclothem and below Brereton cyclothem. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Name derived from Briar Hill near village of DeKoven, Union County, Ky.

Briceville Shale

Briceville Formation

Briceville Shale (in Pottsville Group)[1]

Pennsylvanian: Eastern Tennessee.

Original reference: A. Keith, 1896, U.S. Geol. Survey Geol. Atlas, Folio 25, p. 4.

H. R. Wanless, 1946, Geol. Soc. America Mem. 13, p. 58–63. Briceville formation includes 500 to 1,000 feet of strata, predominantly shale. Underlies Jellico formation; overlies Lee group. Term Briceville seems to have been applied to strata down to Corbin sandstone near Oneida and Helenwood, Scott County, but farther south it seems to have been extended down to Rockcastle sandstone. Recommended that term Duskin

Creek be used for strata between the Corbin and Rockcastle where position of Corbin can be determined.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1958, Pennsylvanian Geology of Cumberland Plateau: Tennessee Div. Geology [Folio], p. 1. As result of recent field work, formation names Briceville, Jellico, Scott, and Anderson are discontinued and complete new classification is presented. Strata termed Briceville are included in Slatestone group (new).

U.S. Geological Survey has discontinued the use of the term Pottsville Group in Tennessee.

Named for occurrence at Briceville, Anderson County.

Brickeys Member (of Mifflin Formation)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., figs. 3, 10, 16. Limestone or dolomite; thin- to medium-bedded. Thickness about 2 feet. Shown on columnar section as underlying Boarman member (new) of Mifflin formation and overlying Oglesby member (new) of Pecatonica formation.

In copy of guidebook used by compiler, a handwritten note states Brickeys member overlies Boarman member. Since compiler had no way to determine what changes, if any, had been made in other copies of guidebook, it was impossible to be certain of true stratigraphic relation.

Occurs in Dixon-Oregon area.

Brick Yard Limestone[1]

Pennsylvanian: Northern central Texas.

Original reference: W. G. Wender, 1929, Texas Bur. Econ. Geology, geol. map of Eastland County.

Bridalveil Granite[1]

Cretaceous: Northern California.

Original reference: H. W. Turner, 1899, Jour. Geology, v. 7, p. 154.

U.S. Geological Survey currently designates the age of the Bridalveil Granite as Cretaceous on the basis of a study now in progress.

Forms brink of Bridalveil Fall in Yosemite National Park.

Bridgeburg horizon[1]

Silurian: Western New York.

Original reference: G. H. Chadwick, 1917, Geol. Soc. America Bull., v. 28, p. 173–174.

Derivation of name not stated.

Bridge Creek Limestone Member (of Greenhorn Limestone)[1]

Upper Cretaceous: Western Kansas and southeastern Colorado.

Original reference: N. W. Bass, 1926, Kansas Geol. Survey Bull. 11, p. 67.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 153. In Hamilton County, Kans., Pfeifer shale member and underlying Jetmore chalk member are thicker than farther east; they cannot be distinguished and have been together designated the Bridge Creek limestone member, having a total thickness of 74 feet.

T. G. McLaughlin, 1954, U.S. Geol. Survey Water-Supply Paper 1256, p. 117–119. In Baca County, Colo., member contains alternating beds of chalky limestone and limy shale with a few thin layers of bentonite;

limestone beds are 3 to 12 inches thick and are separated by 6 inches to 6 feet of shale. Thickness 62 feet along Two Butte Creek; thickens eastward to 74 feet in Hamilton County, Kans.; thins westward to 35 feet in Model anticline in Las Animas County. Overlies Hartland shale member.

Named for exposures in Bridge Creek northwest of Medway, Hamilton County, Kans.

Bridge Creek Shales[1]

Oligocene or Miocene: Central northern Oregon.

Original references: R. W. Chaney, 1927, Carnegie Inst. Washington Pub. 346; 1927, Pub. 349, p. 1–22.

John Day Basin.

Bridgeport Limestone (in Palo Pinto Formation)[1]

Pennsylvanian: Central northern Texas.

Original reference: E. Bose, 1918, Texas Univ. Bull. 175, p. 12–13.

Exposed in western part of East Bridgeport, Wise County.

Bridgeport Member (of Bloomsburg Formation)

Bridgeport Sandstone (in Wills Creek Shale)[1]

Silurian: Central Pennsylvania.

Original reference: E. W. Claypole, 1885, Pennsylvania 2d Geol. Survey Rept. F_2, p. 57–58.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 5. Reallocated to member status in Bloomsburg formation. Occurs near middle of formation.

Named for exposures near Bridgeport, Perry County.

Bridger Formation[1]

Eocene, middle and upper(?): Southwestern Wyoming, northwestern Colorado, and northeastern Utah.

Original references: F. V. Hayden, 1869, U.S. Geol. Survey Terr. 3d Ann. Rept., p. 191 of 1873 ed.; Henry Engelmann, 1876, (Fort Bridger series) *in* Appendix 1 of a report of explorations across the Great Basin of the territory of Utah for a direct wagon route from Camp Floyd to Genoa, in Carson Valley, in 1859, by Capt. James H. Simpson, Engineer Dept., U.S. Army: Washington, U.S. Govt. Printing Office, p. 287–291.

W. H. Bradley, 1931, U.S. Geol. Survey Prof. Paper 168, p. 19–22. In part of Piceance Creek basin, Colorado, rocks of Green River formation are overlain by 400 feet of sandy beds of fluviatile origin that appear to be lithologically and stratigraphically equivalent to basal beds of Bridger formation of Uinta basin. In eastern part of Uinta basin, lower part of Bridger is brown massive sandstone about 800 feet thick. Upper part of formation consists of greenish, drab, red, maroon, ash-gray, and buff sandy mudstone. Locally, contact between Bridger and underlying Green River has been distorted by differential compaction. Underlies Uinta formation.

H. E. Wood 2d, 1934, Am. Mus. Nat. History Bull., v. 67, art. 5, p. 241–242. In southwestern Wyoming, subdivided into Blacks Fork member below and Twin Buttes member above.

R. L. Nace, 1939, Wyoming Geol. Survey Bull. 27, p. 11 (table), 19–21, pl. 1. For purposes of this report [Red Desert], Bridger formation is divided into upper and lower parts, but terms "upper" and "lower" are not intended to indicate time relation to typical Bridger formation in Bridger basin. They are lithologic divisions of formation as it is developed in map area. Lower Bridger is an alternation of somber-colored sandstones, clays, mudstones, shales, and limestones. Upper Bridger is predominantly sandstone and shale. Thickness 670 to 765 feet. Overlies Morrow Creek tongue of Green River; disconformably underlies Continental Peak formation (new). Middle Eocene.

C. H. Dane, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 3, p. 416. Discussion of Green River and Uinta formations 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 recognized 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 as was formerly divided by U.S. Geological Survey into Bridger and Uinta formations. More general recent usage has been to refer entire sequence to Uinta formation, which usage is followed here.

G. N. Pipiringos, 1955, Wyoming Geol. Assoc. Guidebook 10th Ann. Field Conf., p. 101, 103. Overlies Morrow Creek member of Green River formation in central part of Great Divide basin, Sweetwater County, Wyo.; underlies Browns Park formation. Thickness 60 to 100 feet.

W. H. Bradley, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 5, p. 1074. Overlies Laney shale member of Green River in Bridger basin. Term Morrow Creek abandoned.

C. L. Gazin, 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 136. Formation discussed in report on paleontological exploration and dating of early Tertiary deposits in basins adjacent to Uinta Mountains.

Named for exposures in vicinity of Fort Bridger, Uinta County, Wyo.

Bridgerian 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 the Bridger formation of southwestern Wyoming (of a redefinition of Bridgerian "series" of C. R. Keyes), or more specifically, the time of deposition of Blacks Fork and Twin Buttes members of Bridger formation (Eocene) with enclosed faunas. Covers time interval between Eocene Wasatchian (older) and Uintan ages. Report defines 18 provincial time terms, based on mammal-bearing units, for North American continental Tertiary. [For sequence see under Puercan.]

†Bridgerian series[1]

[Tertiary]: Colorado, Utah, and Wyoming.

Original reference: C. R. Keyes, 1924, Pan-Am. Geologist, v. 41, p. 36, 279, 309.

Bridgetimber Gravel[1]

Pliocene or Pleistocene: Southwestern Colorado.

Original reference: W. W. Atwood and K. F. Mather, 1932, U.S. Geol. Survey Prof. Paper 166.

Harley Barnes, E. H. Baltz, Jr., and P. T. Hayes, 1954, U.S. Geol. Survey Oil and Gas Inv. Map OM-149. Mapped as Pliocene or Pleistocene.

Caps Bridge Timber Mountain southwest of Durango.

Bridgeton Formation (in Columbia Group)[1]

Pleistocene: New Jersey.

Original reference: R. D. Salisbury, 1898, New Jersey Geol. Survey Ann. Rept. State Geologist 1897, p. 13-15.

J. H. C. Martens, 1956, Rutgers Univ. Bur. Mineral Research Bull. 6, p. 72-74. Oldest Pleistocene formation in southern New Jersey. Commonly occurs immediately below surface with no younger formations, or only a small amount of windblown sand, overlying it; in Cumberland and Cape May Counties is overlain by Cape May formation; unconformably overlies Cohansey and Kirkwood formations. Composed mostly of coarse sand deposited by rivers. Maximum thickness 60 feet; commonly less than 30 feet. Glassboro phase as described by Salisbury and Knapp (1917, New Jersey Geol. Survey, v. 8) includes greater part of formation.

Named for exposures at Bridgeton, Cumberland County.

Bridgewater Member (of Marcellus Shale)[1]

Middle Devonian: Central eastern New York.

Original reference: G. A. Cooper, 1930, Am. Jour. Sci., 5th ser., v. 19, p. 133, 219.

R. E. Stevenson, 1948, New York State Sci. Service Rept. Inv. 1, p. 2 (table 1). Underlies Solsville member; overlies Chittenango member.

Named for exposures on Seabridge Farm 2¼ miles west of Bridgewater, Oneida County.

Bridle Formation

Precambrian (Yavapai Series): West-central Arizona.

C. A. Anderson, E. A. Scholz, and J. D. Strobell, Jr., 1955, U.S. Geol. Survey Prof. Paper 278, p. 1, 7-10, pl. 3. Metamorphosed series of amygdaloidal and massive flows of andesite and basalt and intercalated sedimentary rocks and rhyolitic tuff. Includes belt of chlorite-biotite schist mapped separately as "spotted schist" (pl. 3). Sedimentary rocks were predominantly deposited in water; they have become schistose rocks in which chlorite and sericite are chief foliated minerals. Thickness 3,000 feet in mapped area; greater thickness exposed in unmapped area south of Bridle Creek. Oldest formation of Yavapai series; underlies Butte Falls tuff (new). Intruded by Dick rhyolite and Lawler Peak granite (both new). Mass of King Peak rhyolite (new) exposed west of Niagara Creek is essentially concordont with southwestern belt of Bridle formation, but evidence proves that rhyolite is intrusive.

Crops out in two belts in southern part of Bagdad area, Yavapai County. Named from Bridle Creek.

Bridport Dolomite Member (of Chipman Formation)

Bridport Dolomite (in Beckmantown Group)

Lower Ordovician: West-central Vermont and northwestern New York.

W. M. Cady, 1945, Geol. Soc. America Bull., v. 56, no. 5, p. 524, 539, 540, 545-546. Corresponds to Division E of "Calciferous" of Brainerd and Seely (1890, Am. Mus. Nat. History Bull., v. 3). Includes beds of fine-grained dolomite, 1 or 2 feet thick, weathering drab, yellowish, or brown. Occasional fossiliferous pure limestone layers. Rarely thin layers of slate. Maximum thickness 500 feet. Underlies Crown Point limestone; conformably overlies Bascom formation (new). Upper contact of Bridport is in most places a distinct stratigraphic break, above which may be any of the formations of the Chazy or Black River-Trenton that crop out in area occupied by Bridport.

Marshall Kay, 1950, (abs.) Geol. Soc. America Bull., v. 61, no. 12, pt. 2, p. 1476. Bridport dolomite formation along Lake Champlain is uppermost part of Beekmantown, Canadian series. Underlies quartz arenites and calcarenites of basal Chazy Day Point within and west of Lake Champlain in Vermont and New York. Beldens calcite marble is a calcitic facies of the Bridport.

W. M. Cady and E-an Zen, 1960, Am. Jour. Sci., v. 258, no. 10, p. 728–739. Rank reduced to member status in the Chipman herein reduced to rank of formation. Consists of massive dolomitic beds, which in Cornwall area interfinger with limestones (Burchards, Weybridge, and Beldens) of Chipman formation. Beekmantown age. [See Chipman formation, this reference.]

Named for wide exposures on hills in southeastern part of town of Bridport, Addison County, Vt.

Bridwell Formation

Pliocene, middle: Western Texas.

G. L. Evans, 1949, West Texas Geol. Soc. Guidebook Field Trip 2, Nov. 6–9, p. 4 (table 1), 6–7. Bedded, unconsolidated sand and clay with thick channel gravel occurring both at base and at higher levels; characteristically reddish brown; locally a few gray highly calcareous members, including caliche cap rock. Thickness at type locality 155 feet; locally pinches out against higher relief features on bed rock surface which extends well above upper level of Couch formation (new). Underlies Blanco formation.

D. C. Van Siclen, 1957, Jour. Geology, v. 65, no. 1, p. 49 (fig. 2), 51, 52. Thickness 75 feet. Stratigraphic section lists formation under heading Pliocene (Miocene?).

Typically exposed on Fowler Ranch, 10 miles north of Crosbyton, Crosby County. Named for Bridwell Ranch in Blanco Canyon.

Brier Slate 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. As defined here, Vulcan iron-formation includes (ascending) Traders iron-bearing member, Brier slate member, Curry iron-bearing member, and Loretto slate member.

Named for Brier Hill, Menominee district, [Dickinson County].

†Brier Creek Marl[1]

Oligocene and Miocene: Southeastern Georgia and western South Carolina.

Original references: E. Sloan, 1905, South Carolina Geol. Survey geognostic map of South Carolina, advance copies; published in 1908, in South Carolina Geol. Survey, ser. 4, Bull. 2; 1907, Summary of mineral resources of South Carolina, p. 12, 18, name only, not defined; 1908, South Carolina Geol. Survey, ser. 4, Bull. 2, p. 435, 464, 465.

Typically exhibited along Brier Creek, near Jacksonboro, Ga.

Brierfield Dolomite[1]

Upper Cambrian: North-central Alabama.

Original reference: E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, p. 628, 633, 634, pl. 27.

C. E. Resser, 1938, Geol. Soc. America Spec. Paper 15, p. 17. *Cryptozoon* masses are only indications of organisms present; consequently age determination not possible. Seems Brierfield should be regarded as closely associated with the Ketona and should have stratigraphic position between Nolichucky and Copper Ridge.

B. F. Howell and others, 1944, Geol. Soc. America Bull., v. 55, no. 8, chart 1. Shown on correlation chart below Ketona dolomite. Middle Cambrian.

T. N. McVay and L. D. Toulmin, 1945, Alabama Geol. Survey Bull. 55, p. 23. Listed with formations of Cambrian or Ordovician age.

Named for exposures on Mahan Creek in Vicinity of Brierfield, Bibb County.

Brier Hill Sandstone (in Washington Group)

Permian (Dunkard): Southwestern Pennsylvania.

W. O. Hickok, 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, ser. 4, Bull. C-26, p. 152. Name proposed for heavy-bedded to massive gray coarse-grained, slightly micaceous sandstone in upper part of Washington group. Thickness 10 to 30 feet; average about 15 feet. Underlies Upper Washington limestone; overlies Jollytown coal. Noted by Stevenson (1876) in his Washington County group but not named.

Well exposed in roadcuts on hilltop northwest of Brier Hill, Fayette County, for which settlement it is named.

Briggs Formation

Lower Permian: Western Texas.

C. C. Albritton, Jr., 1937, Jour. Paleontology, v. 11, no. 1, p. 19. Section in Malone Mountains shows Briggs formation consists of gypsum with interbedded limestones. Thickness more than 300 feet. Separated from Upper Jurassic Malone formation (emended) by unconformity.

C. C. Albritton, Jr., 1938, Geol. Soc. America Bull., v. 49, no. 12, pt. 1, p. 1753–1757. Includes minimum of 630 feet of anhydrite and gypsum with interbedded limestone; base of formation not exposed. Interbedded bodies of limestone range from laminae of microscopic dimensions to lenses more than 100 feet thick and several miles in width. Three lenses of sufficient magnitude to be mapped and considered as members are described (ascending): Black limestone member as much as 150 feet thick; black brecciated limestone member as much as 80 feet thick; and buff limestone member. At least in part equivalent to Leonard formation in Glass Mountains.

R. M. Huffington, 1943, Geol. Soc. America Bull., v. 54, no. 7, p. 992 (fig. 2), 994–995. In northern Quitman Mountains, consists only of medial black brecciated limestone member. Thickness about 200 feet.

Named for Briggs (now Gypsum) Switch on Southern Pacific Railroad, Hudspeth County, Malone Mountains area.

Brigham Quartzite[1]

Lower(?) and Middle Cambrian: Northeastern Utah and southeastern Idaho.

Original reference: C. D. Walcott, 1908, Smithsonian Misc. Colln., v. 53, no. 1804, p. 6, 7.

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1115–1116, 1117 (fig. 4), 1118. Walcott's (1908) Blacksmith Fork section restudied. Base of Brigham not exposed. Estimated thickness 1,000 feet. Underlies Langston limestone (emended).

A. J. Eardley and R. A. Hatch, 1940, Geol. Soc. America Bull., v. 51, no. 6, p. 809–812. Described in Bakers Canyon (which may have been Walcott's type locality for Brigham quartzite). Underlies Langston limestone. Total thickness below limestone 1,775 feet.

G. B. Richardson, 1941, U.S. Geol. Survey Bull. 923, p. 7–8, pl. 1. Described in Randolph quadrangle, where it is about 1,600 feet thick, base not exposed. Underlies Langston limestone.

J. S. Williams, 1948, Geol. Soc. America Bull., v. 59, no. 11, p. 1130 (table). Table of summary formations in Logan quadrangle, Utah, lists Brigham quartzite (Waucobian) above Precambrian Big Cottonwood Canyon series.

W. L. Stokes, 1953, Intermountain Assoc. Petroleum Geologists [Guidebook] 4th Ann. Field Conf., p. 14. Summary discussion. Although no fossils known, great thickness suggests span of deposition from at least early to middle Cambrian time. Probably passes into Flathead quartzite to north and east. Up to 6,000 feet thick with base not exposed.

G. B. Maxey, 1958, Geol. Soc. America Bull., v. 69, no. 6, p. 667. In area of this report [northern Utah and southeastern Idaho], all but uppermost shaly units of so-called Brigham quartzite are assigned to Prospect Mountain quartzite.

Type locality: West front of Wasatch Range, northeast of Brigham, Box Elder County, Utah.

Brigham Hill Graywacke

Lower Cambrian: Western Vermont.

E. C. Jacobs, 1935, (abs.) Geol. Soc. America Proc. 1934, p. 85. In Green Mountains, westernmost nappe is made up of Cheshire quartzite, of Lower Cambrian age, infolded with a fine-grained graywacke, which has been traced from Essex Junction into southern Quebec, where it is known as Gilman "quartzite." In Vermont, this rock has been named Brigham Hill graywacke.

E. C. Jacobs, [1937], Vermont State Geologist 20th Rept., p. 100–101. Yellowish to dark-gray very fine-grained graywacke, often with thin bandings of argillaceous material. Phase of Cheshire quartzite, not a formation. Age designated. Exposures described and derivation of name given.

Named for exposure on Brigham Hill, Essex Township, Chittenden County. Crops out intermittently in Green Mountains from Lake Dunmore north to Quebec border. Makes up Arrowhead Mountain as a klippe thrust onto Upper Cambrian slate.

Bright Angel Shale (in Tonto Group)[1]

Bright Angel Group

Middle Cambrian: Northern Arizona, southeastern California, and southern Nevada.

Original reference: L. F. Noble, 1914, U.S. Geol. Survey Bull. 549.

H. E. Wheeler, 1943, Geol. Soc. America Bull., v. 54, no. 12, pt. 1, p. 1797. Since Lyndon formation does not continue eastward from western Grand Canyon to Granite Gorge region as cartographic unit, underlying and overlying Pioche and Chisholm shales in latter area merge into Bright Angel shale. Thus beyond eastern limit of Lyndon in Grand Canyon, Bright Angel is recognized as corresponding to combined Pioche, Lyndon, and Chisholm formations to the west.

E. D. McKee, 1945, Carnegie Inst. Washington Pub. 563, p. 17, 20–21, 80–84. Thickness varies considerably from place to place owing to lateral changes in lithology along time planes. Both base and top of formation rise stratigraphically, but at irregular rate, from west to east. Thickness 325 feet at type locality. Intertongues with Muav limestone to west. Includes Flour Sack member (new) and Meriwitica and Tincanebits tongues (new).

H. E. Wheeler and E. M. Beesley, 1948, Geol. Soc. America Bull., v. 59, no. 1, p. 75, 77–78. Bright Angel group defined as predominantly argillaceous strata which lie between underlying Prospect Mountain quartzite and overlying Middle Cambrian limestone. This lithogenetic unit ranges in age from partly Precambrian in Nopah Range of southeastern California to entirely Middle Cambrian in Grand Canyon of Arizona.

H. E. Wheeler and V. S. Mallory, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 10, p. 2413 (fig. 2e), 2414. Includes Chisholm shale member in parts of Grand Canyon.

D. F. Hewett, 1956, U.S. Geol. Survey Prof. Paper 275, p. 32, 34–35, fig. 4, pl. 1. Widely distributed throughout eastern half of Ivanpah quadrangle, California and Nevada, where shale attains maximum thickness of about 420 feet.

Named for Bright Angel Canyon in walls of which formation is well exposed; Arizona.

Bright Diamond Limestone (in Morrison Formation)[1]

Upper Jurassic: Southwestern Colorado.

Original reference: J. D. Irving, 1905, U.S. Geol. Survey Bull. 260, p. 56.

Name probably derived from Bright Diamond mine.

Bright Diamond Quartzite (in Morrison Formation)[1]

Upper Jurassic: Southwestern Colorado.

Original reference: J. D. Irving, 1905, U.S. Geol. Survey Bull. 260, p. 56.

Probably named from Bright Diamond mine.

Brighton Melaphyr (in Boston Bay Group)[1]

Devonian or Carboniferous: Eastern Massachusetts.

Original reference: W. W. Dodge, 1881, Boston Soc. Nat. History Proc., v. 21, p. 205–208.

Named for occurrence at Brighton.

Brightseat Formation

Paleocene: Eastern Maryland.

R. R. Bennett and G. G. Collins, 1952, Washington Acad. Sci. Jour., v. 42, no. 4, p. 114–116. Dark-gray micaceous sandy clay. Thickness 4 to 8 feet. Unconformably underlies Eocene Aquia greensand; unconformably overlies Upper Cretaceous Monmouth formation.

Type locality: One mile west-southwest of Brightseat, Md., and one-fifth mile south of Sheriff Road.

Brimfield Schist[1]

Pre-Pennsylvanian: Central Massachusetts, northern Connecticut, and southern New Hampshire.

Original reference. B. K. Emerson, 1898, U.S. Geol. Survey Mon. 29, p. 17, pl. 24, map.

W. G. Foye, 1949, Connecticut Geol. Nat. History Survey Bull. 74, p. 76–80, pl. 1. Believed to be late Precambrian or early Paleozoic.

W. R. Hansen, 1956, U.S. Geol. Survey Bull. 1038, p. 20. Proposed that Brimfield schist be restricted to areas where the schist is not known to be equivalent to Worcester formation as redefined in this report [Hudson and Maynard quadrangles, Massachusetts]. Brimfield schist of previous reports dealing with this area are referred to as "mica schist facies" of redefined Worcester. Carboniferous.

M. E. Willard, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–85. Intruded by Belchertown tonalite at type locality of the Belchertown.

Named for occurrence at Brimfield, Mass.

Brindle Pup Andesite (in Ash Creek Group)

Precambrian (Yavapai Series): Central Arizona.

C. A. Anderson and S. C. Creasey, 1958, U.S. Geol. Survey Prof. Paper 308, p. 14, pl. 1. Dark-gray rock which weathers to light-brown surfaces on which cream-colored plagioclase phenocrysts are conspicuous. Groundmass aphanitic to very finely crystalline. Vesicles and quartz amygdules present, increasing in abundance near flow tops. Intercalated Buzzard and Deception rhyolitic flows and basaltic flows similar to Shea basalt. Basaltic flows highly vesicular greenish-black lava containing sparse plagioclase phenocrysts in finely crystalline groundmass. Thickness ranges from about 2,500 feet in widest outcrop to a wedge line. Underlies Deception rhyolite; overlies Buzzard rhyolite (new).

Named and defined from Brindle Pup Gulch, Jerome area, Yavapai County, where it is well exposed. Occurs as thick lense to south of Mingus Mountain.

Brine Creek Formation

Cretaceous: Northern Alaska.

T. C. Hiestand, 1957, Oil and Gas Jour., v. 55, no. 49, p. 194 (table 1). Name appears only on table. Nonmarine. Included with formations assigned Lower and Upper Cretaceous age.

Under heading Arctic foothills and coastal plain.

Briones Sandstone (in San Pablo Group)[1]

Briones Stage or Substage

Miocene, upper: Western California.

Original reference: A. C. Lawson, 1914, U.S. Geol. Survey Geol. Atlas, Folio 193.

J. E. Eaton, U. S. Grant, and H. B. Allen, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 2, p. 199–200. The Monterey comprises three substages (ascending): Briones, Cierbo, and Neroly. Substages can be recognized strandward by distinctive echinoderm faunas and by a number of more or less distinctive mollusks.

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 17 (table 3), 75–78. Shown on table as underlying Cierbo sandstone and overlying Rodeo shale. Includes Hercules shale member. In San Pablo group.

M. D. Crittenden, Jr., 1951, California Div. Mines Bull. 157, p. 22 (fig. 4), 39–41, pl. 1. Described in San Jose-Mount Hamilton area as thick series of massive coarse-grained fossiliferous sandstones and sandy shales. Thickness 3,400 to 5,000 feet. Unit crops out almost without interruption for entire length of Tularcitos syncline; on west limb it rests on Monterey formation; on east limb rests for considerable distances on Cretaceous Berryessa formation (new). Underlies Orinda formation, slight angular unconformity; in some areas underlies Packwood gravels (new).

J. W. Durham, 1954, California Div. Mines Bull. 170, chap, 3, p. 24 (fig. 2), 25 (fig. 3), 26 (fig. 4). Listed as megafaunal stage. Follows Temblor and precedes Cierbo.

G. D. Robinson, 1956, U.S. Geol. Survey Geol. Map GQ–88. Described in Hayward quadrangle as pale-yellow thick-bedded coarse calcareous arkosic sandstone; discontinuous pebble conglomerate. Thickness ranges from 500 to 1,500 feet. Overlies Rodeo shale. In this report, the San Pablo is considered a formation overlying the Briones.

C. A. Hall, Jr., 1958, California Univ. Pubs. Geol. Sci., v. 34, no. 1, p. 21–25, fig. 2, geol. map. Formation crops out in northwestern corner and southern half of Pleasanton area. Thickness about 2,000 feet in northern area and 5,000 feet in southern area. Divided into three members: upper, fine-grained sandstone; middle, gray to brown conglomerate fossiliferous calcareous lithic wacke; upper, fine-grained sandstone and interbedded silty claystone. Overlies Hambre sandstone. Near Calaveras Reservoir, transgressively overlaps older Tertiary formations and rests on Niles Canyon formation (new). Underlies Leona rhyolite, Livermore gravels, and in Tularcitos syncline, Orinda formation. Upper Miocene. Term San Pablo group not used in this report.

Named for exposures in Briones Hills, Contra Costa County.

Brisbois 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.

Briscoe Glacial Substage

Pleistocene (Wisconsin): Central Colorado.

Q. D. Singewald, 1950, U.S. Geol. Survey Bull. 955–D, p. 120, pl. 9 [1951]. Times of maximum ice advance and of two principal ice stands during retreat are called Fairplay, Briscoe, and Alma substages, respectively, of Wisconsin stage of glaciation. The Briscoe represents time covered by deposition of Briscoe moraines.

In northwestern Park County. Moraines present only in Platte, Sacramento, Horseshoe, and Middle Tarryall Valleys.

Brister Limestone Member (of Big Saline Formation)

Lower Pennsylvanian: Central Texas.

F. B. Plummer, 1947, Jour. Paleontology, v. 21, no. 2, p. 142, 143, 144; 1947, Jour. Geology, v. 55, no. 3, pt. 2, p. 196 (table 2), 198. Medium- to thick-bedded coarsely crystalline crinoidal limestone made up of conglomeratelike nodules and crinoidal detritus with very irregular bedding planes and other characteristics which suggest reeflike origin. Total thickness 50 to 75 feet. Overlies Lemons Bluff member east of Cavern Ridge; underlies Smithwick formation.

F. B. Plummer, 1950, Texas Univ. Bur. Econ. Geology Pub. 4329, p. 71–73. Referred to as Brister Bluff lentil. Thickness at designated type locality 20 feet.

Type section: At Rough Creek crossing on Bend-San Saba road, San Saba County.

Brister Bluff Lentil (in Big Saline Formation)

See Brister Limestone Member (of Big Saline Formation).

†Bristol Formation[1]

Pliocene: Northern Florida.

Original reference: E. H. Sellards, 1918, Florida Geol. Survey 10th and 11th Ann. Rept., p. 51.

Typically exposed in vicinity of Bristol, Liberty County.

Bristol Granite Gneiss[1]

Pre-Triassic: Central Connecticut.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 104–105, map.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Redescribed as granitoid gneiss with layers and patches of hornblende-plagioclase gneiss occurring locally, especially near borders. Pre-Triassic. Derivation of name.

Named for town of Bristol, Hartford County.

Bristol Limestone (in Washington Formation)[1]

Bristol limestone member

Permian: Northern West Virginia and Eastern Ohio.

Original reference: R. V. Hennen, 1912, West Virginia Geol. Survey Rept. Doddridge and Harrison Counties, p. 168.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 203 (table 14), 213–215. Member of Washington cyclothem in report on Athens County. Tentatively correlated with Bristol limestone of Hennen.

Thickness about 5½ feet. Occurs above a redbed and shale member and below Washington fire-clay shale member.

Named for Bristol, Harrison County, W. Va.

Bristol Bay Silts and Gravels[1]

Pleistocene: Southern Alaska.

Original reference: J. E. Spurr, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 177–178.

Extent from Togiak Bay to Bristol Bay.

Bristol Pass Limestone[1]

Lower Mississippian: Eastern Nevada.

Original reference: L. G. Westgate and A. Knopf, 1932, U.S. Geol. Survey Prof. Paper 171, p. 7, 20, 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 pertaining to the Great Basin, Bristol Pass limestone is shown equivalent to Joana limestone member of White Pine shale. Joana is recommended term. Pioche district as used in this report extends north to Dutch John Mountain, about 40 miles north of Pioche.

Named for occurrence at Bristol Pass, in summit of hill immediately north of bench mark 6149, Pioche district, Lincoln County.

†Bristow Formation[1]

Pennsylvanian: Central Oklahoma.

Original reference: A. E. Fath, 1925, U.S. Geol. Survey Bull. 759, p. 13–15.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 106. Rejected by Oklahoma Geological Survey. Essentially upper part of Vamoosa formation. Name preoccupied by Bristow shale and sandstone of Indiana and Kentucky.

Named for Bristow, Creek County.

Bristow Shale and Sandstone (in Chester Group)[1]

Mississippian: Southwestern Indiana and western central Kentucky.

Original reference: W. N. Logan, 1924, Indiana Dept. Conserv. Pub. 42, p. 11, 125.

C. A. Malott, 1952, Stratigraphy of the Ste. Genevieve and Chester formations of southern Indiana: Ann Arbor, Mich., The Edwards Letter Shop, p. 6. Replaced by Palestine sandstone. Local Indiana names of upper Chester are dropped and formations given names of standard Chester column.

Named for exposures near village of Bristow, Perry County, Ind.

Brite Ignimbrite (in Vieja Group)

Tertiary: Southwestern Texas.

R. K. DeFord, 1958, Texas Jour. Sci., v. 10, no. 1, p. 13, 15 (fig. 3), 26, 28. Name proposed for ignimbrite underlying Petan basalt and overlying Capote Mountain tuff (new). Resembles sanidine rhyolite porphyry; in thin section matrix shows glass shards and other pyroclastic material. Thickness about 100 feet. Locally overlain by a post-volcanic gravel.

Type locality: Top of Capote Mountain, Rim Rock country, Presidio County. Name derived from Brite Ranch.

Briton Member (of Mifflin Formation)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., figs. 3, 10, 16. Limestone or dolomite. Thickness 10 feet. Shown on columnar section as overlying Hazelwood member (new) and underlying Dement member (new) of Grand Detour formation (new).

Occurs in the Dixon-Oregon area.

Britton Clay[1]

Upper Cretaceous (Gulf Series): Eastern Texas.

Original reference: W. S. Adkins, 1933, Texas Univ. Bull. 3232, p. 239, 270, 425.

C. C. Albritton, Jr., and others, 1941, Field and Lab., v. 10, no. 1, p. 23. As originally defined, the Arcadia Park included 20 feet of bluish-gray clay at its base; this clay would seem to be more logically grouped with the Britton, from which it cannot be distinguished lithologically. With some adjustment regarding boundary between these two units, the Tarrant, Britton, and Arcadia Park might stand as members of Eagle Ford formation.

W. L. Turner, 1951, Field and Lab., v. 19, no. 2, p. 54. Abandoned in Eagle Ford quadrangle.

Type locality: Britton, northwestern part of Ellis County.

Broadalbin (passage) Beds

Upper Cambrian or Lower Ordovician (Cambrovician): Central New York.

W. J. Miller, 1911, New York State Mus. Bull. 153, p. 29. Incidental mention as transition beds in Theresa formation.

A. W. Grabau, 1936, Paleozoic formations in the light of the pulsation theory, pt. 1, Caledonian and St. Lawrence geosynclines: Peiping, China, Univ. Press, Natl. Univ. Peking, p. 322 (fig. 7), 325–327, 350. The Theresa in Mohawk Valley sections is believed not to be of same age as true Theresa of northern Adirondack Embayment and is referred to as "Theresa" or Broadalbin passage beds. Constitute passage beds from upper Potsdam to Little Falls dolomite. Consist of alternating sandstones and dolomites. Thickness 150 to 250 feet; greatest thickness where Hoyt member of Theresa is not developed.

Occurs in Mohawk Valley, especially in Broadalbin quadrangle.

Broad Branch series[1]

Precambrian: District of Columbia.

Original reference: W. J. McGee, G. H. Williams, and N. H. Daron, 1893, 5th Internat. Geol. Cong., p. 244.

Broad Ford Sandstone

Broad Ford Sandstone (in Pocono Sandstone)[1]

Devonian or Mississippian (Kinderhookian): Southwestern Virginia and southeastern West Virginia.

Original reference: D. B. Reger, 1925, Econ. Geology, v. 20, p. 778–779.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 170, chart 5 (columns 98, 99). Generally included in the Pocono, but its Mississippian age at type locality has been doubted. Shown on correlation chart in Pocono series (Kinderhookian) below Lindside sandstone and above Sunbury shale.

Lynn Glover, 1953, Virginia Jour. Sci., v. 4, new ser., no. 4, p. 259–260. Broadford [Broad Ford] is unfossiliferous at its type locality. By use of stratigraphic position and key beds, the Broadford has been located in six measured sections northeast of Broadford, and in each a Conewango fauna has been found. Generally the real Broadford sandstone in Virginia has been mapped as part of "Chemung formation," and younger Mississippian units have been mistakenly identified as the Broadford.

Type locality: At line between Smyth and Tazewell Counties, Va., about one-half mile north of Broad Ford village where Laurel Creek of Holston River cuts gap through ridge known as Pine Mountain on west and Brushy Mountain on east.

Broad Top series[1]

Carboniferous: Pennsylvania.

Original reference: H. D. Rogers, 1836, Pennsylvania State Geologist 12th Ann. Rept., p. 16–18.

Broadwater Formation

Pleistocene, lower: Western Nebraska.

C. B. Schultz and T. M. Stout, 1945, Am. Jour. Sci., v. 243, no. 5, p. 232–237. Proposed for sediments of early Pleistocene age. Sediments which constitute Broadwater were deposited in following order: basal gravel member, composed of reddish-brown crystalline gravels; Lisco member (new) consisting of diatomaceous marl and peat, with sand and silt lenses; and upper gravel member. Thickness at type locality 65 to 69 feet. Ogallala sediments were deeply eroded before deposition of Broadwater.

C. B. Schultz and T. M. Stout, 1948, Geol. Soc. America Bull., v. 59, no. 6, p. 553–588. Discussion of Pleistocene mammals and terraces in Great Plains. Unconformity between Kimball and Broadwater formations is most significant stratigraphic break in upper Tertiary and Pleistocene deposits of western Nebraska and Great Plains in general; likewise faunal break between the two formations is most important one paleontologically in same area. This break is believed to be Pliocene-Pleistocene boundary.

Type locality: At Broadwater locality of University of Nebraska State Museum, quarry 1, in NE¼ sec. 20, T. 19 N., R. 47 W., Morrill County.

Broadway Alluvium

Pleistocene (late Wisconsin): Northeastern Colorado.

G. R. Scott, 1960, Geol. Soc. America Bull., v. 70, no. 10, p. 1543. Consists of 12 to 15 feet of reddish-brown fine- to coarse-grained sand and some pebbles. Younger than Louviers alluvium (new).

Type locality: Gravel pit in SE¼ sec. 30, T. 2 S., R. 67 W. Named from Broadway Avenue on Broadway terrace, which lies 25 feet above South Platte River in Denver.

Brock Shale[1]

Upper Triassic: Northern California.

Original reference: J. S. Diller, 1906, U.S. Geol. Atlas, Folio 138.

A. F. Sanborn, [1953], Stanford Univ. Abs. Dissert., v. 27, p. 436; 1960, California Div. Mines Spec. Rept. 63, p. 6 (figs. 3, 4), 7–8, pl. 1. Underlies Hawkins Creek member (new) of Modin formation (redefined); overlies Hosselkus limestone. Estimated thickness 400 feet.

Named from Brock Mountain, Redding quadrangle, between Squaw Creek and Pit River.

Brocklebank Granite

Upper Devonian(?): East-central Vermont.

C. G. Doll, [1945], Vermont State Geologist 24th Rept., p. 20–21. Light-gray medium-grained binary granite.

Named from good exposures in several quarries in vicinity of Brocklebank Hill, 4 miles south-southeast of village of Chelsea, Strafford quadrangle.

Brodhead Formation (in Borden Group)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 76, 135–191, pls. 15, 16. Name proposed for a generalized unit in Kentucky which lies between New Providence formation below and Floyds Knob formation above. Falls within Burlington-Keokuk range of general Mississippian column. Comprises rock equivalent to combined Locust Point and Carwood units of Borden group in Indiana, and includes both Rosewood shale and Holtsclaw sandstone of Butts (1915) in Jefferson County and much of New Providence group as described by Butts (1922, Kentucky Geol. Survey, ser. 6, v. 7) for Kentucky. Composed mostly of silty shale, shaly siltstone, massive siltstone, and fine-grained sandstone with many variations from place to place produced by lateral transitions in facies. Thickness ranges from 135 to 270 feet. Unit is thinnest along axis of Cincinnati Arch from where it is progressively thicker both east and west. Includes following members (not in sequence): Caney Creek, Christy Creek siltstone, Clementsville limestone, Combs Mountain siltstone, Conway Cut siltstone, Culver Springs shale, Frenchburg siltstone, Ginseng siltstone, Haldeman siltstone, Indian Fort shale, Lebanon Junction siltstone, McKinney Knob, Perry Branch siltstone, and Rolling Fork limestone. Differentiated into six facies (in order of occurrence along outcrop belt around Lexington Plain from Indiana to Ohio): Holtsclaw Hill, Pilot Knob, Athertonville, Liberty, Irvine, and Morehead.

Type section: Starting at sandstone quarry just east of bridge over Dicks River, at Louisville and Nashville Railroad Station, Brodhead, Rockcastle County, and along road up hill east-southeast. Name derived from town of Brodhead.

Brodhead Member (of Marcellus Formation)

Middle Devonian: East-central Pennsylvania.

Bradford Willard, 1938, Pennsylvania Geol. Survey, ser. 4, Bull. G–11, p. 17. Name proposed for very finely arenaceous dark-gray nonfissile phase of formation. Bedding generally obscured. Exhibits subconchoidal fracture. May carry bands of small concretions. Devonian. Also referred to as Brodhead Creek member.

Bradford Willard, 1939, *in* Bradford Willard, F. M. Swartz, and A. B. Cleaves, Pennsylvania Geol. Survey, ser. 4, Bull. G–19, p. 139, 170–171. Thickness 20 to 30 feet. Middle Devonian.

Well exposed in quarry on north side of Stroudsburg and beyond, up Highway 90 along west bank of Brodhead Creek, Monroe County. Named for Brodhead Creek valley.

Brodhead Creek Member (of Marcellus Formation)

See Brodhead Member (of Marcellus Formation).

Brodhead Creek 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. Middle member of formation. Variable lithology; consists of shales and sandy shales changing eastward to fine sandstone at East Stroudsburg. Contains lense of dense hard limestone. Thickness about 75 feet at type section where appears to include whole of Tully. Overlies Weissport member (new) on Pohopoco Creek east of Lehighton. Grades into Trimmers Rock sandstone east of Stroudsburg.

Type section: On Brodhead Creek 3 miles northwest of East Stroudsburg, Monroe County.

†Broken Arrow Formation[1]

Pennsylvania (Des Moines Series): Northeastern Oklahoma.

Original reference: R. H. Wood, 1925, Oklahoma Geol. Survey Bull. 35, p. 71.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 99. Abandoned by Oklahoma Geological Survey. Name was given to facies of Labette shale and Nowata shale in area where Oologah and Lenapah were not recognized. Term is not useful, and name is one of those applied to Croweburg coal bed.

Named for Broken Arrow, Tulsa County.

Broken Jug Limestone (in Bisbee Group)

Lower Cretaceous: Southwestern New Mexico.

S. G. Lasky, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 5, p. 531, figs. 2, 4; 1947, U.S. Geol. Survey Prof. Paper 208, p. 16–18, pl. 1. In general, consists of limestone, pure, shaly, and sandy, interbedded with sandstone, shale, and conglomerate. Coarse limestone conglomerate prominent locally. Red to green shale and sandstone present at three horizons in Eureka district. Thickness approximately 3,400 feet in Sylvanite district and perhaps more than 5,000 feet in Eureka district. Overlain by Howells Ridge formation (new) in Sylvanite district and by Ringbone shale (new) and Hidalgo volcanics (new) in Eureka district. Trinity age.

Named from Broken Jug Pass in Sylvanite part of Little Hatchet Mountains, where formation occupies several square miles on east side of the crest. Makes up dissected chain of hills and ridges that front northeast corner of range, in Eureka district.

Brokeoff Andesite[1]

Cenozoic: Northern California.

Original reference: Howel Williams, 1932, California Univ. Pub., Bull. Dept. Geol. Sci., v. 21, no. 5, p. 71 (map).

O. P. Jenkins, 1943, California Div. Mines Bull. 118, p. 674. Cenozoic.

J. A. S. Adams, 1955, Geochim. et Cosmochim. Acta, v. 8, p. 77 (table 2), 78 (table 3), 79, 80 (table 4). Listed on tables and mentioned in text in report on uranium geochemistry of Lassen volcanic rocks.

Brokeoff Mountain is in Lassen Volcanic National Park.

Bromide Formation[1] (in Simpson Group)

Middle Ordovician: Central southern and southwestern Oklahoma.

Original reference: E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, pl. 27.

C. E. Decker, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 4, p. 655–656, measured sections. Outcrops are more widespread than those of any other formation of Simpson group. Measured sections show thickness varies from 87½ feet to 674½ feet. Uppermost formation of group; overlies Tulip Creek formation.

A. R. Loeblich, 1942, Jour. Paleontology, v. 16, no. 4, p. 413–436. Formation, as used in this report, is same as that defined and mapped by Decker and Merritt (1931, Oklahoma Geol. Survey Bull. 55) and thus includes typical Bromide, Criner, and Cool Creek formations of Ulrich. At type section, herein described for first time, formation includes 15 beds with total thickness of 127½ feet; underlies Viola limestone; base of section covered. Evidence presetned by bryozoa suggests lower Trenton age, and fauna is closely allied to Decorah of Minnesota. Review of previous stratigraphic work.

R. S. Bassler, 1943, Am. Jour. Sci., v. 241, no. 11, p. 694–695. Black River age on basis of cystids.

C. E. Decker, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 1, p. 100, 135 (table 5). Discussion of Athens graptolites in Bromide formation. Trenton in age.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 120–123, chart 1. Consists of sandstone. shale, and limestone, latter predominating at least in upper part. Thickest at west end of Arbuckle Mountains where it measures 647 feet. Subdivided into two members: Mountain Lake below and Pooleville above (both new). Overlies Tulip Creek formation; underlies Viola formation. Bromide has been variously placed from Chazyan to Trenton. Brachiopod evidence does not support Loeblich's (1942) conclusion of a lower Trenton age. Chart shows Bromide spans interval from upper part of Chazyan to upper part of Bolarian.

R. W. Harris, 1957, Oklahoma Geol. Survey Bull. 75, p. 84–94, fig. 1, charts 1, 2. Loeblich (1942) measured and described type section. Topmost 10 to 18 feet of dense, thin-bedded limestone of Loeblich's beds 2 and 3 are quite probably Corbin Ranch formation (new) of this report. Also, it is quite possible that lower part of section (plus covered section at base) involves some normal or faulted Tulip Creek strata. U.S. Highway 77 Bromide section is 427 feet thick and subdivisible into a 55- to 60-foot basal sandstone and a 370-foot section of overlying shales and limestones; West Spring Creek section is 420 feet thick and subdivisible into same basal sandstone 60 to 75 feet thick, and overlying shale and limestone section 355 feet thick. Disconformable contact with both underlying Tulip Creek and overlying Corbin Ranch. Ostracoda discussed. Fossils indicate an age essentially Blackriverian.

Type section: Along old road on hill northwest of old Galbraith Hotel in town of Bromide, in sec. 32, T. 1 S., R. 8 E., Johnston County. Section is exposed as faulted inlier in upper Simpson.

Bromley Shale (in Cynthiana Formation)[1]

Bromley Shale Member (of Cynthiana Formation)

Middle Ordovician: Northern Kentucky and southwestern Ohio.

Original reference: R. S. Bassler, 1906, U.S. Nat. Mus. Proc., v. 30, p. 9.

A. C. McFarlan and W. H. White, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1642–1643. Division of the Cynthiana. Consists of 30 feet of drab and blue shales in lower part of bank of Ohio River at Cincinnati. Some of the shales and fine-grained siliceous, earthy and commonly gnarly limestones of lower Cynthiana in northern Bluegrass and also in northern Madison County have been regarded as Bromley, perhaps not too accurately. The Bromley is a facies of lower Greendale and has its own distinctive fauna. 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 lithologic and paleontologic units heretofore defined as Brannon, Woodburn, Greendale, Millersburg, Nicholas, Bromley, Gratz, and Rogers Gap.

L. H. Lattman, 1954, Am. Jour. Sci., v. 252, no. 5, p. 265, 267. Bromley shale appears to be local facies which crosses major faunal zone boundary and may well be discarded as formational name. Cincinnatian series should be extended downward to embrace Cynthiana formation.

Well exposed along river just below Bromley, Kenton County, Ky.

Broncho Mountain Granite[1]

Precambrian: Colorado.

Original reference: R. D. Crawford and P. G. Worcester, 1916, Colorado Geol. Survey Bull. 10.

Exposed on Broncho Mountain, Gold Brick district, Gunnison County.

Bronco Volcanics

Cretaceous or lower Tertiary: Southeastern Arizona.

James Gilluly, 1945, Am. Jour. Sci., v. 243, no. 12, p. 643, 645, 648. Consists dominantly of andesite flow breccias and flows in lower part and of quartz latite flows and tuffs in upper part. These is interfingering of the two varieties of rock; andesitic rocks constitute about two-thirds of the formation. Thickness 5,000 to 6,000 feet. Unconformably overlies Bisbee formation. Intruded by Uncle Sam porphyry.

James Gilluly, 1956, U.S. Geol. Survey Prof. Paper 281, p. 8, 87–90, pl. 5. At the base, formation locally has a conglomerate composed mainly of volcanic material. Invaded, deformed, and altered by Uncle Sam porphyry, Schieffelin granodiorite, and andesite porphyry east-northeast of Bronco Hill. Typical exposure designated.

Typically exposed northeast and north of Bronco Hill, Tombstone area, central Cochise County. Outcrop of formation in this area covers about 3½ square miles. Smaller bodies found in other parts of central Cochise County.

Bronson Formation or Group[1]

Bronson Subgroup (in Kansas City Group)

Pennsylvanian (Missouri Series): Eastern Kansas, southern Iowa, western Missouri, southeastern Nebraska, and northeastern Oklahoma.

Original reference: G. I. Adams, 1904, U.S. Geol. Survey Bull. 238, p. 1, 17, 21.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2029, 2031 (fig. 4). Strata included in Kansas City group as now defined are divisible into three main parts of subequal thickness, which are treated as subgroups (ascending): Bronson, Linn (new), and Zarah (new). Bronson extends from base of Hertha formation to top of Dennis formation and includes (ascending) Hertha, Ladore, Swope, Galesburg, and Dennis formations. Uppermost Bronson unit (Winterset limestone) extends as far southward as T. 8 N. in Oklahoma, but Hertha disappears before Kansas-Oklahoma State line is reached. South of point where Hertha disappears, lower Missourian deposits are referred to Skiatook group and are named (ascending) Seminole formation, Checkerboard limestone, Coffeyville formation, Dennis formation, Cherryvale shale, and Drum limestone. Oklahoma Geological Survey uses Hogshooter (instead of Dennis) and Dewey as a formation name, rather than member of Drum limestone.

Type region: Vicinity of Bronson, Bourbon County, Kans.

Brook Lentil (in Big Saline Formation)

See Brook Ranch Member (of Big Saline Formation).

†Brooke Formation[1]

Lower Cretaceous: Northeastern Virginia.

Original reference: L. F. Ward, 1895, U.S. Geol. Survey 15th Ann. Rept., p. 321.

Vicinity of Brooke Station, 9 miles north of Fredericksburg, Spotsylvania County.

Brookfield Diorite[1]

Brookfield Diorite Gneiss

Brookfield Plutonic Series

Pre-Triassic: Western Connecticut.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 107, map.

E. N. Cameron, 1951, Connecticut Geol. Nat. History Survey Bull. 76, p. 13. Included in Mount Prospect complex and not mapped by name.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Redescribed as diorite gneiss. Generally dark or speckled fine- to medium-grained gneiss, mostly layered, locally schistose. Interlayered with and cut by bodies of light rock of similar composition but with more potash feldspar, especially as large porphyroblasts. Associated with small bodies of biotite hornblendite and pyroxenite in Mount Prospect and West Torrington areas. Pre-Triassic. Derivation of name stated.

J. W. Clarke, 1958, Connecticut Geol. Nat. History Survey Quad. Rept. 7, p. 31–38, map. Redefined as Brookfield plutonic series. Occurs in well-defined plutons, four of which crop out in Danbury quadrangle [this report].

Named for town of Brookfield, Fairfield County.

Brookline Conglomerate Member (of Roxbury Conglomerate)[1]

Devonian or Carboniferous: Eastern Massachusetts.

Original reference: B. K. Emerson, 1917, U.S. Geol. Survey Bull. 597, p. 56–57.

Extensively exposed at Brookline, Suffolk County.

Brooklyn Gneiss[1]

Precambrian or early Paleozoic: Southern New York.

Original reference: B. K. Emerson, 1917, U.S. Geol. Survey Bull. 597, p. 7.

T. W. Fluhr, 1057, Geol. Soc. America Eng. Geology Case Histories No. 1, p. 2, 7 (fig. 1). Bedrock formations in Queens midtown tunnel, New York, include Fordham gneiss, Hell-Gate dolomite, Brooklyn injection gneiss, Inwood limestone, and Manhattan schist. All formations are highly folded, faulted, and metamorphosed. There is disagreement regarding age of formations, but they are here considered to be early Paleozoic. Brooklyn injection gneiss is mixed rock produced from the Fordham by intrusion and injection of Ravenswood granodiorite.

Occurs in New York City.

Brook Ranch Member (of Big Saline Formation)

Pennsylvanian: Central Texas.

F. B. Plummer, 1947, Jour. Paleontology, v. 21, no. 2, p. 142, 143 (table), 144–145; 1947, Jour. Geology, v. 55, no. 3, pt. 2, p. 196 (table 2), 197 (fig. 2), 198. Typically very hard subcrystalline dark-gray, nearly black cherty limestone. Total thickness 15 to 25 feet. Overlies Gibbons conglomerate member, west side of Cavern Ridge; underlies Lemons Bluff member.

F. B. Plummer, 1950, Texas Uni. Bur. Econ. Geology Pub. 4239, p. 64. Brook lentil makes up basal layers of Big Saline in Kimble, Mason, and McCulloch Counties. Occurs between Gibbons conglomerate lentil and Lemons Bluff member, where it is present, and otherwise between Gibbons conglomerate or older rocks and Soldiers Hole limestone beds. Member extends from mouth of Big Saline Creek in Kimble County to Little Brady Creek south of Rochelle in McCulloch County where it pinches out against Ellenburger uplift. Thickness at designated type locality 22 to 25 feet.

Type locality: Along abandoned highway 3½ miles south and 1 mile east of Brady and ¾ mile northwest of Brook Ranch headquarters, McCulloch County.

Brooks Bed[1]

Mississippian: Northwestern Kentucky.

Original reference: A. F. Foerste, 1910, Kentucky Geol. Survey Rept. Prog. 1908, 1909, p. 83.

Derivation of name not explained; may be from Brooks, Bullitt County.

Brooks Lake Glaciation

Pleistocene (late Wisconsin): Southwestern Alaska.

E. H. Muller *in* T. L. Pewé and others, 1953, U.S. Geol. Survey Circ. 289, p. 2-3, 13 (table 1). Four major glaciations tentatively recognized in northern part of Alaska Peninsula. Brooks Lake, last major glaciation of Aleutian Range, succeeded Mak Hill glaciation (new). In lowlands moraine front rises prominently from well-developed outwash plain. Morainic system controls drainage in eastern part of lowlands and encloses basins of Brooks, Naknek, and other large piedmont lakes. Moraines of this glaciation are the most prominent and least modified in lowland. Boulders abundantly exposed on surface of moraine and drainage of moraine belt completely unintegrated, indicating relatively short interval since recession of glaciers.

Named for large lake 36 miles east-southeast of Naknek, northern Alaska Peninsula.

Brookville Clay (in Allegheny Formation)[1]

Brookville Clay (in Pottsville Formation)

Brookville clay or underclay member

Pennsylvanian: Eastern Ohio and western Pennsylvania.

[Original reference]: Wilber Stout, 1918, Ohio Geol. Survey, 4th ser., Bull. 21, p. 125–128.

G. W. White, 1949, Ohio Geol. Survey, 4th ser., Bull. 47, p. 160–169, geol. map. In Holmes County is uppermost member of Pottsville formation. Average thickness 6 feet 5 inches. Lies immediately below Brookville coal which in turn underlies Putnam Hill limestone; typically rests on white thin-bedded micaceous clay-bonded sandstone; at some localities rests immediately upon Tionesta coal.

N. K. Flint, 1951, Ohio Geol. Survey, ser. 4, Bull. 48, p. 40, 41, table 1. Included in Brookville cyclothem, Allegheny series, in Perry County. Lies stratigraphically above Homewood sandstone, base of which is considered boundary between the Pottsville and Allegheny series.

R. E. Lamborn, 1956, Ohio Geol. Survey Bull. 55, p. 54–66, geol. map. Termed Brookville clay member of Pottsville series. Thickness in Tuscarawas County 2 to 12 feet. Lies about 74 feet above Lower Mercer limestone, 45 feet below Upper Mercer limestone, and about 55 feet below Lower Kittanning coal.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 49 (table 7), 51. Underclay member of Brookville cyclothem in report on Athens County. Thickness 2½ feet. Overlies Homewood sandstone member; underlies Brookville (No. 4) coal or Putnam Hill limestone member. Allegheny series.

Described by Stout in Muskingum County, Ohio.

Brookville cyclothem

Pennsylvanian (Allegheny Series): Southeastern Ohio

N. K. Flint, 1949, Ohio Acad. Sci. [Guidebook] 24th Ann. Field Conf., p. 6. Incidental mention in road log.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 40–42, table 1, geol. map. Includes (ascending) Homewood shale and (or) sandstone, 15 feet; Brookville clay, 4 feet; Brookville coal; Putnam Hill limestone, 1 to 6 feet. Occurs above Tionesta cyclothem of Pottsville series and below Clarion cyclothem. In area of report, Allegheny series is described on a cyclothemic basis; nine cyclothems are named (ascending):

Brookville, Clarion, Scrubgrass, Lower Kittanning, Strasburg, Middle Kittanning, Lower Freeport, Bolivar, and Upper Freeport.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 49 (table 7), 50–53. In Athens County, includes (ascending) Homewood sandstone, Brookville underclay, Brookville (No. 4) coal, Putnam Hill limestone member. Occurs above Tionesta cyclothem of Pottsville series. In area of this report, Allegheny series is described on a cyclothemic basis; 13 cyclothems are named (ascending): Brookville, Ogan, Winters(?), Clarion, Scrubgrass, Lawrence, Lower Kittanning, Strasburg, Middle Kittanning, Upper Kittanning, Lower Freeport, Bolivar, and Upper Freeport.

Name derived from Brookville, Jefferson County, Pa. Rogers (1858, Geology of Pennsylvania, v. 3, pt. 1) used name Brookville for the coal.

Brookville terrane[1]

Cretaceous: Kansas.

Original reference: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 255.

Derivation of name not stated but probably Brookville, Saline County.

Broom Creek Group

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

G. E. Condra, E. C. Reed, and O. J. Scherer, 1940, Nebraska Geol. Survey Bull. 13, p. 2 (fig. 2), 5, 18, 19 (fig. 6), 21, 37, 45. Consists of interbedded limestones and sandstones. Comprises interval from base of Cassa group to top of Wendover group (both new). Age uncertain (Pennsylvanian or Permian). Thickness 14 to 75 feet.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull, 14, p. 37, 38 (fig. 15). Stratigraphically expanded to include a few higher beds than included in original definition, placing top at an unconformity located in the overlying Cassa group. Thickness exposed on Broom Creek 85 to 101 feet. Permian.

Type locality: In Broom Creek valley, sec. 10, T. 28 N., R. 66 W., Platte County, Wyo.

Broomhill facies[1] (of New Providence Formation)

Lower Mississippian: Southern Indiana.

Original reference: P. B. Stockdale, 1931, Indiana Dept. Conserv., Div. Geology Pub. 98, p. 77, 100–103.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 127–128, pl. 1. Facies nomenclature discussed. Correlation chart lists Broom Hill [Broomhill] facies of New Providence formation.

Name derived from village of Broomhill, SW cor. sec. 5, T. 1 S., R. 6 E., Clark County.

Brophy Canyon Formation

Upper Jurassic[?] or Cretaceous[?]: Northern California.

J. E. Lawton, 1956, Dissert. Abs., v. 16, no. 10, p. 1885. Shown in list as underlying Fiske Creek formation and overlying Davis Creek formation (both new). Upper Jurassic and Cretaceous section about 40,000 feet thick, consists of sequences of shale and silty shale which alternate with sequences of sandstone.

Occurs in Morgan-Wilbur area in Lake, Yolo, and Colusa Counties.

Brougher Dacite[1]

Miocene, upper(?): Central Nevada.

Original reference: J. E. Spurr, 1905, U.S. Geol. Survey Prof. Paper 42, p. 44, 50, map.

H. G. Ferguson, S. W. Muller, and S. H. Cathcart, 1953, Geology of Coaldale quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ-23]. Oddie rhyolite, as described in this report, includes Brougher dacite of Spurr.

Composes Butler, Brougher, Siebert, and Golden Mountains, Tonopah district.

Brown Bear Leader Sandstone (in Frontier Formation)

Upper Cretaceous: Southern Idaho.

T. K. Kiilsgaard, 1951, Idaho Bur. Mines and Geology Pamph. 92, p. 17, 32. Massive resistant sandstone about 80 feet thick. First massive sandstone underlying the important coal beds in Frontier formation.

Crops out as ribs, crossing ridge crests on western side of Horseshoe Creek Basin, and extends north of Superior Creek to southern side of Packsaddle Creek near Pintar mine. In vicinity of Brown Bear mine and Brown Bear Creek, Horseshoe Creek district, Teton County.

Brown County Bed (in Valentine Formation)

Pliocene: Northwestern Nebraska.

M. K. Elias, 1942, Geol. Soc. America Spec. Paper 41, p. 137. Name applied to a 2-foot bed of diatomaceous marl from arboreous flora was collected by Chaney and Elias (1936, Carnegie Inst. Washington Pub. 487). A slightly lower horizon than Niobrara River channel sand in the Valentine.

Brown 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, 381.

D. A. Zimmerman and G. D. Glover, 1956, Soc. Econ. Paleontologists and Mineralogists Permian Basin Sec. [Guidebook] Spring Mtg., p. 71. Predominantly white sandstone 240 feet thick. Overlies Big Valley bed; underlies Spring Creek bed. Strawn series.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315-D, p. 27, pl. 58. 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 Brown Creek, Mills County.

Browne Glaciation

Pleistocene: Central southern Alaska.

Clyde Wahrhaftig, 1953, *in* T. L. Péwé and others, U.S. Geol. Survey Circ. 289, p. 7, 13 (table 1); Clyde Wahrhaftig, 1958, U.S. Geol. Survey Prof. Paper 293-A, p. 16-17, 22-26, pls. 2, 3, 5. Four distinct glacial advances separated by marked ice withdrawals recognized along Nenana River. Browne, the earliest recognized, preceded Dry Creek glaciation (new). Deposits are granite blocks, largest of which are 40 feet in length.

Blocks rest on terraces 500 feet above Nenana River at Browne, 1,000 feet above river near Ferry, and 2,500 feet above river at Lignite Creek, 6 miles north of Healy.

Browning Sandstone Member (of Spoon Formation)

Browning Sandstone (in Carbondale Formation)

Pennsylvanian: Western Illinois.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 26, 78. Eastward-trending channel sandstone in lower Carbondale, about 5 feet below Colchester (No. 2) coal. Deposits locally truncate lower Carbondale and Pottsville strata and rest on pre-Pennsylvanian.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 10. Type locality stated.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 33, 46 (table 1), 62, pl. 1. Reallocated to member status in Spoon formation (new). Stratigraphically above Abingdon coal member. Thickness 8⅔ feet.

Type locality: Sec. 18, T. 2 N., R. 1 E., Browning Township, Schuyler County.

Brown Mountain Sandstone (in Panoche Formation or Group)

Brown Mountain Sandstone Member (of Moreno Grande Formation)

Upper Cretaceous: Central California.

P. P. Goudkoff, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 7, p. 962 (fig. 2). Listed as uppermost of 10 subdivisions of Panoche formation (or group). Underlies Dosados member of Moreno formation; overlies Ragged Valley shale. Name credited to J. Q. Anderson.

A. S. Huey, 1948, California Div. Mines Bull. 140, p. 31. Southward from Pacheco Pass to Coalinga region, Moreno Grande formation (new) includes restricted Moreno, Brown Mountain sandstone, and *Pachydiscus* silt (also called Ragged Valley shale) as members.

L. I. Briggs, Jr., 1953, California Div. Mines Bull. 167, p. 31. Brown Mountain sandstone, a poorly defined stratigraphic unit of late Upper Cretaceous, is included in uppermost part of Panoche formation of this report [Ortigalita Peak quadrangle].

Occurs in Coalinga-Ortigalito area, San Joaquin Valley.

Browns Mills 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. Dark-gray limestone. Overlies Social Island limestone member (new); underlies New Market limestone. Name credited to J. G. Palacas (unpub. thesis).

In Franklin County.

Browns Park Formation[1]

Miocene(?): Northeastern Utah, northwestern Colorado, and southern Wyoming.

Original reference: J. W. Powell, 1876, Geology of eastern part of Uinta Mountains, p. 40, 44, 168.

W. H. Bradley, 1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 32. Mapped in Carbon and Sweetwater Counties, Wyo. Formation was laid down on eroded surface that cuts older slightly deformed Eocene rocks, but was deformed by subsequent movements that affected both Browns Park and older rocks. Miocene(?).

G. E. Untermann and B. R. Untermann, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 5, p. 685, 686 (table). In Dinosaur National Monument, consists of friable chalk-white to grayish crossbedded sandstones, in part tuffaceous; lake, fluviatile, and some eolian deposits; cherty sandstones and chert beds and concretions; basal conglomerate composed of conglomeratic sandstone and quartzite from Uinta Mountain group. Unconformably overlies Bishop(?) conglomerate; unconformably underlies Quaternary alluvium. In northeast corner of Monument, Browns Park lies on Precambrian Uinta Mountain group with angular discordance. Thickness 1,200 feet. Pliocene.

B. D. Carey, Jr., 1955, Intermountain Assoc. Petroleum Geologists Guidebook 6th Field Conf., p. 47–49. Commonly two units: lower, conglomerate of variable thickness which consists primarily of Precambrian cobbles; upper, composed of beds of chalky-white and grayish-white sandstone, tuffaceous sandstone, thin beds of chert and occasional beds of vitric tuff and fresh-water limestone. Thickness of basal conglomerate 0 to 300 feet; aggregate thickness of upper unit 1,200 feet. Powell estimated 1,800 feet, and this appears to be fairly representative for northwestern Colorado. Unconformably overlies all formations from Precambrian through middle Eocene Bridger formation. Suggestion before Society of Vertebrate Paleontologists to consider formation as middle Miocene (Hemingfordian) and perhaps, partly lower Miocene (Arikareean) in age.

Well developed in Browns Park, northwestern Colorado and northeastern Utah.

Browns Point Formation

Miocene: Northwestern Washington.

S. L. Glover, 1940, (abs.) Geol. Soc. America Bull., v. 51, no. 12, pt. 2, p. 2022–2023. Name applied to marine sedimentary series in strata designated by earlier workers as part of Hoh formation. At type section, comprises about 5,000 feet of moderately cemented buff to gray arkosic sandstones and thin-bedded dark-gray mudstones. Here strata are on south flank of northwesterly trending anticline; some beds are vertical or overturned; formation includes similar rocks, not before described, that form Destruction Island, and also 1,500 feet of exposures at Grenville Bay. Comparative studies indicate the Browns Point is younger than Hoh formation, older than immediately overlying early Pleistocene Taholah or late Pleistocene Queets beds, and older than Pliocene Quinault formation.

Type section: Olympic Peninsula along 3 miles of coast from NE¼ sec. 33 to SW cor. sec. 16, T. 25 N., R. 13 W., Jefferson County.

Brownsport Formation[1]

Brownsport Group

Middle Silurian: West-central Tennessee and northeastern Mississippi.

Original reference: A. F. Foerste, 1903, Jour. Geology, v. 11, p. 566–583, 681–708.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Brownsport group shown on correlation chart as comprising (ascending)

Beech River formation, Bob formation, Lobelville formation, and Decatur limestone.

T. W. Amsden, 1949, Yale Univ., Peabody Mus. Nat. History Bull. 5, p. 138. Described in Decatur, Perry, Wayne, and Hardin Counties, Tenn., as Brownsport formation. Consists of about 100 feet of thin-bedded argillaceous limestones and calcareous and shales with lenses of thick-bedded nonargillaceous limestone. Overlies Dixon formation with apparent conformity; underlies Decatur limestone with apparent conformity. Present investigation does not reveal any satisfactory lithologic or faunal basis for division of Brownsport into formations or members, and it is proposed that terms "Beech River," "Bob", and "Lobelville" be abandoned.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 257–270, fig. 2 From a study of Foerste's descriptions of his Brownsport bed, it is apparent that he included all the beds that today comprise the Beech River Bob, Lobelville, and Decatur formations. Brownsport group as used in this report includes these four units as formations. Overlain by formations of the Devonian or by Chattanooga shale; overlies Wayne group.

Named for exposures in vicinity of Brownsport Furnace, Perryville quadrangle, Decatur County, Tenn.

Brownstown Marl[1] **or Formation**

Brownstown Marl (in Austin Group)

Upper Cretaceous (Gulf Series): Southwestern Arkansas, northwestern Louisiana, southwestern Oklahoma, and northeastern Texas.

Original references: R. T. Hill, 1888, Arkansas Geol. Survey Ann. Rept. 1888, v. 2, p. 72, 86–87, 188; 1894, Geol. Soc. America Bull., v. 5, p. 302, pl. 12; 1901, U.S. Geol. Survey 21st Ann. Rept., pt. 7, p. 340.

L. W. Stephenson and others, 1942, Geol. Soc. America Bull., v. 53, no. 3, chart 9. Correlation chart does not show Brownstown marl as outcropping in Louisiana.

D. L. Frizzell, 1954, Texas Univ. Bur. Econ. Geology Rept. Inv. 22, p. 36. Brownstown marl included in Austin group. Foraminifera described.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Brownstown and Ozan formations mapped undifferentiated.

L. V. Davis, 1960, Oklahoma Geol. Survey Bull. 86, p. 46–48, pl. 1. Brownstown and Ozan formations undifferentiated in McCurtain County. In Arkansas, Brownstown rests unconformably on Tokio formation; this unconformity not recognized in McCurtain County.

First described in vicinity of Brownstown, Sevier County, Ark.

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

Pennsylvanian: Central-western West Virginia.

Original reference: I. C. White, 1903, West Virginia Geol. Survey, v. 2, p. 586.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 78, pl. 7. In Kanawha group a little below Campbell Creek coal. Derivation of name given.

Named from Brownstown (now called Marmet), Kanawha County.

Brownstown Hills Sandstone Member[1] (of Edwardsville Formation)

Mississippian (Osagean): Southern Indiana.

Original reference: P. B. Stockdale, 1931, Indiana Dept. Conserv., Div. Geology Pub. 98, p. 76, 172, 174, 175, 237, 240, 245.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 74. Brownstown Hills sandstone and Dry Creek sandstone members included in Medora Knob facies of formation.

Named for fact it caps Brownstown Hills of south-central Jackson County.

†Browntown Sandstone (in Monongahela Formation)[1]

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

Original reference: I. C. White, 1891, U.S. Geol. Survey Bull. 65, p. 58.

Exposed along bed and bluffs of Ten Mile Creek, at and below Brownstown, Harrison County, W. Va.

Brownville Limestone Member (of Wood Siding Formation)

Brownville Limestone (in Wabaunsee Group)[1]

Brownville Limestone Member (of Konawa Formation)

Pennsylvanian (Virgil Series) : Southeastern Nebraska, southwestern Iowa, eastern Kansas, and north-central Oklahoma.

Original reference: G. E. Condra and N. A. Bengston, 1915, Nebraska Acad. Sci. Pub., v. 9, no. 2, p. 17, 29.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 43. Overlies Wood Siding formation (new).

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2273–2275. Rank reduced to member status in Wood Siding formation (redefined). Overlies Pony Creek shale member; underlies Towle shale member of Onaga formation (new).

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 67–71. Member described in Pawnee County where it is a single limestone unit. Thickness less than 1 foot to as much as 15 feet. Overlies Pony Creek shale member; underlies Permian Admire shale. Continuous from southeastern Nebraska to north-central Oklahoma, where it has been traced as far south as North Canadian River; south of river, the "Prague" of Seminole County is probably continuation of Brownville.

A. E. West, 1960, Shale Shaker, v. 11, no. 3, p. 4–6. Basal member of Konawa formation in report on Lincoln County, Okla. Underlies Americus(?) limestone. Stratigraphically above Grayhorse limestone. Thickness less than 1 foot to more than 3 feet.

Type locality: In Missouri River bluffs southwest of railway station at Brownville, Nemaha County, Nebr.

Brownville Slate[1]

Age(?) : Maine.

Original reference: C. T. Jackson, 1837, Geol. rept. public lands of Maine, v. 1, p. 37.

†Brownwood division[1]

Pennsylvanian: Central Texas.

Original reference: E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept. p. lxvii, pl. 3.

Named for Brownwood, Brown County.

Brownwood Shale Member (of Graford Formation)[1]

Brownwood Shale (in Canyon Group)

Upper Pennsylvanian: Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 387, 389.

F. B. Plummer, 1950, Texas Univ. Bur. Econ. Geology Pub. 4329, p. 94–95. Referred to as Brownwood shale member in Canyon group. Shale is quite sandy throughout, contains at least a dozen sandstone lentils and layers and one conglomerate bed designated as Rough Mountain conglomerate. Thickness measured 3½ miles north of Rochelle, 325 feet. Overlies Rochelle conglomerate; underlies Adams Branch limestone.

R. J. Cordell and D. A. Zimmerman, 1954, Abilene Geol. Soc. Guidebook. Nov. 19–20, p. 47–49. On basis of faunal studies in Brown County, the lower Brownwood is probably late Strawn and upper Brownwood early Canyon. Base of conglomerate separating the two parts of the Brownwood should apparently be regarded as Strawn-Canyon contact.

D. H. Eargle, 1958, San Angelo Geol. Soc. Guidebook Apr. 17–19, p. 51. Shown on composite section of Brown and Coleman Counties as member of Graford formation. Underlies Adams Branch limestone member; is base of section here described. Thickness about 200 feet. Consists of silty gray to red fissile shale; contains sandstone beds locally, and coquinas of crinoid columnals, brachiopods, and pelecypods. Fusulinid-bearing limestone about 60 feet below top, 1.2 miles east of Winchell.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 58 (table 1), 63–64, pl. 27. Drake (1893) placed Brownwood bed in Canyon division of Cummins (1891). He included in it shale and some sandstone which overlie both the Rochelle conglomerate and his Coral limestone bed (Capps limestone lentil of Plummer and Moore, 1921). Drake's Brownwood bed is practically identical with unit that has been considered by later geologists as Brownwood shale member. Plummer and Moore used term Brownwood shale in sense that Drake used it but considered the Rochelle conglomerate to underlie their Capps limestone lentil. Some geologists [see the bibliography of this report] have considered base of Brownwood shale to be top of Capps limestone lentil. Most geologists have considered base farther south, where the Capps is absent, to be the base of Rochelle conglomerate. Name Brownwood shale member is proposed for formal adoption in area of present report [Brown and Coleman Counties] because of lateral continuity of the member, its conspicuous topographic expression, its consistent relationship to other traceable units, and also because of wide usage of name at present time. Recommended that base of member be drawn at top of Capps limestone lentil of Plummer and Moore (1921). Also proposed that top of Brownwood be drawn at base of Adams Branch limestone member. In Brown County, basal beds of Brownwood member are gray shale containing marine fossils. They grade upward into red shale containing several beds of impure limestone and beds of sandstone. About 50 feet above base are additional beds of gray shale containing marine fauna, including brachiopod genus *Chonetina*. This shale is overlain alternately by lenticular beds of sandstone and a calcareous bed that appears in different places to be a desiccation breccia of limestone fragments, a cemented mass of algal(?) limestone pebbles, an impure clastic limestone, a sandy limestone, or (as in Winchell area) a bed of gray limestone 2 feet thick containing fusulinids. This is the limestone considered to be the Palo Pinto equivalent by Nickell (1938, Texas Univ. Bur. Econ, Geology Pub. 3801) and by Cheney and Eargle (1951, West Texas Geol. Soc. Guidebook Spring Field Trip, June 1–2). Above this carbonate bed, and in many places cutting into it, is conglomeratic sandstone. Mostly gray silty shale and some lenticular beds of sandstone occupy interval from the conglomeratic sandstone, near middle part of the Brownwood, to base of Adams Branch member. This part of the Brownwood was called lower member of Graford formation by Nickell (1938). Thickness about 225 feet along Colorado River; about 300 feet in central part of Brown County where entire unit is exposed.

Named for Brownwood, Brown County.

Brownwood Canyon[1]

Carboniferous: Texas.

Original reference: E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept., p. lxvii, pl. 3.

In vicinity of Brownwood, Brown County.

Bruja Island Diorite or Dolerite

Oligocene or Miocene: Panamá.

[T. F. Thompson], 1943, Panama Canal Spec. Eng. Div., 3d Locks Proj., pt. 2, chap. 3, p. 26. Diorite represents massive dike that has cut through and distorted lower beds of Gatún sandstone.

S. M. Jones, 1950, Geol. Soc. America Bull., v. 61, no. 9, p. 898 (table 2), 901. Referred to as dolerite. Lower Miocene.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 326. Oligocene or Miocene.

Quarried on Bruja Grande Island, in Gatún Lake, C.Z.

Brujo Limestone (in Mayagüez Group)

Cretaceous: Southwestern Puerto Rico.

P. H. Mattson, 1958, Dissert. Abs., v. 18, no. 1, p. 197; 1960, Geol. Soc. America Bull. 71, no. 3, p. 337, pl. 1. Contains massive- to thick-bedded microcoquina, pellet limestone, some calcilutite, and minor wacke and mudstone. Lithologically the Brujo is identical with Cotui limestone member (new) of San Germán formation; the two are differentiated only by structural or age relationships. At type section, limestone probably dips northwest beneath a series containing conglomerate, limestone, breccia, and volcanic rock, part of San Germán formation. Southeast of El Brujo ridge the El Brujo fault separates the limestone from another area of San Germán formation to the south. Turonian to Campanian.

Type section: Near El Brujo where the microcoquina forms ridge trending northeast.

Brule Formation[1] or **Clay**[1] (in White River Group)

Oligocene, middle and upper: South Dakota, northeastern Colorado, western Nebraska, and eastern Wyoming.

Original reference: N. H. Darton, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 4, p. 736, 755–759.

A. L. Lugn, 1938, Am. Jour. Sci., v. 36, 5th ser., no. 213, p. 227. Upper formation of White River group. Thickness 500 to 600 feet. Contains *Leptauchenia* and *Oreodon* beds. Overlies Chadron formation. Underlies Gering formation of Arikaree group.

C. B. Schultz and T. M. Stout, 1938, (abs.) Geol. Soc. America Bull., v. 49, no. 12, pt. 2, p. 1921; 1941, Guide for a field conference on the Tertiary and Pleistocene of Nebraska: Nebraska Univ. State Mus. Spec. Rept., p. 4 (table 1), 37. Formation, in Nebraska, subdivided into Orella member below and Whitney member above (both new). Overlies Chadron formation; contact between the two formations provisionally drawn at base of certain continuous purple-tinted white, sometimes silicified, limestone layers, which is upper of several such limestone beds in lower part of local section.

C. B. Schultz and T. M. Stout, 1955, Nebraska Univ. State Mus. Bull., v. 4, no. 2, p. 38–46. Darton did not specify type locality. For practical purposes, Darton's (1899) "Round Top to Adelia Station" section, near Crawford, Sioux County, Nebr., should be considered type locality. Brule formation, in this typical area, approximately 480 feet thick. This same area was used for type definitions of Brule subdivisions. Orella and Whitney members overlie Chadron formation. Writers depart from their 1938 action in defining base of Brule as base of "purplish white layers" and suggest top of "purplish white layer" as redefined plane of division between Chadron and Brule. Locally Whitney member is capped by unit herein named Bayard paleosol complex. Middle and Upper Oligocene.

J. C. Harksen, 1960, Geology of the Sharps Corner quadrangle (1:62,500): South Dakota Geol. Survey. Underlies Sharps formation (new). Consists of at least 200 feet of interbedded pinkish to greenish clays and sands. In White River group.

Named for Brule Indians who once roamed over Pine Ridge Indian Reservation in southern South Dakota.

Brule Schists[1]

Brule Volcanics[1]

Precambrian: Northwestern Michigan.

Original reference: R. C. Allen, 1910, Michigan Geol. and Biol. Survey Pub. 3, geol. ser. 2, p. 34.

Named for exposures north and south of Brule River. Iron River district.

Bruno 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. 38, 40.

Named from exposures on Bruno Creek, a few miles northeast of Florence, Kans.

Brunswick Conglomerate (in Newark Group)[1]

Upper Triassic: Eastern Pennsylvania.

Original reference: E. T. Wherry, 1914, B. L. Miller, Anniversary history of Lehigh County, v. 1, chap. 1, p. 8.

Crops out in region adjoining Boyertown Hills, Berks County.

Brunswick Formation (in Newark Group)

Brunswick Shale[1] or lithofacies (of Newark Group)

Upper Triassic: New Jersey and southeastern Pennsylvania.

Original references: H. B. Kummel, 1897, New Jersey Geol. Survey Ann. Rept. State Geologist 1896, p. 47–55; 1897, Jour. Geology, v. 5, p. 547–549.

D. B. McLaughlin and Bradford Willard, 1949, Pennsylvania Acad. Sci. Proc., v. 23, p. 43. Interpretation of Newark group implies: (1) Brunswick and Lockatong were largely formed contemporaneously as red torrential and nonred paludal facies respectively; (2) Stockton and early Brunswick sedimentations were also to a degree contemporaneous; and (3) Newark is not a group of three distinct formations successively deposited, but a series of interfingering, in part contemporaneously formed, continental facies.

M. E. Johnson and D. B. McLaughlin, 1957, Geol. Soc. America Guidebook for Field Trips Atlantic City Mtg., p. 44–46, 50–51, pl. 1. Formation includes Perkasie member near top and Graters member near middle. Much of formation is soft bright-red argillaceous shale with interbeds of thin- to medium-bedded siltstone; lower part of section contains large amount of thick-bedded tough red argillite with several dark-gray interbedded members; some gray, greenish, and bluish shale occurs high in section. Distribution noted.

D. B. McLaughlin, 1959, Pennsylvania Geol. Survey, 4th ser., Bull. C–9, p. 90–108, pls. Brunswick lithofacies discussed in detail in Bucks County, Pa.

Named for exposures in valley of Raritan, near New Brunswick, Middlesex County, N.J. In New Jersey, occurs in three belts separated by faults and by outcrop of Stockton and Lockatong in respective fault blocks. Owing to dying out of Hopewell fault in both directions, two southern belts merge in Pennsylvania and at northeast end of Sourland Mountain in New Jersey. Southern belt crosses Delaware near Washington Crossing. Middle belt extends northward from Hopewell fault to 1½ miles north of Lambertville where it is cut off by Flemington fault; west of the Delaware, shale of this band is bordered on northwest side by Paleozoic rocks of the floor, brought up by the fault. Northern band crosses Delaware north of Point Pleasant, Pa., and has width of about 10 miles north to Triassic border north of Milford, N.J. In Pennsylvania, continues as wide unbroken band through Bucks, Montgomery, into Berks County.

Brush Coal Member (of Spoon Formation)

Pennsylvanian: Western Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 33, 45 (table 1), 63, pl. 1. Name applied to thin unit formerly designated as Middle DeLong coal. Stratigraphically above Hermon coal member (new), formerly designated as Lower DeLong coal, and below DeLong coal member, formerly designated as Upper DeLong coal. Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification is retained but is entirely independent of rock-stratigraphic classification.

Type locality: Along Brush Creek, secs. 6 and 8, T. 9 N., R. 2 E., Knox County.

Brush cyclothem (in Spoon Formation)

Pennsylvanian: Western Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 42, 52 (table 2), pl. 1. Name applied to cyclothem formerly called Middle DeLong. Above Hermon cyclothem (new) and below DeLong cyclothem. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois. Cyclical classification independent of rock-stratigraphic classification.

Type locality: Along Brush Creek, secs. 6 and 8, T. 9 N., R. 2 E., Knox County.

Brush formation[1]

Upper Jurassic: Utah.

Original reference: C. R. Keyes, 1924, Pan-Am. Geologist, v. 41, p. 36, 301.

Derivation of name not stated.

Brush Creek Clay (in Conemaugh Formation)[1]

Brush Creek Fire Clay (in Conemaugh Formation)[1]

Pennsylvanian: Western Pennsylvania and eastern Ohio.

Original reference: J. P. Lesley, 1879, Pennsylvania 2d Geol. Survey Rept. Q_2.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 62–65, table 1. Brush Creek clay listed as member of Brush Creek cyclothem in report on Perry County.

Brush Creek limestone was named for occurrence along Brush Creek, Cranberry Township, Butler County, Pa.

Brush Creek cyclothem

Pennsylvanian (Conemaugh Series): Southeastern Ohio.

N. K. Flint, 1949, Ohio Acad. Sci. [Guidebook] 24th Ann. Field Conf., p. 11, 15. Incidental mention in road log.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 62–65, table 1, geol. map. Includes (ascending) Brush Creek shale, 17 feet; Brush Creek clay and Brush Creek coal (both absent in Perry County); and Brush Creek limestone, 3 inches to 10 feet. Occurs above Mason cyclothem and below Wilgus cyclothem. In area of this report, Conemaugh series is described on cyclothemic basis; seven cyclothems are named. [For sequence see Mahoning cyclothem.]

Exposed in Perry County.

Brush Creek Fire Clay Shale (in Conemaugh Formation)[1]

Pennsylvanian: Northern West Virginia.

Original reference: R. V. Hennen and D. B. Reger, 1913, West Virginia Geol. Survey Rept. Marion, Monongalia, and Taylor Counties, p. 315.

W. A. Tallon and R. G. Hunter, 1959, West Virginia Geol. Survey Rept. Inv. 17, p. 14. Brush Creek clay is light gray and varies from plastic to hard. Underlies Brush Creek coal. Conemaugh series.

Brush Creek Limestone Member (of Conemaugh Formation)[1]

Brush Creek limestone member

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

Original reference: I. C. White, 1878, Pennsylvania 2d Geol. Survey Rept. Q, p. 34.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 62, table 1. Limestone member of Brush Creek cyclothem in report on Perry County. Average thickness about 2 feet. Marine fauna. Conemaugh series.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 32–37. Discussed as Brush Creek limestone member, Conemaugh series, in report on Morgan County. Commonly consists of two limestones, each from 6 inches to 1½ feet thick, separated by 4 to 8 feet of shale, clay shale, or sandstone. Locally some exposures have only lower bed from 1 to 1½ feet thick. Occurs above Brush Creek coal and below Buffalo sandstone and shale. In earlier years of geological work in tracing strata from Maryland, Pennsylvania, and West Virginia into Ohio, there was much difference of opinion as to correlation of lower Conemaugh beds. Term Brush Creek was applied variously to Cambridge limestone, to the true Brush Creek limestone, and to Mahoning limestone. Much of this miscorrelation resulted from lack of knowledge that the well-established Cambridge limestone changed in character and became discontinuous westward in Ohio. As a result, the true Brush Creek was called Cambridge, and term Brush Creek was applied to the still lower Mahoning limestone. Coals were involved also in changes in terminology over the years. Regional changes in lithology of Brush Creek limestone member added further difficulty to the correlations. Condit (1912, Ohio Geol. Survey, 4th ser., Bull. 17) discussed some of these difficulties in correlation.

See Lower Brush Creek Limestone and Upper Brush Creek Limestone.

Named for exposures along Brush Creek, Cranberry Township, Butler County, Pa.

Brush Creek Red Bed (in Conemaugh Formation)[1]

Pennsylvanian: Southern Pennsylvania.

Original reference: C. K. Swartz, 1922, Maryland Geol. Survey, v. 11, p. 58, pls. 6, 7.

See Lower Brush Creek redbed member.

Somerset, Somerset County.

Brush Creek Sandstone (in Conemaugh Formation)[1]

Pennsylvanian: Southwestern Pennsylvania.

Original reference: J. P. Lesley, 1878, Pennsylvania 2d Geol. Survey Rept. Q, p. 305–308.

Allegheny County.

Brush Creek Shale (in Conemaugh Formation)[1]

Brush Creek shale and sandstone member

Brush Creek shale member

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

Original reference: R. V. Hennen and D. B. Reger, 1913, West Virginia Geol. Survey Rept. Marion, Monongalia, and Taylor Counties, p. 309.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 62. Basal member of Brush Creek cyclothem in report on Perry County. Average thickness 17 feet. Typically buff to greenish sandy or clayey shale. Lies between Mason coal and Brush Creek limestone.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 31. Brush Creek shale and sandstone member occupies interval between base of Brush Creek limestone and top of Mason coal. In early geological reports on Ohio, Mason coal was one of the beds to which name Brush Creek coal was applied, as in original description. Thickness of Brush Creek shale and sandstone varies from 6 to 14 feet in eastern York Township, Morgan County [this report], where Mason coal is best developed. In some exposures, member consists of gray to dark-gray shales. In most of the area, the lithology varies from sandy shale with siderite nodules to shaly thin-bedded sandstone or to more massive sandstone phase. Changes from shale to sandstone are rapid. Above Mason coal and below Brush Creek coal. Conemaugh series.

Named for association with Brush Creek limestone and coal.

Brush Hollow Limestone

Cenozoic (probably Quaternary): Southwestern Colorado.

W. F. Tanner, 1954, Oklahoma Acad. Sci. Proc., v. 35, p. 95 [1955]. Limestone of continental origin. Unconformably overlies sandstones and conglomerates of Cretaceous and Pennsylvanian age. Thickness varies from a few inches to approximately 25 feet. Formation includes three facies: conglomerate, travertine, and medium- to fine-crystalline limestone. Color is buff to tan. Locally the surface has appearance of caliche.

Crops out in Canon City area in T. 18 S., Rs. 69 and 70 W. Named after Brush Hollow Reservoir in T. 18 S., R. 69 W.

Brushy Basin Shale 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, strat. sections.

W. L. Stokes and D. A. Phoenix, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map. 93. In San Miguel and Montrose Counties, Colo., overlies Salt Wash member and underlies Burro Canyon formation (new). Average thickness about 400 feet.

C. T. Smith, 1951, *in* New Mexico Geol. Soc. Guidebook 2d Field Conf. p. 13 (chart), 38; 1954, New Mexico Bur. Mines Mineral Resources Bull. 31, p. 17–18, pl 1. Described in Thoreau quadrangle, New Mexico, where average thickness is about 100 feet. Grades laterally into thin-bedded sandstone to west and south, and into siltstone and mudstone to east and north. Overlies Prewitt sandstone member (new); underlies Dakota(?) sandstone.

W. L. Stokes, 1952, Utah Geol. and Mineralog. Survey Bull. 46, p. 9 (table 1), 11–12, pl. 1. In Thompsons area, overlies Salt Wash sandstone member and underlies Cedar Mountain formation. Consists of mudstone, varicolored, bentonitic, with few lenses of siltstone, sandstone, and conglomerate. Thickness 306 feet.

L. C. Craig and others, 1955, U.S. Geol. Survey Bull. 1009–E, p. 155–156. Constitutes upper part of Morrison in region of this study [Colorado Plateau], where it is present in western Colorado, eastern Utah, northern New Mexico, and part of northeastern Arizona. To southwest, has been removed by post-Morrison erosion. Eastern and northeastern boundary is arbitrary line drawn where Salt Wash member loses its identity and cannot be distinguished from upper part of Morrison. Member is predominantly variegated claystone containing varying amounts of silt and sand. Thickness varies over the Plateau—more than 600 feet at Vernal, Utah, and 450 feet in southwestern Colorado.

V. L. Freeman and L. S. Hilpert, 1956, U.S. Geol. Survey Bull. 1030–J, p. 314, 315 (fig. 60), 320–321, 323–324, 326, 329, 332–333. In Laguna,

N. Mex., area, 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 known locally as Jackpile ore-bearing bed. Thickness ranges from 0 to about 370 feet; thickness largely determined by amount of deformation and erosion before deposition of Dakota sandstone.

J. W. Harshbarger, C. A. Repenning, and J. H. Irwin, 1957, U.S. Geol. Survey Prof. Paper 291, p. 55, strat. sections. Present in northeastern and eastern parts of Navajo country. Intertongues with Westwater Canyon member; underlies Burro Canyon formation and where that is absent Dakota sandstone. Thicknesses: 194 feet at McElmo Creek; 156 feet in Carrizo Mountains area; 148 feet at Toadlena; 51 feet at Thoreau.

E. B. Ekren and F. N. Houser, 1959, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–221. In Moqui SE quadrangle, Montezuma County, Colo., member is 150 to 300 feet thick and consists of varicolored bentonitic mudstone with a few conglomeratic sandstone lenses. Overlies Westwater Canyon sandstone member. Intertongues with overlying Burro Canyon formation.

Named for exposures in Brushy Basin, near Blanding, San Juan County, Utah.

Brushy Canyon Formation (in Delaware Mountain Group)

Lower Permian (Guadalupe Series): Western Texas.

P. B. King *in* R. K. DeFord and E. R. Russell, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 4 (fig. 2), 8. Delaware Mountain group divided into (ascending) Brushy Canyon, Cherry Canyon, and Bell Canyon formations (all new).

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 577–579, 585 (fig. 7), 586–588, pl. 2; 1948, U.S. Geol. Survey Prof. Paper 215 p. 28–30, pl. 3 [1949]. Characterized by many sandstone beds that are coarser grained than those elsewhere in group; individual beds are lenticular and pinch out within short distances; many sections include as many as dozen beds of sandstone of various thicknesses, but others contain only a few; sandstones extend to top of a formation. Thickness 1,000 feet. Conformably overlies Bone Spring formation with Cutoff shaly member (new) forming transition zone between: overlaps northwestward on to Bone Spring.

Named for Brushy Canyon, 6 miles south-southeast of Guadalupe Peak, Culberson County; canyon drains westward down Delaware Mountains escarpment and crosses whole thickness of formation.

†Brushy Creek Chert[1]

Middle Devonian: Southeastern Oklahoma.

Original reference: E. O. Ulrich, 1927, Oklahoma Geol. Survey Bull. 45, p. 30.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 106. Abandoned by Oklahoma Geological Survey. Name preoccupied by Pennsylvanian sandstone in Illinois. Unit now called Pinetop chert.

Named for exposures on Brushy Creek, Pittsburg County.

Brushy Creek Sandstone (in McLeansboro Formation)[1]

Pennsylvanian: Southeastern Illinois.

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

Exposed on north flank of ridge along Brushy Creek at Town Hall near center of Brushy Township, and at other places.

†Brushy Mountain measures (in Pottsville Group)[1]

Pennsylvanian: Southeastern Tennessee.

Original reference: J. M. Safford and J. B. Killebrew, 1900, Elements of geology of Tennessee, p. 104, 149–153, 167, 169.

Named for Brushy Mountain, Morgan County.

Brussels Formation

Pleistocene (Sangamon? and Illinoian): West-central Illinois and east-central Missouri.

W. W. Rubey, 1952, U.S. Geol. Survey Prof. Paper 218, p. 82–87, pl. 1. Proposed for thick series of well-laminated silts which locally contains much sand and gravel. Lithology varies but in general has fairly characteristic development in each of four regions. Most typical and most widespread facies is developed near Brussels. Here, lower third or fourth of formation is massive calcareous clay, and upper part an alternating series of laminated and massive beds of silt, clay, and fine sand. Maximum thickness 75 feet. Formation is younger than parts of Illinoian till and as old or older than Sangamon(?) loess.

Named for exposures near Brussels, Calhoun County, Ill. Widespread throughout Hardin and Brussels quadrangles. Deposits recognized in Lincoln and St. Charles Counties, Mo., and downstream to St. Louis.

Bruton Formation (in Fresnal Group)

Pennsylvanian (Virgil Series): Central New Mexico.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 27 (table 2), 79–82. Term introduced for the red shales, arkosic sandstones and conglomerates, with interbedded nodular to irregularly bedded limestones, which occur between top of the Moya formation (new) below and base of the Permian Wolfcamp above. In eastern part of Oscura Mountains, grades southward laterally into limestones, sandstones, and shales of lower part of Fresnal group. Locally underlies Abo formation. Thickness at type locality 113 feet; in Abo Canyon about 120 feet.

M. L. Thompson, 1954, Kansas Univ. Paleont. Contr. 14, Protozoa, art. 5, p. 17–18. Upper 40 feet of Bruton as defined by Thompson (1942) is transferred to Bursum formation. A lower part of the Bursum as defined by Wilpolt and others is here retained in the Bruton.

Type locality: Northeast side of Oscura Mountains in SE¼ sec. 32, T. 5 S., R. 6 E., Socorro County. Name derived from Bruton Tank on northeast side of Oscura Mountains.

Bryan Sand (in Yegua Formation)

Bryan Sandstone (in Yegua Group)

Eocene (Claiborne): Eastern Texas.

H. B. Stenzel, 1939, Texas Univ. Bur. Econ. Geology Pub. 3945, pt. 2, p. 853 (fig. 131), 856. Lenticular body of sand at base of Yegua formation. Overlies Mount Tabor member (new) of Crockett formation.

Discussion of Yegua problem; author favors placing Crockett-Yegua boundary at base of Bryan sand.

A. A. Matthews, 1950, Texas Eng. Expt. Sta. Research Rept. 14, p. 3, geol. map. Rank raised to formation in Yegua group. At type locality, medium- to coarse-grained, well-sorted, irregularly bedded, coarsely laminated, uniformly crossbedded nearly white sandstone of characteristic deltaic origin. Locally, includes an 8-inch red iron sandstone bed. Contains petrified wood. Estimated thickness 553 feet. Lenticular along strike but not absent except where cut out by faulting. Overlies Smetana sandstone (new); underlies Easterwood shales (new).

Type locality: Along State Highway 21 from 2.1 to 3.75 miles west of court house, Brazos County.

†Bryant limestone[1]

Middle Ordovician: Central eastern Missouri.

Original reference: C. R. Keyes, 1898, Iowa Acad. Sci. Proc., v. 5, p. 59, 61.

Named for exposures along Bryant Creek, Lincoln County.

Bryant Lake Limestone[1]

Precambrian: New York.

Original reference: H. L. Alling, 1927, Geol. Soc. America Bull. v. 38, p. 798, 800.

Derivation of name not stated and not indicated on map.

Bryantsville Breccia or Bed (in Levias Member of Ste. Genevieve Limestone)

Mississippian (Meramec): Southern Indiana.,

J. B. Patton, 1949, Indiana Div. Geology Prog. Rept. 3, p. 9–10. Uppermost bed of Levias is brown rubbly brecciated dense limestone termed Bryantsville bed by C. A. Malott (unpub. ms.) and marks Meramec-Chester contact where Aux Vases is absent.

C. A. Malott, 1952, Stratigraphy of the Ste. Genevieve and Chester formations of southern Indiana: Ann Arbor, Mich., The Edwards Letter Shop, p. 9, 95, 96. Bryantsville breccia applied to persistent bed that is characteristically present at top of Levias member. Commonly 4 feet thick and has uneven base above a thin shale break; usually highly brecciated at top and has loose shaly and nodular facies a few inches thick at very top; frequently quite cherty, chert being flintlike, and the masses partly brecciated and arranged more or less obliquely with the bedding; lower part usually less brecciated than top and well cemented into hard limestone. Contains *Platycrinus penicillus* columnals and colonies of *Lithostrotion harmodites*. This latter fossil has been listed by Butts and Ulrich in Fredonia limestone, but it seems probable that these authors confused the sandstones in many of their sections and that their described occurrence of this fossil actually is in top of Levias instead of top of Fredonia; it has not been observed below Bryantsville in southern Indiana. Butts, Ulrich, and Weller recognized a limestone breccia in the interval in Indiana and Kentucky but did not apply name to it It is quite probable that Bryantsville breccia may extend continuously southward from Ohio River and westward about the whole of eastern and southern outcrop about Illinois basin. Type exposures noted.

T. G. Perry and N. M. Smith, 1958, Indiana Geol. Survey Bull. 12, p. 21, 30–36, pl. 1. Field separation of the Levias member of the Ste. Genevieve limestone from younger Paoli limestone is dependent upon recognition of Aux Vases formation, if it is present, or of the Bryantsville breccia. Where Bryantsville is exposed, it is best stratigraphic marker in locating Meramec-Chester boundary as currently defined. Detailed description of unit; thickness as much as 12 feet.

Type exposures: NW¼NW¼ sec. 25, T. 4 N., R. 2 W., north side of U.S. Highway 50, about 1 mile southwest of Bryantsville, Lawrence County, Ind.; Richard Burton quarry section SW¼NW¼ sec. 20, T. 4 N., R. 1 W., north of road, 1¼ miles east of Bryantsville; Hixon quarry, SE¼NE¼ sec. 20, T. 4 N., R. 1 W., 2 miles east of Bryantsville.

Bryn Mawr Gravel[1]

Pliocene (?): Southeastern Pennsylvania, northern Delaware, and northeastern Maryland.

Original reference: H. C. Lewis, 1881, Philadelphia Acad. Nat. Sci. Proc., v. 32, p. 258–272, 277–278, 288, 296–309.

C. W. Cooke, 1952, Maryland Dept. Geology, Mines and Water Resources Bull. 10, p. 37–39. Described in Prince Georges County, Md., and District of Columbia where it consists of coarse poorly sorted pebbles in red sand and silt; bright-red color distinguishes it from pink or yellow Brandywine formation with which it is nowhere in contact. The farther inland parts lie unconformably on crystalline rocks of the Piedmont; extends eastward onto eroded surface of Patuxent formation; forms surface of ground wherever it occurs. Formation may be Miocene or older but is here assigned to Pliocene(?)

R. M. Overbeck and T. H. Slaughter, 1958, Maryland Dept. Geology, Mines and Water Resources Bull. 21, p. 84–85. In Cecil County, rests unconformably on Patuxent, Patapsco, and Raritan formations; locally, as at Bay View, lies on schists and intrusive rocks.

First described in vicinity of Bryn Mawr, Pa.

Bryson Formation

Bryson Formation (in Pottsville Group)[1]

Middle Pennsylvanian: Northeastern Tennessee and southeastern Kentucky.

Original reference: G. H. Ashley and L. C. Glenn, 1906, U.S. Geol. Survey Prof. Paper 49, p. 33, 44, 208, pl. 40–A.

H. R. Wanless, 1946, Geol. Soc. America Mem. 13, p. 111–114, 138. Highest Pennsylvanian subdivision in Cumberland Gap coal field. Overlies Hignite formation. Partially equivalent to Anderson formation of Tennessee.

Named for Bryson Peak, Claiborne County, Tenn.

Búcaro Formation

Eocene: Panamá.

Karl Sapper, 1937, Mittelamerika, Handbuch der regionalen Geologie: Heidelberg v. 8, Abt. 4a, no. 29, p. 134 (correlation chart). Name Búcaro appears in correlation chart. Underlies Tonosi formation.

A. A. Olsson, 1942, 8th Am. Sci. Cong. Proc., v. 4, p. 235–236. Referred to as Bucarú formation. Exposed thickness of Eocene rocks north of Guanico Point is about 2,000 feet. Lower beds are coarse dark-gray sandstones, conglomerates, and sandy shales. These beds are followed by about 1,500 feet of blue-green or black shales with thin gritty sandstones; in their lower part are several fossil zones, the lower about 50 feet above base of section. Underlies David formation.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 327. On north side of Point near Bucarú, is in fault contact with volcanics; to south grades downward into volcanics. Lexicon uses Búcaro as preferred spelling.

Near village of Búcaro, Los Santos Province.

Bucarú Formation

See Búcaro Formation.

Bucatunna Clay Member (of Byram Formation)[1]

Bucatunna Formation or Clay

Oligocene, middle: Southeastern Mississippi and southwestern Alabama.

Original reference: B. W. Blanpied and others, 1934, Shreveport Geol. Soc. Guidebook 11th Ann. Field Trip, p. 3, 4, 12–16, charts.

F. S. MacNeil, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 9, p. 1315 (fig. 1), 1316, 1332–1341. Uppermost member of Byram formation. Unconformably overlies and in some areas grades into unnamed marl member; underlies Chickasawhay limestone. Near Leaf River, Miss., cuts out or overlapped by Catahoula sandstone. Thickness 11 to 55 feet.

G. E. Murray, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 4, p. 700, 702 (fig. 1). Referred to as Bucatunna clay. Overlies Byram formation. Included in Vicksburg stage.

E. C. Tonti, 1955, Dissert. Abs., v. 15, no. 8, p. 1372. Name Hennessey Bayou member proposed for lower Bucatunna transgressive unit heretofore included in Byram formation.

Type locality: Along Bucatunna Creek, north of Denham post office, which is located in sec. 19, T. 8 N., R. 5 W., Wayne County, Miss.

Buchanan Gravel[1]

Pleistocene (Kansan): Eastern and central Iowa.

Original reference: S. Calvin, 1896, Iowa Acad. Sci. Proc., v. 3, p. 58–60.

A. E. Flint *in* A. V. Heyl, Jr., and others, 1959, U.S. Geol. Survey Prof. Paper 309, p. 25. Buchanan gravels considered to be of Kansan age.

Named for Buchanan County.

Buchanan Hill Conglomerate[1]

Devonian or Carboniferous: Northwestern Pennsylvania.

Original reference: J. P. Lesley, Pennsylvania 2d Geol. Survey Summ. Final Rept., v. 2, p. 1489–1536.

Caps Buchanan Hill, just south of New York line.

Buck Tongue (of Mancos Shale)[1]

Buck Formation

Buck Shale Member (of Price River Formation)

Upper Cretaceous: Central eastern Utah and central western Colorado.

Original reference: C. E. Erdmann, 1934, U.S. Geol. Survey Bull. 851, p. 23, 32.

W. A. Cobban and J. B. Reeside, Jr., 1952, Geol. Soc. America Bull., v. 63, no. 10, p. 1 (facing p. 1011). Shown on correlation chart as formation.

H. E. Wheeler and V. S. Mallory, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 10, p. 2413 (fig. 2), 2417. Member of Price River formation. Stated that term "tongue" is misleading when used in formal designation and that there should be no implication that the Buck shale is part of Mancos as lithostratigraphic or map unit. Montana age.

R. G. Young, 1955, Geol. Soc. America Bull., v. 66, no. 2, p. 180 (fig. 2), 182. Buck tongue of Mancos occurs above Castlegate member and below Sego member of Blackhawk formation. From its western edge near Woodside, Utah, the tongue thickens eastward to maximum of 380 feet at West Salt Creek, Colo., where it passes into main body of the Mancos.

Named for Buck Canyon, T. 19 S., R. 23 E., Utah.

†Buck Creek Formation[1]

Pennsylvanian (Virgil Series): Northeastern Oklahoma.

Original reference: C. N. Gould, 1925, Oklahoma Geol. Survey Bull. 35, p. 78.

U.S. Geological Survey has abandoned the name Buck Creek formation.

Named for exposures along Buck Creek in northeastern part of Osage County.

Buck Creek Sandstone[1]

Buck Creek Sandstone Member (of Grindstone Creek Formation)

Pennsylvanian (Strawn Series): Central northern Texas.

Original reference: F. B. Plummer and J. Hornberger, Jr., 1936, Texas Univ. Bull. 3534, p. 162.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Shown on chart as basal member of Grindstone Creek formation. Occurs below Santos limestone member and above Brannon Bridge limestone member of Lazy Bend formation.

Crops out on Buck Creek in southwestern part of Parker County.

Buckeye Shale (in Sumner Group)[1]

Buckeye Shale Member (of Wellington Shale)

Permian: Southeastern Kansas.

Original reference: R. C. Moore, 1936, Kansas Geol. Soc. Guidebook 10th Ann. Field Conf., p. 12 (fig. 4).

J. L. Garlough and G. L. Taylor, 1941, *in* Stratigraphic type oil fields; Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 87 (table 2). Table lists rocks of Sumner group at their outcrop, 200 miles east of Hugoton gas field; Wellington shale is divided into (ascending) Buckeye shale, Carlton limestone, shale, and Geuda salt.

Buck Hill Volcanic Series

Eocene, upper, Oligocene and younger(?): Western Texas.

S. S. Goldich and C. L. Seward, 1948, West Texas Geol. Soc. [Guidebook] Oct. 29–31, p. 13–22. Name applied to Tertiary volcanic succession unconformably overlying Boquillas formation. Includes (ascending) Pruett formation with its intercalated flows (Crossen trachyte, Sheep Canyon basalt, and Potato Hill andesite), Cottonwood Spring basalt, Duff formation, Mitchell Mesa rhyolite, Tascotal formation, and Rawls basalt. Eocene to Miocene(?). [See Green Valley volcanic series.]

S. S. Goldich and M. A. Elms, 1949, Geol. Soc. America Bull., v. 60, no. 7, p. 1138 (table 1), 1143–1145, 1170, pl. 1. Described in Buck Hill quadrangle where Mitchell Mesa rhyolite is uppermost unit. Thickness 2,000 feet or more. Flows came into region from north, and thus mapped boundaries probably represent their original southern limits closely; flows were eroded in part and weathered before being covered with ash. In Buck Hill and Jordan Gap quadrangles, series has been folded into broad northwest-plunging nose. Lower Tertiary. Pruett is tentatively assigned to Eocene and the Duff to Oligocene. Derivation of name.

R. L. Erickson, 1953, Geol. Soc. America Bull., v. 64, no. 12, pt. 1, p. 1358 (table), 1361–1371, pl. 1. Series described in Tascotal Mesa quadrangle where it includes (ascending) Pruett tuff (formation), Duff tuff (formation), Mitchell Mesa tuff-flow, Tascotal tuff (formation), and Rawls basalt. Thickness about 3,900 feet. Overlies Boquillas formation; angular unconformity. Underlies Quaternary gravels. Eocene(?), Oligocene, Miocene(?).

W. N. McAnulty, 1955, Geol. Soc. America Bull., v. 66, no. 5, p. 536 (table 1), 542–543, pl. 1. Described in Cathedral Mountain quadrangle where Rawls basalt is uppermost unit. Crossen trachyte, Sheep Canyon basalt, and Potato Hill andesite, considered intercalated flows in Pruett formation by Goldich and Elms, are here given formational status, and name Pruett is restricted to the tuff, sandstone, conglomerate, and limestone below Crossen trachyte. Aggregate thickness more than 4,600 feet. Overlies Boquillas formation; angular unconformity. Top of Eocene is placed at disconformity between Crossen trachyte and Sheep Canyon basalt. Suggested that overlying lava and tuff layers are Oligocene and younger(?).

Named for outcrops in Buck Hill quadrangle, Brewster County, Tex.

Buckhorn Asphalt

Pennsylvanian: Southern Oklahoma.

H. J. Smith, 1938, The cephalopod fauna of the Buckhorn asphalt: Dept. Geology and Paleontology, Chicago Univ., p. 1, 3. Asphalt deposit containing cephalopod fauna; main fossil-bearing bed is shaly limestone; thin veneer of calcium carbonate gives rocks a white appearance, but on fresh exposure rocks are black.

A. G. Fisher and Robert Finley, Jr., 1949, (abs.) Geol. Soc. America Bull., v. 60, no. 12, pt. 2, p. 1887. Buckhorn sediment of Oklan age was laid down as shell breccia in argillaceous and sandy matrix, grading upward into gravel; faulting of Arbuckle orogeny permitted Ordovician oil to saturate the sediment.

Occurs in abandoned quarry in sec. 2, T. 1 S., R. 3 E., about 3 miles south of Sulphur, Murray County. Region is on northern flank of Ardmore basin.

Buckhorn Conglomerate (in Cedar Mountain Group)

Buckhorn Conglomerate Member (of Cedar Mountain Formation)

Lower Cretaceous(?): Central eastern Utah.

W. L. Stokes, 1944, Geol. Soc. America Bull., v. 55, no. 8, p. 958, 965–966, pl. 4. At type locality, unit is 20 to 30 feet thick, irregularly bedded with minor sandy lentils, but generally present as single massive stratum. Underlies Cedar Mountain shale (new); overlies Brushy Basin shale member of Morrison. Together with Cedar Mountain shale comprises Cedar Mountain group (new).

W. L. Stokes, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 9, p. 1773, 1774. Rank reduced to member status in Cedar Mountain formation.

Type locality: Buckhorn Flat at southwest flank of Cedar Mountain, Emery County. Prominent in northern part of San Rafael area where it caps Cedar Mountain, a tabular mass of Jurassic sediments about 75 square miles in extent.

†Buckhorn Limestone[1]

Lower Mississippian: Central northern Utah.

Original reference: F. M. Wichman, 1920, Eng. and Mining Jour. v. 110, no. 12, p. 563.

Ophir mining district.

Buckhorn 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, argillaceous, with green shale partings; contains bentonite zone. About 6 feet thick. Shown on columnar section (fig. 3) as underlying St. James member (new) and overlying Glenhaven member (new) of Guttenberg formation.

In the copy of the guidebook used by the compiler, in figure 3 the name Buckhorn had been crossed out and the name Red Oak written in. Likewise, the name Glenhaven had been crossed out and the name Garnet written in. Thus, the sequence would read (descending) St. James, Red Oak, Garnet. However, in figure 9, the name Glenhaven had not been changed. Since the compiler had no way to determine what changes, if any, had been made in other copies of the guidebook, it was impossible to be certain which names were to be retained.

Occurs in Dixon-Oregon area.

†Buckingham Marl or Limestone

Miocene, upper: Florida.

W. C. Mansfield, 1938, (abs.) Geol. Soc. America Bull., v. 49, no. 12, pt. 2, p. 1916; 1939, Florida Geol. Survey Bull. 18, p. 11–16. Proposed for limestone cropping out in Lee County. Believed to be uppermost Miocene. Underlies Tamiami limestone. Fossils listed.

G. G. Parker, 1951, Am. Water Works Assoc. Jour., v. 43, no. 10, p. 823. Tamiami formation as herein defined includes Buckingham limestone of Mansfield.

Type locality: Quarry near State Highway 25, one-half mile west of Orange River, sec. 5, T. 44 S., R. 26 E., Lee County.

Buck Island Member (of Davis Creek Formation)

Upper Jurassic[?] or Cretaceous[?]: Northern California.

J. E. Lawton, 1956, Dissert. Abs., v. 16, no. 10, p. 1885. Upper member of formation. Overlies Baldy Mountain member (new); underlies Brophy Canyon formation (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.

Buck Lodge diabase[1]

Upper Triassic: Central northern Maryland.

Original reference: C. R. Keyes, 1891, Geol. Soc. America Bull., v. 2, p. 320.

East of Sugarloaf Mountain, Frederick County.

Buck Mountain Granite

Precambrian(?): Northwestern Wyoming.

C. C. Bradley, 1956, Wyoming Geol. Assoc. Guidebook 11th Ann. Field Conf., p. 36–37. Name applied to granite in Buck Mountain stock. A pink or white granite resembling alaskite.

Named for Buck Mountain in Grand Teton National Park.

Buckner Formation

Buckner Member (of Haynesville Formation)

Upper Jurassic: Subsurface in Arkansas, Louisiana, Mississippi, and Texas.

H. K. Shearer, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 6, p. 724. Formation, approximately 200 feet thick, is characterized by anhydrite with shale and dolomitic limestone. Overlies Smackover limestone; underlies Cotton Valley formation.

W. B. Weeks, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 8, p. 959 (fig. 2), 960 (fig. 3), 966. Maximum thickness penetrated in Arkansas 270 feet. Pre-Comanche.

R. T. Hazzard, 1939, Shreveport Geol. Soc. Guidebook 14th Ann. Field Trip, p. 158. Jurassic(?).

R. W. Imlay, 1940, Arkansas Geol. Survey Inf. Circ. 12, p. 21–25, cross sections. Presumably Upper Jurassic.

R. W. Imlay, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 11, p. 1437 (table 1), 1451–1458. Detailed discussion with Jurassic formations of Gulf Coast region. Upper Jurassic (Kimmeridgian).

F. M. Swain, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 5, p. 578 (table 1), 592, strat. sections, chart. Underlies Bossier formation (new) of Cotton Valley group. Upper Jurassic.

T. H. Philpott and R. T. Hazzard, 1949, Shreveport Geol. Soc. Guidebook 17th Ann. Field Trip, fig. 5 (correlation shart). Chart shows Buckner as basal member of Haynesville formation (new).

Named after Buckner field, Columbia County, Ark.

Buckner Group

See Boice Formation.

†Buck Point Sandstone Member (of Nelagoney Formation)

Pennsylvanian (Missouri Series): Northeastern Oklahoma.

Original reference: F. R. Clark, 1918, U.S. Geol. Survey Bull. 686–I, p. 94.

Buck Point Sandstone is considered the equivalent of Okesa Sandstone, and name is abandoned.

Well exposed at Buck Point and elsewhere around edges of main divide between Sand and Buck Creeks in T. 26 N., 11 E., Osage County.

Buckrange Sand Lentil (of Ozan Formation)[1]

Upper Cretaceous (Gulf Series): Southwestern Arkansas.

Original reference: C. H. Dane, 1926, U.S. Geol. Survey Press Bull. 8823, Sept. 10.

Crops out short distance north of village of Buckrange, Howard County; also 1 mile northeast of village, on road to Nashville.

†Buck Ridge Gneiss[1]

Precambrian: Southeastern Pennsylvania.

Original reference: J. P. Lesley, 1892, Pennsylvania 2d Geol. Survey Summ. Final Rept., v. 1, p. 80–91, 118.

Forms Buck Ridge.

Buck Ridge Schist

Precambrian (Archean?): Western North Carolina.

C. E. Hunter and P. W. Mattocks, 1936, Tennessee Valley Auth. Div. Geology Bull. 4, p. 12, 14. Rather variable both in composition and texture, but usually is fine textured and composed of secondary micas, chlorites, and feldspars. Includes Bearwallow schist (new).

Named from Buck Ridge in Spruce Pine quadrangle, where it has its largest outcrops.

Bucks Granodiorite

Late Jurassic(?): Northern California.

Anna Hietanen, 1951, Geol. Soc. America Bull., v. 62, no. 6, pl. 1. Shown on map as Bucks granodiorite.

Occurs on Feather River in Merrimac area, Plumas National Forest, Butte and Plumas Counties.

Bucks Bridge Member (of Tribes Hill Formation)

Bucks Bridge (mixed) Beds[1]

Lower Ordovician (Beekmantown): Northern New York.

Original reference: G. H. Chadwick, 1915, Geol. Soc. America Bull., v. 26, p. 289–291.

R. R. Wheeler, 1946, Harvard Univ. Summ. of Theses 1942, p. 144. Middle member of Tribes Hill formation in St. Lawrence Valley. Underlies Ogdensburg member; overlies Heuvelton member.

Apparently named for Bucks Bridge on Nettle Creek in St. Lawrence Valley.

Buckshot Ignimbrite (in Vieja Group)

Tertiary: Southwestern Texas.

R. K. DeFord, 1958, Texas Jour. Sci., v. 10, no. 1, p. 13, 15 (fig. 3), 20. Name proposed for rhyolite porphyry, 40 to 75 feet thick, that caps Buckshot Rim. Fresh rock is grayish red to moderate yellowish brown; weathered surface, pale to dark reddish brown; locally a dusky green layer of brittle glassy rock is present at base. In thin section, matrix shows glass shards and other pyroclastic material. Overlies Colmena tuff (new); underlies Chambers tuff (new).

P. C. Twiss, 1959, Texas Univ. Bur. Econ. Geology Quad. Map 23. Described in Van Horn Mountains area where it forms a resistant cap rock from 3 to 20 feet thick. Overlies Colmena formation. Crops out only on southern flanks of Colquitt syncline in the Sierra Vieja.

Type locality: Four miles east of Candelaria, Rim Rock country, Presidio County.

Buckskin Schist

Pre-Ordovician(?): North-central Washington.

E. A. Youngberg and T. L. Wilson, 1952, Econ. Geology, v. 47, no. 1, p. 2–4, 12. Name applied to series of quartz-amphibole schists containing two horizons of intermittent marble beds and calcareous schist. Mapping indicates beds may be 3,000 to 3,500 feet thick. Age sequence not clear; it would appear that Fernow unit (new) is older than less metamorphosed Buckskin and Martin Ridge schists; this would require that beds be overturned as Fernow gneisses lie stratigraphically above the schists.

Named for occurrence in vicinity of Buckskin Mountain, near Holden, Chelan County.

Buckskinian series

Cretaceous (Mid-Cretacic): Northwestern Kansas, and eastern Colorado.

[C. R.] Keyes, 1941, Pan-Am. Geologist, v. 76, no. 4, p. 304 (chart). Includes Gove chalk below and Wallace shales above; thickness about 700 feet. Occurs above Pueblan series and unconformably below Rawlinsian series.

Charles Keyes, 1942, Pan-Am. Geologist, v. 77, no. 3, p. 207. Includes a great section of dark shales, exposed in eastern Colorado and northwestern Kansas, usually called vaguely and erroneously the Pierre formation. Section covers a large but indefinite part of the median part of Asiniboine centrum shales. There is doubtless another series between the Buckskinian and the top of Apishapa shale member of Pueblan series.

Name derived from a way station in Wallace County, Kans.

Buckskin Mountain Formation

Permian (Wolfcampian): Northeastern Nevada.

T. G. Fails, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no 10, p. 1693–1697. Proposed for a 1,200-foot uniform sequence of yellow-tan quartzose calcisiltites and minor gray calcarenite beds of Wolfcampian age conformably overlying Pennsylvanian-Permian Strathearn formation and conformably overlain by Permian Beacon Flat formation (new).

Type section: On north side of Humboldt River at Carlin Canyon loop area; base in NW¼NW¼SW¼ sec. 22, T. 33 N., R. 53 E., and top in NW¼SE¼NW¼ sec. 22, Elko County. Crops out prominently on Buckskin Mountain, 3 miles south of type locality.

Bucksport Formation

Age not stated: Eastern Maine.

L. A. Wing, 1957, Maine Geol. Survey GP. and G. Survey 1, sheet 1. Thin-banded limey quartzite-uniform bands of light-greenish and dark-gray to purple bands. Lighter bands are quartz rich, and original calcareous minerals have been recrystallized to form lime silicates, mostly diopside; darker bands are quartz and biotite rich, and purple tints are due to finely divided biotite. Overlies Penobscot formation; appears to be overlain and interbedded with unit referred to as Veazie formation (new). Name credited to J. M. Trefethen (1950, Preliminary map of Bucksport area, Maine: Maine Univ.). [Compiler was unable to locate this reference.]

Report covers portions of Hancock and Penobscot Counties.

Buck Spring Formation

Cambrian: South-central Wyoming.

A. B. Shaw and P. O. McGrew, 1954, Wyoming Geol. Soc. Guidebook 9th Ann. Field Conf., chart 2; A. B. Shaw and C. R. DeLand, 1955, Wyoming Geol. Soc. Guidebook 10th Ann Field Conf., p. 38. Name applied to facies equivalents of Gros Ventre group in south-central Wyoming. Contains brown to red sandstone, siltstone with minor amounts of glauconite, and no limestone; by comparison Gros Ventre group contains green fissile highly glauconitic shales and much limestone. Where Death Canyon limestone is missing, entire shale sequence may be called Gros Ventre formation, but where these rocks are in brown to red sand and siltstone facies name Buck Spring is applied. Thickness at type locality 106 feet.

Type locality: Near Buck Spring in SE¼ sec. 4, T. 22 N., R. 88 W., in northwestern part of Rawlins uplift.

Buda Limestone (in Washita Group)[1]

Buda Limestone (in Sixshooter Group)

Upper Cretaceous (Comanche Series): Southeastern Texas, and northern Mexico.

Original reference: T. W. Vaughan, 1900, U.S. Geol. Survey Bull. 164, p. 18.

R. W. Imlay, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 3. Correlation chart shows Buda limestone in Washita group, Upper Cretaceous (lower Cenomanian). Overlies Grayson shale. Present in Chihuahua, Mex.

S. S. Goldich and M. A. Elms, 1949, Geol. Soc. America Bull., v. 60, no. 7, p. 1138 (table 1), 1140–1141, pl. 1. Described in Buck Hill quadrangle, Texas, where it is 65 to 68 feet thick. Disconformably overlies Grayson clay; disconformably underlies Boquillas formation. Lower Cretaceous.

Elliot Gillerman, 1953, U.S. Geol. Survey Bull. 987, p. 10 (table 1), 13, 31, pl. 1. Described in Eagle Mountains, Hudspeth County, where it underlies Eagle Ford formation and overlies Eagle Mountains sandstone member (new) of Grayson formation. Maximum thickness 225 feet. Upper Cretaceous.

Hugh Hay-Roe, 1957, Texas Univ. Bur. Econ. Geology, Geol. Quad. Map 21. In Wylie Mountains and vicinity, uppermost formation in Sixshooter group (new). Overlies Boracho formation (new); overlain with angular discordance by Tertiary volcanic strata. Thickness 40 to 150 feet.

J. P. Brand and R. K. DeFord, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 2, p. 374 (fig. 2), 385–386. Described in Kent quadrangle where it is uppermost formation in Sixshooter group. Unconformably overlies San Martine member (new) of Boracho formation; unconformably underlies Boquillas flags. Thickness 160 feet. Cenomanian.

R. G. Yates and G. A. Thompson, 1959, U.S. Geol. Survey Prof. Paper 312, p. 10, pl. 1. Described in Terlingua district, Texas, where it is commonly 90 feet thick, overlies Grayson formation and underlies Boquillas flags. Comanche series, Upper Cretaceous.

A. P. Noyes, Jr., and Keith Young, 1960, Texas Jour. Sci., v. 12, nos. 1–2, p. 70 (fig. 3), 74 (fig. 5), 90–92. Described in Purgatory Creek area, Texas, where it is 40 feet thick, overlies Del Rio clay and unconformably underlies Eagle Ford formation.

B. F. Perkins, 1960, Geol. Soc. America Mem. 83, p. 9 (fig. 3), 12 (fig. 4), 41–42, pl. 2. At Grayson Bluff, southern Denton County, Tex., the Buda consists of clastic coquinitic buff to yellow limestone about 18 inches thick. Unconformable with underlying Denison formation; contact with overlying Woodbine is irregular surface of erosion. Washita group. Upper Cretaceous.

Named for Buda, Hays County, Tex.

Buell Limestone

Eocene, upper: Eastern Oregon.

J. E. Allen, 1946, Oregon Dept. Geology and Mineral Industries G.M.I. Short Paper 15, p. 8 (pl. 4), 9–11. Dense gray rock with both carbonaceous and clastic fragments. Weathers brown near surface. Estimated thickness 20 feet. Deposit is similar in appearance and composition to Dallas limestone (new) 10½ miles to southwest. Both appear to lie disconformably on older basalt. Fossils occur in Buell limestone but have not been identified. If Buell does occupy stratigraphic position similar to Dallas limestone, it would be of upper Eocene age.

Occurs about 2 miles west of Buell and 3½ miles southeast of Willamina, Polk County, a short distance south of State Highway 22. Extensively quarried.

Buena Vista Sandstone Member (of Cuyahoga Formation)[1]

Buena Vista Sandstone Member (of Logan Formation)

Buena Vista Siltstone Member (of New Providence Formation)

Mississippian: Southern Ohio and north-central Kentucky.

Original reference: E. Orton, 1874, Ohio Geol. Survey, v. 2, pt. 1, p. 615, 618, 626.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 77, 78, 133, pl. 6. Buena Vista siltstone considered member of New Providence formation in area of Vanceburg facies in Kentucky. Overlies Henley member; underlies Rarden member; [Stockdale] cannot clearly justify Hyde's recognition of the Buena Vista in Lewis County; this is partly because of difficulty in distinguishing overlying "Rarden shale member" of Hyde in Kentucky. 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), 60–61, 62. Buena Vista sandstone considered basal member of Logan formation. In area of Vanceburg facies, underlies Rarden shale member; in area of Scioto Valley facies, underlies Portsmouth shale member.

J. E. Hyde, 1953, Ohio Geol. Survey Bull. 51, p. 3 (table 1), 24, 25. Here considered member of Cuyahoga formation in areas of Scioto Valley and Vanceburg facies where it overlies Henley shale member; in Scioto Valley facies, underlies Portsmouth shale member; in Vanceburg facies, underlies Rarden shale member. Editor's note states that Hyde (1921, Ohio Geol. Survey Bull. 23) correlated Buena Vista sandstone with Berne and lower part of Byer in discussion geology of Camp Sherman quadrangle; such a correlation would necessitate placing Rarden, Vanceburg, Churn Creek, and most of Portsmouth shale in Logan formation.

Named for Buena Vista, Scioto County, Ohio.

†Buena Vista Shale[1]

Lower and Middle Cambrian: Central western Virginia.

Original reference: H. D. Campbell, 1905, Am. Jour. Sci., 4th, v. 20, p. 445–447.

Named for Buena Vista, Rockbridge County.

†Buffalo Cement Bed[1]

Silurian: Western New York.

Original reference: G. H. Chadwick, 1917, Geol. Soc. America Bull., v. 28, p. 173–174.

Buffalo, Erie County.

Buffalo Formation (in Conemaugh Formation)[1]

Pennsylvanian: Southwestern Pennsylvania.

Original reference: G. H. Ashley, 1926, Pennsylvania Topog. and Geol. Atlas 65, p. 24–25, pl. 4.

Punxsutawney quadrangle.

†Buffalo Glaciation, Drift, or Till

Buffalo Glacial Stage[1]

Pleistocene: Rocky Mountain region.

Original reference: E. Blackwelder, 1915, Jour. Geology, v. 23, p. 310, 328–336.

John de la Montagne, 1956, Wyoming Geol. Soc. Guidebook 11th Ann. Field Conf., p. 29–30. Glacial sequence in Jackson Hole area (ascending): Buffalo, Bull Lake, and Pinedale.

G. M. Richmond, 1957, Internat. Assoc. for Quarternary Research, 5th Cong., Madrid, p. 157; 1960, Geol. Soc. America Bull., v. 71, no. 9, p. 1371–1382. 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. Buffalo stage includes till sheets of three ancient glaciations. Lower and middle sheets are precanyon and the upper is of intracanyon or postcanyon age. Where stratigraphically superimposed, each of these tills is overlain by thick strongly developed reddish clay soil.

Named for occurrence of drift along Buffalo Fork or Snake River in Wyoming.

Buffalo Granite[1]

Precambrian: Central southern Virginia.

Original reference: F. B. Laney, 1917, Virginia Geol. Survey Bull. 14, p. 36, map.

In vicinity of Buffalo Lithia Springs, Mecklenburg County, Va.

Buffalo Sandstone Member (of Conemaugh Formation)[1]

Buffalo shale and (or) sandstone member

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

Original reference: I. C. White, 1878, Pennsylvania 2d Geol. Survey Rept. Q, p. 33.

M. T. Sturgeon and others, 1958, Ohio Div. Geology Bull. 57, p. 95 (table 11), 114. Referred to as Buffalo shale and (or) sandstone member of Wilgus cyclothem in report on Athens County. White (1878) used name Buffalo for thick sandstone between Brush Creek and Cambridge (Pine Creek in Pennsylvania) limestones. Adams (1903) called shale between Cambridge limestone and Brush Creek coal Buffalo shale. In Ohio, both the sandstone and shale between the Brush Creek and Cambridge limestones are called Buffalo although name is commonly considered as applied to sandstone. Flint's (1951) description of Buffalo shale in Perry County fits that of Meyersdale redbed rather than that of Buffalo member. Term Buffalo is used in this report for both shale and sandstone. Thickness of member varies from 7 to 8 feet to almost 43 feet. Meyersdale redbed member, which overlies Buffalo sandstone in Pennsylvania, is not present in Athens County. Conemaugh series.

Attains maximum development along Buffalo Creek, in Buffalo Township, Butler County, Pa.

Buffalo shale[1]

Upper Ordovician and lower Silurian: Northeastern Missouri and southwestern Illinois.

Original reference: C. R. Keyes, 1898, Iowa Acad. Sci. Proc., v. 5, p. 59, 61.

Named for Buffalo Creek, Pike County, Mo.

Buffalo Shales (in Conemaugh Formation)[1]

Pennsylvanian: Western Pennsylvania.

Original reference: T. K. Adams, 1903, Mines and Minerals, v. 23, p. 360.

N. K. Flint, 1951, Ohio Div. Geology, ser. 4, Bull. 48, p. 65, Table 1. Buffalo shale member included in Wilgus cyclothem in Perry County. Term Buffalo has previously been restricted to massive cliff-forming sandstone, but in this report shale occurring in the same interval is also called Buffalo. Thickness 23 to 52 feet. Consists of shale or clay shale of various gray, green, purple, and red shades. Contains numerous hematite, siderite, and limonite nodules some of which are calcareous. Conemaugh series.

M. T. Sturgeon and others, 1958, Ohio Div. Geology Bull. 57, p. 114. Flint's (1951) description of Buffalo shale in Perry County fits the Meyersdale redbed rather than that of Buffalo member.

Exposed near Pittsburgh, Allegheny County.

Buffalo 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. 71. Clay, 125 feet thick. Underlies Wilbarger Creek bed; overlies Rough Creek bed. Strawn series.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 58, pl. 27. Drake (1893) separated rocks of Strawn group [division] into 20 units of alternating sandstone and shale beds. He gave local names to these units, or "beds" as he termed them, and numbered them from bottom to top, 4 to 23. Only Drake's name for upper unit, the Ricker, is in common use today, and that name has been restricted to the base of Drake's Ricker bed.

Named for Buffalo Creek, Mills County.

Buffalo Creek Limestone (in Kanawha Formation[1] or Group)

Pennsylvanian (Pottsville Series): Southwestern West Virginia.

Original reference: R. V. Hennen and D. B. Reger, 1914, West Virginia Geol. Survey Rept. Logan and Mingo Counties, p. 143.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 78. Marine limestone here considered to be of lower Allegheny age.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 12). In this report, the Kanawha is considered a group in Pottsville series.

Named for association with Buffalo coal, Lee district, Mingo County.

†Buffalo Creek Sandstone Member (of Conemaugh Formation)[1]

Pennsylvanian: Pennsylvania.

Original reference: G. H. Ashley, 1908, Pennsylvania Topog. and Geol. Survey Comm. Rept. 1906–1908, p. 161.

In region of Buffalo Creek, Butler County.

Buffalo Hart Substage

Buffalo Hart Till

Pleistocene (Illinoian): Illinois.

M. M. Leighton and H. B. Willman, 1949, *in* Itinerary State Geologists Field Conference on late Cenozoic Geology of Mississippi Valley, p. 7 (table 1); 1950, Jour. Geology, v. 58, no. 6, p. 602 (fig. 2). Illinoian stage is divided into (ascending) Loveland, Payson, Jacksonville, and Buffalo Hart substages.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 125 (fig. 50), 139, geol. sections 50–52, 58, 61, 64, 66, 69. Buffalo Hart moraine extends through northeast part of Beardstown quadrangle and northward through west part of Vermont quadrangle. Buffalo Hart deposits also form surface drift through all upland areas of Havana and Glasford quadrangles. Outwash deposits scarce, but some gravel and sand occurs over older Illinoian till and under Farmdale or Peorian loess in small ravines north and south of Vermont. Buffalo Hart till cannot be differentiated from older Illinoian tills, except locally where intra-Illinoian gravel, sand, and silt deposits are deposited. Derivation of name given.

Named for Buffalo Hart in northern Sangamon County.

Buffalo Hill Sandstone (in Clear Fork Group)[1]

Permian: Central and central northern Texas.

Original reference: W. E. Wrather, 1917, Southwestern Assoc. Petroleum Geologists Bull., v. 1, opposite p. 96.

Named for Buffalo Hills, Taylor County.

Buffalo Hump 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 uppermost of five formations in group. Overlies Stensgar dolomite.

Report discusses magnesite belt of Stevens County.

Buffalo Peaks Andesite[1]

Oligocene, lower(?): Central Colorado.

Original reference: D. B. Gould, 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 7, p. 900, 990, 999, 1000.

J. T. Stark and others, 1949, Geol. Soc. America Mem. 33, p. 103–105, pl. 1. On Hall Buttes, andesite varies from gray to black, with phenocrysts of hornblende and pryoxene. Flow structure common, and platy jointing often well developed. Small amounts of agglomeratic material at base of volcanics. Thickness between 500 and 600 feet at westernmost end of West Hall Butte and decreases to between 200 and 300 feet at east end of East Hall Butte; much thicker on Buffalo Peaks. An early Oligocene age is suggested.

Lies on truncated surface of Paleozoic strata affected by syncline extending northerly from valley of Trout Creek in sec. 3, T. 14 S., R. 77 W., past Pony Spring, to northeast spur of Buffalo Peaks in Salt Creek area, Park and Chaffee Counties.

Buffalo River Series[1] or Group

Ordovician: Northern Arkansas.

Originial reference (Big Buffalo Series): R. S. Bassler, 1915, U.S. Natl. Mus. Bull. 92, v. 2, pls. 1, 2.

J. S. Cullison, 1938, Jour. Paleontology, v. 12, no. 3, p. 219–228. Buffalo River group as originally defined by Ulrich (1911) included Joachim dolomite at top, St. Peter sandstone, and Everton sandstone and dolmite. McQueen (1937) has described Dutchtown formation, which lies unconformably between the Joachim and the St. Peter and Everton of Ulrich's section. The Dutchtown is only formation of Buffalo River group that contains fossils in abundance.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 113–114. Buffalo River series consists of (ascending) Everton, St. Peter, Dutchtown, and Joachim formations. Originally Big Buffalo series, but name of Big Buffalo River, after which group is named, was changed to Buffalo River.

Ulrich (1911, Geol. Soc. America Bull. v. 22, pl. 27) did not use term Big Buffalo Series. He showed an unnamed epoch preceding the Chazyan and succeeding the Canadian. This unnamed epoch comprised (ascending) Everton, St. Peter, and Joachim Formations. Bassler's Big Buffalo Series comprises (ascending) Sneeds, Everton, St. Peter, and Jasper Formation.

Named for exposures on Buffalo River in Newton County. River was formerly called Big Buffalo.

†Buffalo Run Limestone[1]

Upper Cambrian: Central Pennsylvania.

Original reference: C. D. Walcott, 1916, Smithsonian Misc. Colln. v. 64, no. 3, Pub. 2370, p. 165.

Two miles north of Benore post office, Center County.

Buffalo Springs Formation (in Conococheague Group)

Buffalo Springs 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. Consists of dirty-white or pinkish-gray to medium-gray crystalline limestone, commonly with laminae, alternating with yellowish-gray to light-olive-gray weathered dolomite and magnesian limestone; dolomite is fine to medium crystalline and commonly light gray on fresh surface; thin sandy limestone or silty limestone beds occur locally. Light-olive-gray weathering shaly limestone interbeds present in many outcrops. The white to pinkish-gray limestones commonly grade laterally into very light-gray limestone. Light-blue-gray limestone common near top of member. Estimated thickness more than 700 feet; base of member not exposed in quadrangle; partial section (type section) 247 feet. Underlies Snitz Creek member (new); oldest exposed Cambrian limestone in quadrangle.

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 along old trolley line about 0.7 mile southeast of Buffalo Springs, Lebanon County. No satisfactory type section available in Lebanon County, but best partial section has been measured and used as type section.

Buffalo Wallow Formation[1]

Upper Mississippian: Western central Kentucky and southern Indiana.

Original reference: Charles Butts, 1917, Mississippian formations of western Kentucky: Kentucky Geol. Survey, p. 112.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 840. Name Buffalo Wallow has been used for all of the Chester above Tar Springs sandstone in southeastern part of Eastern Interior basin, but as all of the formations of the Elvira group with the possible exception of the Vienna and Waltersburg can be identified at type locality of the Buffalo Wallow, the name has little value.

Preston McGrain and F. H. Walker, 1954, Kentucky Geol. Soc. Field Trip, April 1954, p. 28. Leitchfield formation differs from Buffalo Wallow (Butts, 1917) in that it includes the Tar Springs as basal member.

Named for Buffalo Wallow, a circquelike excavation in the shales of the formation on highway, 2 miles west of Cloverport, Breckenridge County, Ky.

Buffkin Formation[1]

Buffkin Limestone (in Wabash Formation)

Pennsylvanian: Southwestern Indiana.

Original reference: Marshall Harrell, 1935, Indiana Div. Geology Pub. 133, p. 73 (chart).

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 78. Gives derivation of name.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 25). Correlation chart shows Buffkin limestone in Wabash formation; occurs above Parker limestone and below Grayville limestone.

F. D. Spencer, 1953, U.S. Geol. Survey Circ. 266, p. 14 (fig. 4). Column credited to C. E. Wier (1944–51) shows Buffkin formation at top of section above New Haven formation.

Named for Buffkin, Posey County.

Bufkin Limestone

See Buffkin Formation.

Bug Scuffle Limestone Member (of Gobbler Formation)

Pennsylvanian: Southeastern New Mexico.

L. C. Pray, 1954, New Mexico Geol. Soc. Guidebook 5th Field Conf., p. 93. Appears only on columnar section. Consists of massive gray cherty limestone which grades laterally into sandstone and shale.

In Sacramento Mountains, Otero County.

Bujio Formation

See **Bohío Formation.**

Buldir Volcanics

Quaternary(?): Southwestern Alaska.

R. R. Coats, 1953, U.S. Geol. Survey Bull. 989–A, p. 8, 13–14, fig. 2. In general, rocks are pale-gray dense holocrystalline olivine basalts and olivine-hypersthene basalts. Flows generally thin, averaging less than 10 feet. Interstratified with lava flows on sea cliffs northeast of Kittiwake Pond, at an altitude of 760 feet, are layers of essential basaltic lapilli, consisting of hyalophyric olivine basalt.

Associated with Buldir Volcano and parasitic cone (Hill 1350) to northeast of main cone, which contributed largely to construction of southwestern part of Buldir Island, in western Aleutian Islands.

†Bulger Limestone (in Monongahela Formation)[1]

Upper Pennsylvanian: Southwestern Pennsylvania and eastern Ohio.

Original reference: W. T. Griswold and M. J. Munn, 1907, U.S. Geol. Survey Bull. 318, p. 38–39, 70.

Named for exposures at Bulger, Washington County, Pa.

Bulitan Stage

See Bulitian Stage.

Bulitian Stage

Paleocene: California.

V. S. Mallory, 1953, (abs.) Jour. Paleontology, v. 27, no. 6, p. 903; 1954, Pacific Petroleum Geologist, v. 8, no. 11, p. 1. Named as one of six stages, based on foraminiferal assemblages, in the lower Tertiary of California. Includes interval between Eocene Juniperan [Juniperian] stage above and Paleocene Ynezian stage. Also spelled Bulitan.

V. S. Mallory, 1959, Lower Tertiary biostratigraphy of the California Coast Ranges: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 29–32, 75, 92, fig. 7, tables. Bulitian stage follows Ynezian. Includes two zones, *Bulimina bradburyi* below, and *Valvulineria wilcoxensis* above. Stage generally correlates with Laiming's (1939, 6th Pacific Sci. Cong. Proc., v. 2) "D-Zone." Strata of type Bulitian include Anita shale superjacent to strata of topmost Ynezian and subjacent to the 20 feet of siltstone

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immediately underlying Sierra Blanca limestone. Followed by Penutian stage (name proposed to replace Juniperian stage).

Type area: In Canada el Bulito, Santa Barbara County.

Bull Slate[1]

Bull Formation or Group

Lower Cambrian: West-central Vermont.

Original reference: Arthur Keith, 1932, Washington Acad. Sci. Jour., v. 22, p. 360, 401.

E-an Zen, 1956, (abs.) Geol. Soc. America Bull., v. 67, no. 12, pt. 2, p. 1829–1830. Revised stratigraphic sequence proposed for north end of slate belt in Taconic Range consists of three major units: Biddie Knob formation (base), Bull formation, and Hooker black slate.

E-an Zen, 1959, New England Intercollegiate Geol. Conf. Guidebook 51st Ann. Mtg., p. 1–2. Formation includes (ascending) Castleton conglomerate (new), Mudd Pond (new), Zion Hill, Bomoseen graywacke, and Mettawee members. Overlies Biddie Knob formation; underlies West Castleton 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 divided into four groups and previously described dominant formational names have been elevated to group status. Groups are Bull (Lower Cambrian), West Castleton (Lower Cambrian-Upper Cambrian), Poultney (Lower Ordovician), and Normanskill (Middle Ordovician).

Named for quarry on Bull Hill, 2 miles north of Castleton, Castleton quadrangle.

Bullard Limestone[1]

Pennsylvanian: Utah.

Original reference: O. P. Peterson, 1924, Am. Inst. Min. and Met. Engrs. Trans., v. 70, p. 915.

Bingham district.

Bullard Peak Series

Precambrian: Southwestern New Mexico.

C. H. Hewitt, 1959, New Mexico Bur. Mines Mineral Resources Bull. 60, p. 12–35, 104–105, pl. 1. Rock types that make up Bullard Peak series grouped into five mappable units: (1) quartz-feldspar gneiss, biotite gneiss, quartzite, muscovite schist, and biotite schist; (2) sillimanite gneiss; (3) hornblende gneiss and amphibolite gneiss; (4) granite gneiss; and (5) migmatite and undifferentiated metamorphic rocks. Rocks of series have been intruded and are bounded by granite and related rocks of Burro Mountains granite batholith. Older than Ash Creek series (new).

Crops out along crest, west flank, and north end of Big Burro Mountains in parts of T. 18 S., R. 17 W.; T. 18 S., R. 16 W.; T. 19 S., R. 17 W.; and T. 19 S., R. 16 W., Grant County. Named from exposures in general area of Bullard Peak.

Bull Creek Limestone[1]

Pennsylvanian: Central northern Oklahoma.

Original reference: F. C. Greene, 1918, Am. Assoc. Petroleum Geologists Bull., v. 2, p. 121.

C. C. Branson, 1955, The Hopper, v. 15, nos. 10–11, p. 129. Abandoned. Name is preoccupied by Bull Creek sandstone of Drake (1893) in the Strawn of Texas. Bull Creek is a small tributary of Bird Creek. The bed is Birch Creek limestone of Bowen (1918), the valid name for the member.

Well exposed on Bull Creek, in northwestern part of T. 23 N., R. 11 E., Osage County.

Bull Creek Sand (in Hell Creek Member of Lance Formation)

Cretaceous: Northwestern South Dakota.

E. P. Rothrock, 1937, South Dakota Geol. Survey Rept. Inv. 28, p. 10. Uniform medium-grained golden-yellow sand in upper part of Hell Creek member.

Area of report is Harding County.

Bull Creek Sandstone (in Strawn Formation)[1]

Pennsylvanian: Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 3, p. 374, 379.

D. A. Zimmerman and G. D. Glover, 1956, Soc. Econ. Paleontologists and Mineralogists, Permian Basin Sec. [Guidebook] Spring Mtg., p. 72. Largely floggy layers. Thickness 50 to 75 feet. Overlies Horse Creek clays and shales; underlies Bill Valley 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 Bull Creek, Mills County.

Bull Creek Sandy 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 Stoneville Flats limestone (new).

Carter County, Mont., and Crook County, Wyo.

Bull-Domingo Agglomerate or Breccia

Age not stated: South-central Colorado.

W. C. Peters, 1953, Econ. Geology, v. 48, no. 7, p. 599–600. Agglomerate composed of boulders of gneiss, syenite, and pegmatite held in a solid and impermeable matrix of finer material all derived from Precambrian rocks cut by the pipe. Pipe is which agglomerate accumulated interpreted as the site of a boiling spring which formed in an area of intersecting faults and enlarged to present size by churning rock debris.

D. L. Reynolds, 1954, Am. Jour. Sci., v. 252, no. 10, p. 587. Referred to as breccia.

Limited to an irregular and relatively narrow pipe (1,000 feet of known depth and 100 to 200 feet in diameter) in Silver Cliff mining district, Custer County.

Bullhead Member (of Fox Hills Formation)

Upper Cretaceous: South Dakota.

R. E. Stevenson, 1957, Areal geology of the McIntosh quadrangle (1:62,500): South Dakota Geol. Survey. Consists of thin beds of buff bentonitic silty clay and clayey silts alternating with thin beds of buff, fine, subgraywacke sands. Thickness 400 feet. Overlies Timber Lake member; underlies Colgate member.

Bull Hill Gneiss[1]

Bull Hill Member (of Hoosac Formation)

Cambrian or Lower Ordovician: Southern Vermont.

Original reference: C. H. Richardson, 1931, Vermont State Geologist 17th Rept., p. 221.

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. Described as microcline augen gneiss believed to be metamorphosed rhyolite and rhyolite tuff. Maximum thickness 1,000 feet. Occurs near base of Hoosac formation. Cambrian or Lower Ordovician.

Type locality: On Bull Hill east of northeast of village of Grafton and north of village of Cambridgeport, Saxtons River quadrangle.

Bullington Member (of Magdalena Formation)

Bullington facies (of Morrison Formation)

Pennsylvanian: Central northern New Mexico.

L. L. Ray and J. F. Smith, Jr., 1941, Geol. Soc. America Bull., v. 52, no. 2, p. 184–185. Limestone conglomerate composed of subrounded prismatic fragments of limestone, some almost lithographic in character, embedded in a light-gray to buff matrix of compact limestone. Fragments have maximum length of about 3 inches and breadth of 1 inch. In places, pebbles are smaller shapeless masses of light-buff limestone. Occasionally conglomerate is slightly reddish. Lies stratigraphically above all, or near top of, the "red beds" of the formation and below a sugary yellow sandstone which is presumably near top of formation.

J. F. Smith, Jr., and L. L. Ray, 1943, Geol. Soc. America Bull., v. 54, no. 7, p. 898. Along North Fork of Cimarroncito Creek in Cimarron Range, Bullington member of Magdalena crops out approximately 100 feet below Magdalena-Dakota contact.

K. G. Brill, 1952, Geol. Soc. America Bull., v. 63, no. 8, p. 828. On Cimarroncito Creek, Dakota sandstone is in contact with Morrison formation, and Bullington conglomerate here, as in type locality, is a coarse-grained facies of Morrison formation.

First described from exposures in southern part of Moreno Valley and along western valley wall to a point about 1½ miles north of Comanche Creek, Colfax and Taos Counties.

Bullion Dolomite Member (of Monte Cristo Limestone)[1]

Bullion Member (of Monte Cristo Dolomite)

Bullion Limestone Member (of Monte Cristo Limestone)

Lower Mississippian: Southeastern Nevada and southeastern California.

Original reference: D. F. Hewett, 1931, U.S. Geol. Survey Prof. Paper 162, p. 10, 18.

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 described as limestone 515 feet thick; overlies Anchor limestone member and underlies Yellowpine limestone member (Arrowhead limestone member not recognized in area).

Charles Deiss, 1952, U.S. Geol. Survey Bull. 973–C, p. 116-117, pl. 13. Member described in Sloan district, Nevada, where it is 445 feet thick, overlies Anchor member; uppermost unit of formation; underlies Bird Spring formation. Consists essentially of dolomite.

D. F. Hewett, 1956, U.S. Geol. Survey Prof. Paper 275, p. 42. Described in Ivanpah quadrangle (California-Nevada) where it is nearly pure dolomite. Overlies Anchor limestone member; underlies Arrowhead limestone member.

Named for Bullion mine, sec. 23, T. 25 S., R. 58 E., Goodsprings quadrangle, Clark County, Nev.

Bullion Butte Bed (in Sentinel Butte Shale Member of Fort Union Formation)

Paleocene: Southwestern North Dakota.

E. P. Beroni and H. L. Bauer, Jr., 1952, U.S. Atomic Energy Comm. TEI Rept. 123, p. 6, figs. 2, 4. Thickness about 15 feet at Bullion Butte. Contains uraniferous lignite.

Named for occurrence on Bullion Butte, Golden Valley County.

Bullion Canyon Volcanics

Bullion Canyon Series

Miocene(?): Central Utah.

Eugene Callaghan, 1939, Am. Geophys. Union Trans. 20th Ann. Mtg., pt. 3, p. 439 (fig. 2), 440 (fig. 3), 441–446. Volcanics vary greatly from place to place in proportion of flows to pyroclastics. Total thickness at least 5,000 feet. In eastern part of Tushar Mountains, three distinct parts distinguished, and here includes Delano Peak latite member (new). Overlies Carmel shale and limestone, Navajo sandstone, and Wasatch formation. Underlies (in central part) Mount Belknap rhyolite (new); on west in contact with Roger Peak basaltic breccia and Joe Lott tuff (both new); on east in contact with Dry Hollow latite (new). Tertiary.

P. F. Kerr and others, 1957, Geol. Soc. America Spec. Paper 65, p. 14-22, pl. 1. For purpose of this report, to follow variations in alterations, Bullion Canyon series is divided into 12 members. Rock Candy latite and agglomerate applied to one member, others unnamed.

D. P. McGookey, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 5, p. 595, 605–607, 609–615. Gray Gulch formation as designated by Spieker (1949) includes strata equivalent to Bald Knoll formation of Gilliland (1951), part of Bullion Canyon volcanics of Callaghan (1939) and a previously unnamed interval mapped as Gray Gulch(?) by Lautenschlager (1952, unpub. thesis). Proposed that (1) term Gray Gulch be abandoned; (2) term Bald Knoll formation be used for lower part of interval formerly assigned to Gray Gulch; (3) name Dipping Vat formation (new) be applied to upper coarse interval of lacustrine beds formerly included in Gray Gulch formation; and (4) fluvial beds equivalent to Bullion Cayon volcanics be included in Bullion Canyon volcanics, clastics. Term Bullion Canyon volcanics, clastics is used herein for the sequence of mudflows, conglomerate tuffaceous sandstone, and tuff that disconformably overlies Dipping Vat formation. Section that crops out along Little Lost Creek and Lost Creek is divisible into three distinct units. Thickness about 2,510 feet. Term Bullion Canyon volcanics, lava flows, is used herein for a sequence of igneous rock that appears to have been extruded as lava flows. This sequence lies disconformably on the Bullion Canyon volcanics, clastics. These extrusive rocks are designated as upper member of a sequence that is believed equivalent to Bullion Canyon volcanics as defined in type area near Marysvale. Based on stratigraphic position, Bullion Canyon volcanics, clastics are believed early middle Tertiary. Relations suggest that the lava flows are middle Tertiary, probably Oligocene.

U.S. Geological Survey currently classifies the Bullion Canyon Volcanics as Miocene(?) on the basis of restudy of the area.

Named for Bullion Canyon, west of Marysvale, Piute County.

Bull Lake Glaciation or **Drift**

Bull Lake glacial stage[1]

Pleistocene: Rocky Mountain region.

Original reference: E. Blackwelder, 1915, Jour. Geology, v. 23, p. 310, 325–340.

G. M. Richmond, 1953, Friends of the Pleistocene Rocky Mountain Sec. [Guidebook] 2d Ann. Field Trip Oct. 4–5, correlation chart. Bull Lake stage comprises an early Bull Lake substage, Porcupine Ranch substage (new), and late Bull Lake substage. Bull Lake stage is preceded by Buffalo stage and followed by Lackey Creek stage (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. 175; 1960, Geol. Soc. America Bull., v. 71, no. 9, p. 1371–1382. 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. Bull Lake stage comprises well-developed mature moraines that are commonly the outermost on the canyon floors. Deposits are separable into two substages, which, where superimposed, are each overlain by mature zonal soils.

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. The older, Bull Lake, consists of two distinct advances separated by a major recession. Its two sets of moraines can be traced northeast from mountain front for 18 miles to point where the younger overlaps the older and merges with continental drift of same age. Drift is probably older than Farmdale loess of Illinois, dated as between 22,900 ± 900 years to 26,100 ± 600 years.

Moraines of stage well exposed in vicinity of Bull Lake, on northern slope of Wind River Range.

Bull Lake Creek Shales[1]

Cambrian: Western Wyoming.

Original reference: E. B. Branson, 1917, Geol. Soc. America Bull., v. 28, p. 347–350.

In Wind River Mountains. Probably named from Bull Lake Creek.

Bull Mountain Andesitic Series

Tertiary: Northwestern Arizona.

B. E. Thomas, 1949, Econ. Geology, v. 44, no. 8, p. 667. Comprises oldest Tertiary eruptive rocks in area. Consists of flows, tuffs, and breccias predominantly andesitic in composition. Rests upon surface cut on Cerbat complex (new); disconformably underlies Kingman series (new).

B. E. Thomas, 1953, Geol. Soc. America Bull., v. 64, no. 4, p. 407, pl. 1. Consists mostly of flows of medium-gray to grayish-red purple andesite, with some dark-gray basalt members. Intercalated with flows and especially abundant in basal section are beds of pink and red scoriaceous breccia and yellow to red tuff and lapilli. Strata reach thickness of almost 1,000 feet in northernmost extension of Kingman Mesa. Farther north, series occurs as isolated small cappings of ridges and buttes with maximum thickness of 350 feet. Geographic distribution discussed.

Named after Bull Mountain, which is capped by rocks of the series. Occurs along east side of Cerbat Mountains, Mohave County.

†Bull Mountain Series[1]

Eocene: Central southern Montana.

Original reference: W. Lindgren, 1886, U.S. Tenth Census, v. 15, p. 745, pl. 60.

In Bull Mountains and adjacent territory, Yellowstone County.

Bull Pond Limestone[1]

Age(?): New York.

Original reference: W. W. Mather, 1843, Geology New York, v. 1, pl. 45.

From Monticello, Sullivan County, to Croton River near Bulls Bridge, Westchester County.

Bull Run Glacial Epoch

Pleistocene: Central northern Oregon.

E. T. Hodge, 1938, Geol. Soc. America Bull., v. 49, no. 6, p. 835, 841 (table 1). Second of five glacial epochs. Occurs in interval between Cascadian and Willamettian epochs. During Bull Run epoch, erupted lavas were mostly andesitic; they are named Cascan volcanics.

Bull Run Shales (in Newark Group)[1]

Upper Triassic: Northeastern Virginia.

Original reference: J. K. Roberts, 1923, Pan-Am. Geologist, v. 39, p. 185–200.

Crops out over Bull Run Battlefield, Prince William County.

Bull Shoals Mountain Chert Bed (in Powell Dolomite)

Lower Ordovician: Central northern Arkansas.

J. S. Cullison, 1944, Missouri Univ. School Mines and Metallurgy Bull., Tech. Ser., v. 15, no. 2, p. 39, pls. 2, 12 (fig. 2). Delicately banded chert nodule bed occurring above base of Powell dolomite.

Well exposed on road over Bull Shoals Mountain, in SE¼ sec. 19, T. 20 N., R. 15 W., Marion County.

Bullwagon Dolomite Member (of Vale Formation)

Bullwagon Dolomite (in Clear Fork Group)[1]

Permian (Leonard Series): North-central Texas.

Original reference: W. E. Wrather, 1917, Southwestern Assoc. Petroleum Geologists Bull., v. 1, p. 96–97, pl.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Rank reduced to member status in Vale formation.

Named for Bullwagon Creek, Taylor County.

Bullwhacker Member (of 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. 20, 21, 22, pl. 2. Composed of a rather uniform sequence of thin-bedded platy or shaly limestone, some of which is slightly silty; on fresh fracture, color ranges from medium light to medium dark gray. Shaly or sandy partings and thin interbeds weather to buff or pinkish, and whole member has a collective yellowish-tan color that is distinctive. Limestone beds are from ¼ to 1 inch thick and are fine grained to subporcellaneous in texture. Commonly 400 feet thick throughout area. At Eureka it appears to be conformable with both Catlin member (new) below and Pogonip group above.

Named from exposures in vicinity of Bullwhacker mine, Eureka mining district, Eureka County.

Bully Hill Rhyolite[1]

Middle and Late Triassic: Northern California.

Original reference: J. S. Diller, 1906, U.S. Geol. Survey Geol. Atlas, Folio 138.

J. P. Albers, 1953, California Div. Mines Spec. Rept. 29, p. 5–7, pls. 1, 5. Name Bully Hill rhyolite restored as formal stratigraphic unit. Formation considered largely extrusive soda rhyolite and soda rhyolite porphyry rather than intrusive alaskite and alaskite porphyry (as it was considered by Graton who abandoned the name in 1910). Thickness (in Afterthought mine) about 1,100 feet. Lies with apparent conformity between older Dekkas andesite and younger Pit formation.

M. A. Murphy, W. P. Popenoe, and J. P. Albers, 1957, Sacramento Geol. Soc. Ann. Field Trip May 25–26, p. 12. Noted as being in fault contact with Pit formation near Afterthought mine.

Occurs in Bully Hill region, Shasta County.

†Bully Hill Volcanics[1]

Age(?): Northern California.

Original reference: J. S. Diller, 1905, Am. Jour. Sci., 4th, v. 19, p. 380–385. Redding quadrangle.

Bumpnose Limestone Member (of Crystal River Formation)

Eocene, upper: Northwestern Florida.

W. E. Moore, 1955, Florida Geol. Survey Bull. 37, p. 19 (fig. 4), 21 (table 1), 30, 36–42. Beds younger than the Crystal River of Puri occur in Jackson County at top of Ocala group. These beds are here named Bumpnose limestone and constitute uppermost member of formation. Contains *Lepidocyclina (Nephrolepidina) chaperi* Lemoine and R. Douville. Occurs above *Asterocyclina* zone of Crystal River and below Marianna limestone which contains *Lepidocyclina (Lepidocyclina) mantelli* (Morton). Soft easily crumbled white limestone generally more granular than typical Marianna. Thickness ranges from 0 to 15 feet; appranently thins to southeast where it is replaced in subsurface by Gadsden limestone southeast of Cypress fault.

H. S. Puri, 1957, Florida Geol. Survey Bull. 38, p. 33–34. Moore's Bumpnose member is not stratigraphically valid because beds for which name was proposed are not younger than the Crystal River of Puri since they underlie Marianna limestone of Oligocene age. The interval is a faunizone, and exactly the same beds are defined by MacNeil (1944, Am. Assoc. Petroleum Geologists Bull., v. 28, p. 1313) as *Lepidocyclina fragilis* faunizone at same outcrop.

Type locality: Quarry near center of W½ sec. 23, T. 5 N., R. 11 W., Jackson County. Named for exposures along and near Bumpnose Road north and west of Marianna.

†Buncombe Group[1]

Precambrian and Cambrian(?): Western North Carolina.

Original reference: W. C. Kerr, 1869, North Carolina Geol. Survey Rept. 2, p. 13–35.

Occupies larger part of great transmontane plateau between Blue Ridge and Smoky Mountains.

†Bunger Formation (in Cisco Group)[1]

Pennsylvanian: Central northern Texas.

Original reference: F. B. Plummer, 1919, Am. Assoc. Petroleum Geologists Bull., v. 3, p. 133–145.

Named for Bunger, Young County.

Bunger Limestone Member (of Graham Formation)[1]

Bunger Formation (in Graham Group)

Upper 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). Rank raised to formation in Graham group. Overlies North Leon formation; underlies post-Bunger cycles 1 to 7.

E. L. Thackery, 1951, West Texas Geol. Soc. Guidebook, June 1–2, p. 14–15, chart. Chart shows Bunger limestone in Graham group above Gonzales limestone and below Gunsight limestone in Brazos River outcrop section; thins toward Colorado River section.

John Kay, 1956, North Texas Geol. Soc. Field Guidebook May 25–26, fig. 4. Generalized columnar section shows Bunger limestone in Graham group stratigraphically above Salem School limestone and below unit termed Number 3 limestone.

Named for Bunger, Young County.

Bunje cyclothem (in Bond Formation)

Bunje cyclothem (in McLeansboro Group)

Pennsylvanian: Southwestern 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 below Flat Creek cyclothem and above Sorento cyclothem (new).

H. R. Wanless, 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. 43, 52 (table 2), pl. 1. In Bond formation (new). Above Sorento cyclothem and below Flat Creek cyclothem. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification independent of rock-stratigraphic classification.

Type locality: S½ sec. 7, T. 6 N., R. 4 W., Bond County. Named for village of Bunje.

Bunje 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, pl. 1. Name applied to limestone member that lies stratigraphically above Sorento limestone member (new) and below Flat Creek coal member (new). Olive gray or bluish gray; cone-in-cone structure throughout. Thickness as much as 18 inches. Name credited to J. A. Simon (unpub. ms.). Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification is retained but is entirely independent of rock-stratigraphic classification.

Type locality: SE¼SW¼ sec. 7, T. 6 N., R. 4 W., Bond County. Named for exposures about 1 mile south of village of Bunje.

Bunker Andesite[1]

Eocene: Central southern Colorado.

Original references: W. Cross, 1890, Colorado Sci. Soc. Proc., v. 3, pt. 3, p. 272; 1896, U.S. Geol. Survey 17th Ann. Rept., pt. 2, p. 289.

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 dikes cutting earlier andesite, Bald Mountain dacite flows, rhyolite in dikes, eruptive channels and flows, Pringle andesite, trachyte flows, and Bassick agglomerate.

Forms greater part of Rosita Hills, Silver Cliff-Rosita region.

Bunker Hill Volcanics

See Jonestown Volcanics.

Burbank Member (of Cuyahoga Formation)[1]

Mississippian: North-central Ohio.

Original reference: G. W. Conrey, 1921, Ohio Geol. Survey, 4th ser., Bull. 24, p. 50.

F. T. Holden, 1941, Illinois Acad. Sci. Trans., v. 34, no. 2, p. 172; 1942, Jour. Geology, v. 50, no. 1, p. 49. Included in Killbuck shale facies (new) of the Cuyahoga. Consists of series of alternating gray arenaceous shales and buff-gray fine-grained sandstones and siltstones with maximum exposed thickness of 150 feet. Base not exposed. Underlies Armstrong sandstone member.

E. J. Szmuc, 1958, Dissert. Abs., v. 18, no. 6, p. 2109. Discussion of stratigraphy and paleontology of Cuyahoga formation. Term Burbank not used since it refers to strata lithically and faunally idential with upper part of Meadville member.

Named for Burbank in northern part of Wayne County.

Burchards Member (of Chipman Formation)

Burchards Limestone (in Chipman Group)

Lower Ordovician: West-central Vermont.

Marshall Kay and W. M. Cady, 1947, Science, v. 105, no. 2736, p. 601. Middle Ordovician limestones of west-central Vermont have been described and mapped by Cady (1945, Geol. Soc. America Bull., v. 56, no. 5), who included Crown Point, Beldens, and Middlebury formations in Chazy "group." Inasmuch as first-named formation is structurally separated from Crown Point limestone of type locality and other outcrops in New York and is succeeded by Beldens formation rather than by Valcour limestone, it is here proposed that "Crown Point" formation east of Champlain thrust in west-central Vermont be designated Burchards limestone. Consists of about 150 feet of somewhat magnesian limestone that has species of *Maclurites*. Underlies Beldens formation. Basal formation of Chipman group (new).

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, p. 28–29. Dark-gray and white finely banded marble with few thin brown-weathering dolomite beds. Questionably overlies Bascom formation disconformably. Only surface exposure on eastern edge of West Rutland athletic field.

Marshall Kay *in* W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, p. 263, chart 2 (column 15). Lower Ordovician (Canadian).

W. M. Cady and E-an Zen, 1960, Am. Jour. Sci., v. 258, no. 10, p. 728–739. Rank reduced to member status in the Chipman herein reduced to rank of formation. Characterized by limestone with dolomitic markings. Mapping in Sudbury-Brandon area shows that sequence of the Burchards, Weybridge, and Beldens members, though generally about that order, is locally much varied. Bridport dolomite member interfingers with the limestone members. Beekmantown age.

Named from stream that enters Lemon Fair River, 3 miles west of type locality in belt of outcrop between Cornwall village and The Ledges, Addison County.

†Burches Ferry Marl[1]

Upper Cretaceous: Northeastern South Carolina and eastern North 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, 14.

Named for exposures at Burches Ferry, on west side of Peedee River, in Florence County, S.C.

Burden Conglomerate[1]

Lower Cambrian: Eastern New York.

Original reference: A. W. Grabau, 1903, New York State Mus. Bull. 69, p. 1034.

Rudolf Ruedemann, J. H. Cook, and D. H. Newland, 1942, New York State Mus. Bull. 221, p. 43–62. In Catskill quadrangle, following sequence distinguished (ascending): Nassau beds, Burden iron ore, Bomoseen grit, Burden conglomerate (Grabau), Schodack shale and limestone, and Zion Hill quartzite. Zion Hill quartzite, Schodack shale and limestone, Burden conglomerate, and Bomoseen grit are intimately connected and interfolded. Seems practicable to extend term Schodack formation to include as members the beds that occur associated or interbedded with it. Burden iron ore formation consists of limonite and siderite iron ore between Nassau and Schodack beds. Occurs in belt extending from southern base of Mount Tom to Church Hill, about 4 miles in all. Grabau united under name Burden conglomerate the beds at Burden iron mine of earliest Schodack age with those of later Schodack age found at Claverack Creek and north of Becraft Mountain. All are of Schodack age and not of Normanskill age.

D. W. Fisher, 1956, Internat. Geol. Cong., 20th, Mexico, Cambrian Symposium, pt. 2, p. 330–331. Name Burden originally given by Grabau (1903) to a conglomerate of limestone pebbles in calcite matrix with imbedded rounded quartz sand grains. Grabau was uncertain of age but asserted it to be Ordovician and possible correlate of Rysedorph conglomerate. Ruedemann (1942) used name Burden for an iron ore of local stratigraphic significance in Columbia County. Questionable whether the two workers were speaking of same unit. Type area reexamined and modifications of previous interpretations presented. An excellent section reveals sideritic and limonitic rock with imbedded subangular fragments of limestone, shale, and grit occupying position between interbedded sandy shales and thin quartzites below (Nassau) and a calcitic ferruginous orthoquartzite with abundant quartz crystals above (Zion Hill). In opposition to Ruedemann's views, the writer [Fisher] found no evidence of Schodack formation. It is here suggested that the Burden iron ore denotes a residual soil which accumulated on a Lower Cambrian erosional surface; the hiatus represents Middle and Upper Cambrian times. Ferruginous nature of the Zion Hill explained as iron oxide incorporated in an initial transgressive clastic deposit. Overyling Zion Hill, in turn, are bonafide graptolite-bearing strata of Schaghticoke and Deepkill age.

Named for occurrence at Burden iron mines, 5 miles south of Hudson. Columbia County.

Burditt Marl[1]

Burditt Marl (in Austin Group)

Upper Cretaceous (Gulf Series): Central Texas.

Original reference: W. S. Adkins, 1933, Texas Univ. Bull. 3232, p. 239, 270, 407, 441, 442, 449.

Keith Young and Edward Marks, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 3, p. 477, 480 (fig. 2), 486–487. Report is biostratigraphic study of Austin group in Williamson County. Chart shows group comprises Austin chalk and Burditt marl. Thickness of Burditt 45 feet. Faunal change from Austin chalk to Burditt marl abrupt.

C. L. Durham, Jr., 1955, Corpus Christi Geol. Soc. [Guidebook] Ann. Field Trip, March 11–12, [p. 57], pl. 16. In Travis County, overlies Dessau formation (new).

D. L. Frizzell, 1956, Texas Univ. Bur. Econ. Geology Rept. Inv. 22, p. 38. Foraminifera described. Burditt marl listed in Austin group.

Type locality: Along Little Walnut Creek downstream from Austin-Cameron Road, Travis County. Named from Burditt School.

Burge Sands Member (of Ogallala Formation)[1]

Burge Channel Member (of Valentine Formation)

Pliocene: Northern Nebraska.

Original reference: F. W. Johnson, 1936, Am. Jour. Sci., 5th, v. 31, p. 467–473.

A. L. Lugn, 1938, Am. Jour. Sci., 5th ser., v. 36, p. 223, 227; 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1260, 1264 (table 1). Referred to as Burge channel member of Valentine formation redefined and assigned to Ogallala group (redefined). Occurs at top of formation.

M. K. Elias, 1942, Geol. Soc. America Spec. Paper 41, p. 137–138. Highest known fauna from the Valentine comes from Burge channel quarries. It seems best not to consider the Burge a channel member but merely a channel within the undivided Valentine.

Type locality: Burge quarry, on Snake River, southwest of Valentine, Cherry County.

Burgen Limestone[1]

Lower Ordovician: Central Oklahoma.

Original reference: J. P. Boyle, 1939, Oklahoma Geol. Survey Bull. 40KK.

Present over entire area of Okfuskee County.

Burgen Sandstone[1]

Lower or Middle Ordovician: Northeastern 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), 20–22, pls. 2, 3, 4. Described on southwestern flank of Ozark uplift. Predominantly sandstone with minor amounts of shale and thin dolomitic limestone; thin beds of green fissile shale and sandy dolomite present in upper parts. Thickness 72 feet near Qualls where entire thickness is exposed; 26 feet along Spring Creek in sec. 12, T. 19 N., R. 20 E.; outside mapped area thickness of 100 feet reported. Unconformably overlies Cotter dolomite; conformably succeeded by Tyner shale in southern exposures; truncated by pre-Chattanooga erosion north of T. 19 N., where it is succeeded by Sylamore sandstone member of Chattanooga. Age assignment and correlation not certain; precise dating is dependent upon correct correlation of overlying Tyner; if Tyner is equivalent of Bromide, then Burgen is probably equivalent to lower Bromide sand (Tulip Creek). Chart shows Champlainian series.

Named for exposures in Burgen Hollow, 6 miles northeast of Talequah, northern Cherokee County.

Burgess Oolite Member (of Bangor Limestone)[1]

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. Thickness 0 to 40 feet. Underlies unnamed blue fossilferous limestone; separated from underlying Rockwood oolite by unnamed blue fossiliferous limestone 100 feet thick.

Type locality: Burgess quarry, on hill about 3 miles east of Russellville, Franklin County.

Burgner Formation

Pennsylvanian (Atoka): Southwestern Missouri.

W. V. Searight and E. J. Palmer, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 9, p. 2127–2131. Section from cuttings and cores shows formation to consist of black shale, black siltstone, coal, limestone, and clay. Thickness as much as 67 feet. Occurs as sink fillings in Mississippian formation. Megafauna related to both Morrowan and Desmoinesian but cannot be certainly correlated with either; microfauna includes specimens of *Millerella* and primitive *Fusulinella*; considered post-Morrowan pre-Desmoinesian or Atokan.

Named for occurrence on the Burgner land, Jasper County.

Burgoon Group[1]

Mississippian: Pennsylvania.

Original reference: J. D. Sisler and others, 1933, Pennsylvania Geol. Survey, 4th, Bull. M–19, p. 8.

Named because it is cut through by valley of Burgoon Run above Kittanning Point, Blair County.

Burgoon Sandstone (in Pocono Group)

Burgoon Formation (in Pocono Group)

Burgoon Group

Burgoon Sandstone Member (of Pocono Formation)[1]

Mississippian: Western Pennsylvania, southeastern Ohio, and northern West Virginia.

Original reference: C. Butts, 1904, U.S. Geol. Survey Geol. Atlas, Folio 115.

R. M. Leggette, 1936, Pennsylvania Geol. Survey, 4th ser., Bull. W–3, p. 38–39. In many parts of area [northwestern Pennsylvania], Burgoon sandstone is top formation of Pocono group. As much as 450 feet thick in places. Overlies Cuyahoga formation. In Crawford and adjoining counties, Shenango sandstone of I. C. White marks top of Ponoco and is probably equivalent to part of Burgoon sandstone.

R. E. Sherrill and L. S. Matteson, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. 122, p. 7–8. Referred to as Burgoon group in Pocono series. Thickness 250 to 270 feet in area of this report [Hillards quadrangle]. Upper 75 to 100 feet of group is Burgoon sandstone member. Below this sandstone is Hempfield (Shenango) shale member, 75 to 100 feet thick. Lower 75 to 90 feet of group is Shenango sandstone member. Overlies Cuyahoga group; underlies Lower Connoquenessing sandstone of Pottsville series.

R. C. Bolger and C. E. Prouty, 1953, Pennsylvania Acad. Sci. Proc., v. 27, p. 125. In Cameron County, Burgoon sandstone is topmost unit of Pocono group. Thickness 90 to 100 feet in south; 25 to 30 feet in north. Directly overlies Patton formation.

J. L. Dally, 1956, Dissert. Abs., v. 16, no. 12, p. 2425. Pocono group discussed in West Virginia. In northern part of State, group is represented by Manheim formation (new) and Burgoon formation.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania ,1: 250,000) : Pennsylvania Geol. Survey, 4th ser. Map legend shows Burgoon formation in Pocono group.

Named for exposures in valley of Burgoon Run, above Kittanning Point, Blair County, Pa.

Burica Sandstones

Miocene, upper, or Pliocene, lower: Panamá.

R. A. Terry, 1941, Geog. Rev., v. 31, no. 3, p. 381 (fig. 5). Name Burica listed on map explanation. Upper Miocene.

A. A. Olsson, 1942, Bulls. Am. Paleontology, v. 27, no. 106, p. 173–175 (21–23). Sandstone transitional with overlying Charco Azul shales. Base of sandstones and basement on which they rest not exposed. Age tentatively considered as lower Pliocene or uppermost Miocene.

A. A. Olsson, 1942, 8th Am. Sci. Cong. Proc., v. 4, Geol. Sci., p. 234 (chart). Lower part sandstones and conglomerate; upper part tuffaceous shale.

Crop out on Burica Peninsula, Panamá, at or near Burica Point and Burica Island.

Burke 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. 32–34, pl. 11. Light-gray flaggy fine-grained sandstones and shales, mostly greenish, with variable amount of purple quartzitic sandstone and white quartzite. Shallow water features throughout. Thickness about 2,000 feet. Overlies Prichard slate; underlies Revett quartzite.

C. F. Calkins, 1908, U.S. Geol. Survey Bull. 384, p. 38. Lowermost formation in Ravalli group.

J. W. Hosterman, 1956, U.S. Geol. Survey Bull. 1027–P, p. 728–729, pl. 57. Described in Shoshone County, Idaho, where is is between 2,220 and 2,500 feet thick. Chiefly thin-bedded light- to greenish-gray fine-grained argillaceous quartzite and some white to light-purple thick-bedded quartzite. Contacts with underlying Prichard formation and overlying Revett quartzite transitional.

Typically developed along Canyon Creek from Burke to Gem, Idaho.

Burkes Garden 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. 835, 836, 869, 871, 879, 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 (ascending) 29 zones. Name Burkes Garden limestone member is applied to zones 12 and 13. At type locality, these zones, the *Chasmatopora*, and the crossbedded limestone, are 47 and 63 feet, respectively. In Burkes Garden and Thompson Valley, member is 100 to 200 feet thick; in median belts, thins from about 100 feet near Russell-Tazewell county line to 60 feet at Tazewell; thin or absent on northwest side of Clear Fork Valley east of Gratton. Overlies

Shannondale limestone member (new); underlies Gratton limestone (new).

Type locality: Along County Road 637 and Pounding Mill Branch, immediately south of U.S. Route 19, Tazewell County. Named from Burkes Garden Creek about 1½ miles south of Gose Mill.

Burkesville Limestone Lentil (in Cumberland Sandstone)

Upper Ordovician: South-central Kentucky.

W. R. Jillson, 1951, The Burkesville limestone: Frankfort, Ky., Roberts Printing Co., p. 5–15. Upper 3 feet of lentil consist of gray compact dolomitic bouldery fossiliferous limestone; lower 3 feet consist of grayish to reddish soft limy shale with a 1-inch layer of chert.

W. R. Jillson, 1953, The Haggard limestone: Frankfort, Ky., Roberts Printing Co., [p. 2]. About 70 feet below top of Cumberland and about 40 feet below Haggard limestone (new).

Exposed on P. A. Davis property within southern limits of Burkesville, Cumberland County.

Burket Black Shale Member (of Harrell Shale)[1]

Burket Shale Member (of Rush Formation)

Upper Devonian: Central Pennsylvania.

Original reference: C. Butts, 1918, Am. Jour. Sci., 4th, v. 46, p. 523, 536.

Bradford Willard, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 201, 218–219. Member of Rush formation. Intergrades with Tully member. Underlies Harrell member of Fort Littleton formation.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 3. Rush formation includes Burket shale member and Tully limestone member.

Named for exposures at Burket, a suburb of Altoona, Blair County.

Burkeville Beds[1]

Miocene, upper, and Pliocene(?): Eastern Texas and western Louisiana.

Original reference: A. C. Veatch, 1902, Louisiana Geol. Survey, pt. 6, Rept. for 1902, p. 136, pl. 37.

A. C. Ellisor, 1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 4, p. 494-495. This [Burkville] horizon has been traced in subsurface from Terry Field in Orange County, south of Burkville to Calhoun County. Name *Potamides matsoni* zone suggested for this horizon in subsurface where it is 400 or more feet thick. Since Veatch and others have recognized Burkville beds as mappable unit and have described sections and fauna, it is no doubt worthy of rank of formation. However, it seems inadvisable to introduce a new formation without further fieldwork.

Named for Burkeville [correct spelling], Newton County, Tex.

Burley Lake Beds[1]

Pleistocene: Southern Idaho.

Original reference: H. T. Stearns, 1932, Correlation chart of Idaho compiled by M. G. Wilmarth, dated Sept. 1, 1932; H. T. Stearns, 1936, Jour. Geology, v. 44, no. 4, p. 434–439.

E. G. Crosthwaite, 1956, Ground-water possibilities south of the Snake River between Twin Falls and Pocatello, Idaho: U.S. Geol. Survey Circ. 371, p. 6, 7. Described as unconsolidated to well-compacted clay, silt, sand

and fine gravel. Intercalated basalt layers occur 150 to 325 feet below surface and at bottom of sequence. Geographic area noted.

Known only from drill holes in vicinity of Burley (Cassia County) and Rupert and Paul (Minidoka County).

Burlingame Limestone Member (of Bern Limestone)

Burlingame Limestone (in Shawnee Group)

Burlingame Limestone (in Wabaunsee Group)

Burlingame Limestone Member (of Wabaunsee Formation)[1]

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

Original reference: J. G. Hall, 1896, Kansas Univ. Geol. Survey, v. 1, p. 105.

G. E. Condra, 1933, Nebraska Geol. Survey Paper 8, p. 5, 10; G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 45–46. In Nebraska, comprises (ascending) Taylor Branch limestone, Winnebago shale, and South Fork limestone.

L. W. Wood, 1941, Iowa Geol. Survey, v. 37, p. 309 (fig. 14). Graphic section of Pennsylvanian in Adams County shows Burlingame limestone occurring below Soldier Creek shale and above Silver Lake shale.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 32). Correlation chart shows Burlingame 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.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 18. Three limestones and two shales now included in Soldier Creek shale were formerly included in the Burlingame.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2274 (fig. 1), 2276–2277. Rank reduced to member status in Bern limestone (new). Underlies Soldier Creek shale member; overlies Silver Lake shale member of Scranton shale (reintroduced as a formation).

H. G. Hershey and others, 1960, Iowa State Highway Research Board Bull. 15, p. 13, fig. 5. Consists of three limestone beds separated by shale. Upper limestone, about 6 inches thick, is dark gray and finely crystalline, contains fossil fragments, and is underlain by dark-gray clayey shale about 1½ feet thick. The lower two limestones are separated by calcareous laminated gray shale about 5 feet thick. Upper of the two limestones is gray, argillaceous, and blocky; lower is concretionary, sandy, and fragmental. Total thickness 12 feet. Underlies Soldier Creek shale; overlies Silver Lake shale. Wabaunsee group.

Type locality: Burlingame, Osage County, Kans. Limestone makes a prominent escarpment that crosses west part of Burlingame.

†Burlingame Shale[1]

Pennsylvanian: Eastern Kansas and northwestern Missouri.

Original references: E. Haworth, 1895, Kansas Univ. Quart., v. 3, p. 278, pl. 20; 1895, Am. Jour. Sci., 3d, v. 50, p. 461, pl. opposite p. 466.

Named for Burlingame, Osage County, Kans.

Burlington Limestone

Burlington Limestone (in Osage Group)[1]

Lower Mississippian (Osage Series): Iowa, Illinois, Kentucky, and Missouri.

Original reference: D. D. Owen, 1852, Rept. Geol. Survey Wisconsin, Iowa, and Minnesota, p. 90–140.

J. M. Weller, 1939, Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 131, 132–133. Included in Osage group, Valmeyer series.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5. In Mississippian standard section, Burlington limestone is included in Osagean series. Occurs above the Fern Glen formation and below Keokuk limestone.

C. P. Kaiser, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 11, p. 2163–2168. Discussion of stratigraphy of Lower Mississippian rocks in southwestern Missouri. Burlington limestone ranges in thickness from a trace to 145 feet; thickest in Springfield area. Thins southward from Springfield and disappears from section between Mount Vernon, Lawrence County. and the Tri-State mining district. Divided into six faunal zones that are correlated with equivalent zones in northeastern Missouri. Rests unconformably on Reeds Spring formation in southern part of area. Reeds Spring and St. Joe formations pinch out a short distance north of Springfield, Greene Conuty, and north of here the formation rests unconformably on Northview or Sedalia formations. Keokuk limestone rests with apparent conformity on Burlington limestone in southwestern part of area. Elsewhere the Burlington is either surface formation or is covered by thin veneer of Pennsylvanian sediments. Osagean.

T. R. Beveridge and E. L. Clark, 1952, Missouri Geol. Survey and Water Resources Rept. Inv. 13, p. 71–80. Presentation of revision of early Mississippian nomenclature in western Missouri. Kaiser (1950) proposed that name Pierson be dropped, assigning the more dolomitic lower beds to the Sedalia and the upper beds to the St. Joe. Kaiser considered the entire St. Joe to be Osagean and the Sedalia to be Kinderhookian. Thus he placed a series line in the middle of the Pierson of Weller. In present report, the Pierson is accepted as defined by Weller and base of Osagean is placed at Pierson-Northview contact. The Pierson is extended northward to include the silty dolomitic limestone unit which lies between the Northview and the Burlington in west-central Missouri. This unit was included in upper Sedalia of west-central Missouri by Moore (1928, Missouri Bur. Geology and Mines, 2d ser., v. 21) and Kaiser (1950). Hence, Burlington directly overlies Pierson.

T. J. Laswell, 1957, Missouri Geol. Survey and Water Resources Rept. Inv. 22, p. 9 (fig. 2), 42–47. Formation described in Bowling Green quadrangle where it is 53 to 61 feet thick. Consists of thin- to massive-bedded coarsely crystalline brown to light-gray limestone with chert nodules and lenses. In most of quadrangle, covered by glacial drift, loess, and its own chert residuum. Lies upon undulatory surface of Hannibal formation in that part of quadrangle north of southern boundary of T. 53 N., south of this area overlies Chouteau formation with gradational contact. Osagean series.

Named for exposures at Burlington, Des Moines County, Iowa.

†Burlington Limestone[1]

Pennsylvanian: Eastern Kansas.

Original reference: E. Haworth and M. Z. Kirk, 1894, Kansas Univ., Quart., v. 2, p. 110, 120–121, 125.

Named for Burlington, Coffey County.

†Burlington Limestone (in Chemung Formation)[1]

Upper Devonian: Central northern Pennsylvania.

Original reference: A. Sherwood, 1878, Pennsylvania 2d Geol. Survey Rept. G, p. 37.

Occurs about 1 mile east of Burlington on farms of W. B. Kline, J. Morley, and C. E. Campbell and at other places in Bradford County.

Burls Creek Shale Member[1] (of Katalla Formation)

Oligocene: Southeastern Alaska.

Original reference: N. L. Taliaferro, 1932, Geol. Soc. America Bull., v. 43, no. 3, p. 772–775, 779.

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), 10–11; 1945, Geologic and topographic map and sections of the Katalla area, Alaska: U.S. Geol. Survey War-Minerals Inv. Prelim. Map. Restricted to massive gray shale and associated glauconitic sandstone that lie conformably between the Basin Creek (new) and organic shale members. Lower contact drawn at base of lowest bed of massive glauconitic sandstone or at top of highest bed of gray sandstone of Basin Creek type. Partly sandy shale forms major part of member except near head of east fork of Burls Creek and along Burls Creek-Chilkat Creek ridge, where total thickness of glauconitic sandstone beds nearly equals thickness of shale. Lens-shaped calcareous concretions, averaging more than 2 feet across, abundant in shale. Lithology and thickness range widely in Katalla area. Thickness between 160 and 260 feet near head of west fork of Burls Creek; increases to maximum of perhaps 1,000 feet in western part of area. Oil company geologists (unpub. mss.) have used term Burls Creek formation to include Basin Creek sandstone and shale below and Cannon-ball shale above.

Best exposed on Burls Creek, Controller Bay region.

Burnam Limestone

Upper Ordovician: Central Texas.

V. E. Barnes, P. E. Cloud, Jr., and Helen Duncan, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 5, p. 1030–1043. Coarse-grained and yellowish to light-brownish-gray or almost white; contains pale yellowish-orange stylolites and angular to rounded pebbles and blebs of fine-grained yellowish-gray to pearl-gray limestone; fossiliferous. Thickness unknown; outcrops are collapsed into older rocks. Directly underlies Stribling formation; bedding is approximately parallel between the two units, and both formations dip steeply southward; relations at base of Burnam are uncertain; may rest directly on Honeycut formation or other rocks may intervene between the two units.

Type locality: (Only known occurrence) is midway between Austin and Llano, along Burnam Branch of Doublehorn Creek, southern Burnet County, 4.7 miles airline south-southeast of Marble Falls.

Burned Mountain Metarhyolite

Precambrian: Central northern New Mexico.

Fred Barker, 1958, New Mexico Bur. Mines Mineral Resources Bull. 45, p. 14, 54–56, pl. 1. Ranges from brick red to light pink but generally is reddish orange; relict, commonly drag-folded flow bands clearly visible in most outcrops. Intruded older Moppin metavolcanics (new) as sills and dikes; possibly some small flows. The layers of metarhyolite almost everywhere concordant with underlying and overlying strata. Previously called Vallecitos rhyolite, but here renamed because the earlier name was preempted.

Exposed on La Jarita Mesa, in Canada del Oso, in La Jara Canyon, along Vallecitos Canyon near Escondida Creek, and in areas immediately south of Jawbone Mountain near head of Buckhorn Gulch in Las Tablas quadrangle and in area immediately to the south. Named after exposures on northwest side of Burned Mountain, in sec. 8, T. 28 N., R. 7 E., Las Tablas quadrangle.

Burnet Marble[1]

Cambrian and Ordovician: Central Texas.

Original reference: B. F. Shumard, 1861, Am. Jour. Sci., 2d, v. 32, p. 214.

Named for exposures at Burnet and neighboring parts of Burnet County.

†Burnetan System[1]

Precambrian (Llano Series): Central Texas.

Original reference: T. B. Comstock and E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept., p. lv, 255–267, pl. 3.

Named for Burnet County.

Burnett Formation (in Puget Group)[1]

Eocene: Western Washington.

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

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 63–64. Youngest formation of group in Carbon River area. Composed of shales and sandstones approximately 5,000 feet thick. Underlies lavas and Pleistocene glacial deposits; overlies Wilkeson sandstone. Formations in Carbon Canyon have been folded into anticlines and synclines with a general northwesterly trend.

Named for exposures on South Prairie Creek, near Burnett, Tacoma quadrangle.

Burns Formation (in Silverton Group)

Burns Quartz Latite or Latite Tuff[1] (in Silverton Volcanic Series)

Tertiary, middle or upper: Southwestern Colorado.

Original reference: W. Cross and E. Howe, 1905, U.S. Geol. Survey Geol. Atlas, Folio 120.

E. S. Larsen, Jr., 1949, Am. Geophys. Union Trans., v. 30, no. 6, p. 863. Burns quartz latite listed in Silverton volcanic series in report on San Juan Mountains, Colo. Overlies Eureka rhyolite; underlies unnamed pyroxene quartz latite.

U.S. Geological Survey currently classifies the Burns as a formation in Silverton Group and designates the age as middle or late Tertiary on the basis of a study now in progress.

Named for exposures in Burns Gulch, Silverton quadrangle.

Burnt Lava Flow

Recent: Northern California.

M. A. Peabody, 1931, Geog. Rev., v. 21, no. 2, p. 269–270. Recent flow in the Modoc Lava field.

H. A. Powers, 1932, Am. Mineralogist, v. 17, no. 7, p. 272, 275, pl. 1. Mentioned as the most recent of a group of basalt eruptions or flows for which term Modoc basalt is proposed.

C. A. Anderson, 1941, California Univ., Dept. Geol. Sci. Bull., v. 25, no. 7, p. 371, geol. map. Covers an area of about 14 square miles.

Occurs in Modoc Lava field.

Burnt Limestone

Lower Cretaceous (Comanchean): Southern Texas.

Charles Schuchert, [1943], Stratigraphy of the eastern and central United States: New York, John Wiley and Sons, p. 957. Incidental mention in short discussion of Buda limestone. Suggests name be abandoned. [Compiler was unable to locate an earlier reference to the name.]

Burnt Bluff Formation[1]

Burnt Bluff Group

Middle Silurian (Niagaran Series): Northern Michigan and Wisconsin.

Original reference: G. M. Ehlers, 1921, Geol. Soc. America Bull., v. 32, p. 129.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Burnt Bluff group (Wisconsin and Michigan) includes Byron dolomite below and Hendricks dolomite above.

G. M. Ehlers and R. V. Kesling, 1957, Michigan Geol. Soc. [Guidebook] Ann. Field Excursion, p. 2 (table), 7–19, 31 (fig. 2). Group includes (ascending) Lime Island dolomite (new), Byron dolomite, and Hendricks dolomite. Thickness about 310 feet. Underlies Manistique group; overlies Cataract group.

Named for exposures in high cliff called Burnt Bluff, on east shore of Big Bay de Noc, Delta County, Mich.

Burnt Branch Bed (in Strawn Formation)[1]

Pennsylvanian: Central Texas.

Original reference: N. P. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 374, 375.

D. A. Zimmerman and G. D. Glover, 1956, Soc. Econ. Paleontologists and Mineralogists, Permian Basin Sec. [Guidebook] Spring Mtg., p. 72. Flaggy sandstones 125 feet thick; about 25 feet of clay at base. Overlies Lynch Creek bed, where present; underlies Elliott 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 Burnt Branch, in Lampasas County, or vicinity.

Burnt Canyon Breccia

Quaternary: Southern California.

C. R. Allen, 1954, California Div. Mines Bull. 170, map sheet 20. Shown on map legend as a landslide deposit.

C. R. Allen, 1957, Geol. Soc. America Bull., v. 68, no. 3, p. 325 (table 1), 332, pls. 1, 3. Described in San Gorgonio Pass area as a dissected landslide deposit. Maximum thickness about 100 feet. Rests partly on crystalline complex and partly on Heights fanglomerate.

Report covers San Andreas fault zone in San Gorgonio Pass, Riverside County.

Burnt Canyon Member (of Highland Peak Formation)

Burnt Canyon Formation (in Ophir Group)

Burnt Canyon Limestone

Middle Cambrian: Southeastern Nevada and western Utah.

H. E. Wheeler, 1948, Nevada Univ. Bull., Geology and Mining Ser., no. 47, p. 36–38, fig. 5. Dark-gray to black, thin- to medium-bedded limestone. Previously termed basal or "C" unit of Highland Peak limestone as restricted by Wheeler (1940). Recognition of overlying Dome and Swasey limestones in the Highland Peak requires that unit be given formational rank. Thickness 225 to 420 feet. Overlies Burrows limestone; conformably underlies Dome limestone. In House Range, Utah, formation consists of uppermost 225 feet of Howell limestone as emended by Deiss (1938).

R. E. Cohenour, 1959, Utah Geol. and Mineralog. Survey Bull. 63, p. 12 (table 1), 35, 45–46, pl. 1, measured sections. Formation included in Ophir group in Sheeprock Mountains where it overlies Millard formation and underlies Dome limestone. Thickness 178 to 221 feet. Basal 21 feet may represent Burrows limestone.

R. A. Robison, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 49, 50 (fig. 4). Proposed that name Chisholm be applied to unit in House Range that Wheeler (1948) designated as Burnt Canyon limestone. Correlation chart (fig. 4) shows Wheeler's Burnt Canyon in Wah Wah Range replaced by Whirlwind (new) and Swasey formations; in Pioche district, Wheeler's Burnt Canyon is replaced by part of Burrows formation, Whirlwind formation, and lower part of Highland Peak formation.

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

Named for typical exposures in Burnt Canyon on west slope of Highland Range, Pioche district, Nevada.

Burnt Gulch Conglomerate

Miocene or Pliocene: Northwestern Wyoming.

E. B. Branson and C. C. Branson, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 124 (table 1), 143, fig. 2. Alluvial fan remnants.

Made up in the main of boulders, gravel, and sand almost without stratification. Boulders more than 20 feet in diameter have been measured, but they decrease in size away from mountains. Thickness on Dinwoody Creek 300 feet.

Type locality: At west end of Table Mountain on Burnt Gulch, after which deposits are named. Present along east slope of Wind River Mountains, Fremont County. Best exposures on Dinwoody Creek.

Burnt Meadow Syenite[1]

Post-Carboniferous: Maine.

Original reference: F. W. Toppan, 1932, Geology of Maine, Dept. Geology, Union Coll., Schenectady, p. 26.

Burnt Mill Shale (in Crooked Fork Group)

Pennsylvanian (Pottsville Series): Eastern Tennessee.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [folio], p. 6, 19, pls. 2, 3, 4. Includes beds between top of Crossville sandstone and base of Coalfield sandstone (new). Thickness 35 to 130 feet. Hooper coal occurs near base of shale. In northern part of Barthell Southwest quadrangle, overlying Coalfield sandstone is missing and Burnt Mill and Glenmary shale (new) form a single unit; this composite unit in turn is truncated by overlying Wartburg sandstone which locally rests on the Crossville.

Named from exposures near Burnt Mill Bridge in Robbins and Oneida South quadrangles, Scott County.

Burnt Ridge Sandstone Member (of Rose Hill Formation)

Silurian: Central Pennsylvania.

H. H. Arndt, 1959, Geol Soc. America Guidebook Pittsburgh Mtg., p. 28, 29, 30. Name applied to sandstone in middle part of Rose Hill. Unit previously called Center iron sandstone (Swartz, 1931). Thickness 90 feet in Burnt Ridge section. Thins to 10 feet in Mifflintown quadrangle, and is poorly represented, if at all, to west in section at Mount Union. Name credited to J. T. Miller.

Reference section: Burnt Ridge.

Burnt River Schist[1]

Pre-Carboniferous(?): Northeastern Oregon.

Original reference: James Gilluly, 1937, U.S. Geol. Survey Bull. 879.

C. W. Merriam and S. A. Berthiaume, 1943, Geol. Soc. America, v. 54, no. 2, p. 162–163. Discussion of late Paleozoic formations of central Oregon. Burnt River schist in eastern Oregon shows very little similarity to any of the formations under discussion (Coffee Creek, Spotted Ridge, and Coyote Butte) beyond occurrence of limestone and conglomerates. Indefinite age.

Named for exposures in Burnt River Canyon, T. 11 and 12 S., R. 41 E., Baker quadrangle, Baker County.

Burntside Granite Gneiss[1]

Precambrian (Huronian): Northeastern Minnesota.

Original reference: F. F. Grout, 1926, Minnesota Geol. Survey Bull. 21, p. 29.

Burntside Lake, Vermilion district.

†Burpee Formation[1]

Eocene, middle: Northwestern Oregon.

Original reference: H. G. Schenck, 1927, California Univ. Pub. Dept. Geol. Sci. Bull., v. 16, no. 12, p. 455, 456.

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 as about 5,000 feet thick and consisting of rhythmically bedded arkosic sandstone and intercalated siltstone and, locally, interbedded volcanic material. Conformably overlies Siletz River volcanic series; underlies Nestucca formation (new), angular unconformity.

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, where it is oldest strata exposed and covers more than one-half of area mapped and greater part of Toledo and Tidewater quadrangles. Thickness 6,000 to 7,000 feet; base not exposed. Overlies Moody shale member of Toledo. Eocene.

U.S. Geological Survey has abandoned the term Burpee on the basis of a study now in progress.

Type locality: Rock quarry on Southern Pacific Railroad at Burpee Station, on east bank of Yaquina River, Lincoln County, midway between Toledo and Elk City.

Burr Limestone 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.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 48. Underlies Salem Point shale member; overlies Legion shale member. Thickness 8 to 15 feet. Wolfcamp series.

Type locality: Bluffs and ravines west of South Fork of Little Nemaha River, in sec. 20, at point one-fourth mile west of north-south road. 2½ miles northwest of Burr, Otoe County, Nebr.

Burrego 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), 64, 65. Term proposed for the massive to massively bedded and nodular limestones that overlie the Council Spring limestone (new) and underlie the red shales and arkosic red sandstones at base of Story formation (new). At type locality, formation is almost entirely limestone; in Mocking Bird Gap area, contains several thick sandstones and, on Cadronito Hill, contains several thick shale strata. Thickness about 52 feet.

Type locality: North of Burrego Spring on northeast side of Oscura Mountains, in SE¼ sec. 31, T. 5 S., R. 6 E., Socorro County.

Burro Gravel and Tuff[1]

Tertiary(?): Western Texas.

Original reference: J. A. Udden, 1907, Texas Univ. Bull. 93, p. 17, 67.

Named for Burro Mesa, Brewster County.

Burro quartzite[1]

Cambrian(?): Southwestern New Mexico.

Original references: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 257–259; 1915, Conspectus of geologic formations of New Mexico: Des Moines, Robert Henderson, State printer, p. 4, 5.

Derivation of name not given.

Burroak Shale[1] **Member** (of Deer Creek Limestone)

Pennsylvanian (Virgil Series): Southwestern Iowa, eastern Kansas, northwestern Missouri, and southeastern Nebraska.

Original reference: G. E. Condra and E. C. Reed, 1937, Nebraska Geol. Survey Bull. 11, 2d ser., p. 8, 20, 53–54, figs. 1, 2.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 48. Burroak shale member of Deer Creek limestone underlies Ervine Creek limestone member and overlies Haynies limestone member. Burroak pinches out in southeastern Nebraska where Haynies limestone unites with the Ervine Creek.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2035. Member of Deer Creek formation; overlies Haynies limestone member; underlies Larsh shale member. This is classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma, May 1947. Kansas uses Larsh-Burroak shale member for interval.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 17. In Missouri, interval between Rock Bluff limestone member and uppermost limestone of the Deer Creek is occupied by shale. This shale has been treated by Missouri Geological Survey as the Rock Bluff-Ervine Creek interval with implication that intervening Haynies limestone is absent in Missouri. The shale is now called Larsh-Burroak, but the Missouri Survey recognizes possibility that the Burroak shale member may be absent in Missouri and that the uppermost limestone of the Deer Creek may include both the Haynies and Ervine Creek members.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 17, fig. 5. Burroak shale not everywhere differentiated in southwestern Iowa because of absence in some areas of Haynies limestone, which results in the coalescing of Burroak and Larsh shales. Where Haynies is present, as near Thurman, Burroak shale is bluish gray, argillaceous, and fossiliferous. Thickness about 1 foot near Thurman.

Type locality: Roadcuts and ravines near Burr Oak School, E½ sec. 21, T. 71 N., R. 43 W., Fremont County, Iowa, about 6 miles south of Pacific Junction, and about 3½ miles north of Bartlett, Mills County.

Burro Canyon Formation

Lower Cretaceous: Southwestern Colorado, northeastern Arizona, northwestern New Mexico, and southeastern Utah.

W. L. Stokes and D. A. Phoenix, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 93. Proposed to designate relatively thin sequence of rocks of probable Lower Cretaceous age lying between Morrison formation (Brushy Basin member) and Dakota sandstone. Includes essentially the same rocks as those designated post-McElmo by Coffin (1921, Colorado

Geol. Survey Bull. 16). Consists of alternating conglomerate, sandstone, shale, limestone, and chert. Thickness 150 to 260 feet. Sandstones and conglomerates are gray, yellow, and brown; shales faintly varicolored, mainly purple and green.

E. B. Ekren and F. N. Houser, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 1, p. 192–201. Described in Four Corners area where it is present in all four States. Thickness 140 to 206 feet. Intertongues with Brushy Basin member of Morrison. In Utah and Colorado, includes Karla Kay member (new) at base.

R. G. Young, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 2, p. 157–158. This study indicates that two names, Cedar Mountain formation and Burro Canyon formation, have been applied to same physically continuous unit, which can be traced over wide areas of Colorado Plateau with no significant change in character. Proposed here to drop name Burro Canyon and retain older name Cedar Mountain for these noncarbonaceous deposits.

Type locality: Burro Canyon, sec. 29, T. 44 N., R. 18 W., San Miguel County, Colo.

Burro Mesa Riebeckite

Tertiary: Southwestern Texas.

J. D. Martinez, E. H. Statham, and L. G. Howell, 1960, Texas Univ. Bur. Econ. Geology Pub. 6017, p. 38–39, 44 (fig. 38). Incidental mention in paleomagnetic study of Tertiary volcanics in Big Bend National Park.

Burro Mountains granite

Precambrian: Southwestern New Mexico.

Term used many times in discussion of Bullard Peak Series and Ash Creek Series. Probably refers to granite in Burro Mountains granite batholite.

Burroughs Dolomite[1]

Lower Silurian: Northwestern Illinois and western Wisconsin.

Original reference: F. T. Thwaites, 1923, Jour. Geology, v. 31, no. 7, p. 533.

Near top of Burrough's Bluff, at north end of Savannah, Carroll County, Ill. Also in and above Charles Miles' quarry near southeast edge of same city.

Burroughs Limestone Member (of Modesto Formation)

Burroughs Beds (in McLeansboro Group)

Pennsylvanian: Southwestern Illinois.

J. M. Weller, 1946, *in* C. L. Cooper, Illinois Geol. Survey Bull. 70, p. 13. Name appears in a list of beds above the Shoal Creek limestone in Macoupin County. Name credited to J. R. Ball.

J. R. Ball, 1952, Illinois Geol. Survey Bull. 77, p. 29, 37–38, 85. Succession of beds between the Carlinville and Macoupin cyclothems; beds do not seem to belong to either cyclothem, nor do they comprise enough conventional units to be classed as a cyclothem. Beds consist regularly of three members: a basal sandstone or sandy shale, a middle limestone, and a top shale. Thickness about 6 feet.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 37, 38, 45 (table 1), 68, pl. 1. Name Burroughs limestone member of Modesto formation (new) restricted to middle sandy unit of strata formerly called Burroughs beds. Occurs above Carlinville limestone member and below Womac coal member (new). Thickness as much as 3 feet. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification independent of rock-stratigraphic classification.

Type locality: NW¼SW¼ sec. 27, T. 10 N., R. 7 W., Carlinville quadrangle, Macoupin County.

Burrows Member (of Highland Peak Formation)

Burrows Dolomite

Burrows Limestone (in Ophir Group)

Middle Cambrian: Southeastern Nevada and northwestern Utah.

H. E. Wheeler, 1940, Nevada Univ. Bull., Geology and Mining Ser., no. 34, p. 12, 27–29. Name applied to variable thickness of strata between Peasley limestone (new) and Highland Peak unit "C" of Wheeler and Lemmon (1939, Nevada Univ. Bull., Geology and Mining Ser., no. 31); both contacts unconformable. Consists mainly of a white and light, medium, to dark-gray, coarse-grained (sugary textured) massively bedded dolomite. Basal 29 feet (at type locality) are thinly and distinctly bedded, medium- and dark-gray, fine-grained limestone; beds vary in thickness from about 29 to 33 feet throughout district. Thickness ranges from 130 feet in Panaca Hills to about 400 feet at type section; 230 feet on southwest slope of Ely Range.

H. E. Wheeler, 1948, Nevada Univ. Bull., Geology and Mining Ser., no. 47, p. 36–38. Originally termed dolomite; studies now indicate unit is thickly to massively bedded light-colored limestone which has locally been subjected to epigenetic dolomitization. Underlies Burnt Canyon limestone (new). Geographically extended into House and Wah Wah Ranges, Utah, where it consists of the light-gray zone, 340 [335] feet thick in middle part of the "Howell limestone" (Deiss, 1938, Geol. Soc. America Bull., v. 49, p. 1145).

H. E. Wheeler and Grant Steele, 1951, Utah Geol. Soc. Guidebook 6, p. 32 (fig. 5), 35. In House Range, underlies Burnt Canyon limestone and overlies Millard limestone.

R. E. Cohenour, 1959, Utah Geol. and Mineralog. Survey Bull. 63, p. 35, 44. Burrows limestone included in Ophir group in Sheeprock Mountains although not clearly recognized in area. On basis of grain size, basal 21 feet of Burnt Canyon limestone may represent the Burrows. No unconformity was noted at or near base of Burnt Canyon lithology, but it is possible one may be present which could account for absence of Burrows lithology.

R. A. Robison, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 50. Wheeler's correlation of middle unit of Howell limestone with Burrows limestone of Pioche district is here considered to be incorrect because "Burrows limestone" in House Range underlies Chisholm formation, whereas in Pioche district, the Burrows limestone overlies both Chisholm and Peasley formations. Consequently, because the two units are not correlative, the "Burrows limestone" of House Range is without valid name. Proposed here that definition of Howell limestone be further restricted to include only carbonate sequence of western Utah that underlies Chisholm formation and overlies Busby and Tatow formations, or their equivalents, and that Millard limestone be rank reduced to member of Howell. In Pioche district, the Burrows underlies Whirlwind formation (new) and overlies Peasley. Wheeler's (1948) Burnt Canyon limestone discontinued.

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

Type section: On northwest spur of Comet Peak, immediately south of Peasley Canyon, on west slope of Highland Range, Pioche district, Nevada. Name derived from canyon east of Comet mine, about 1 mile south of type section.

Burrows Shale

Middle Cambrian: Southeastern Nevada.

Charles Deiss, (abs.), 1937, Geol. Soc. America Proc. 1936, p. 274. Mentioned in discussion of succession of Middle Cambrian faunas in southern half of Cordilleran trough.

Present in Highland Range, Lincoln County.

Bursum Formation (in Magdalena Group)

Permian (Wolfcamp): Central and southeastern New Mexico.

R. H. Wilpolt and others, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 61. In mapped area, about 30 miles north of type section, formation consists of dark-purplish-red and green shale in beds up to 40 feet thick, separated by thinner beds of arkose, arkosic conglomerate, and gray limestone. A thin rubbly nodular purplish-gray limestone occurs locally at base. Thickness ranges from 28 to 234 feet. Underlies Abo formation; overlies upper member of Madera limestone. Age given as (Wolfcamp) Permian(?).

R. L. Bates and others, 1947, New Mexico Bur. Mines Mineral Resources Bull. 26, p. 23, pl. 1. At type locality, formation is 250 feet thick and consists of shale, conglomerate, and arkosic sandstone in lower part, and marine limestone and shale in upper part.

E. R. Lloyd, 1949, New Mexico Bur. Mines Mineral Resources Bull. 29, p. 32–33. In discussing Pennsylvanian-Permian contact, Thompson (1942, New Mexico Bur. Mines Mineral Resources Bull. 17) mentioned presence of fusulinid-bearing marine sediments of lower Wolfcamp age unconformably overlying Pennsylvanian rocks [Fresnal group] in a number of localities in south-central New Mexico. These lower Wolfcampian limestones received three different names in 1946. Kelley and Wood introduced name Red Tanks member of Madera limestone in Lucero uplift; Wilpolt and others introduced name Bursum for beds exposed in Los Pinos Mountains and vicinity of Abo Canyon; Stark and Dapples described same section and named it Aqua Torres formation. Name Bursum is preferred by New Mexico Bureau of Mines and Mineral Resources. Bruton formation (Thompson, 1942), of Pennsylvanian age, is very similar in lithology to Bursum, and it is possible that all or part of the Bruton has been included in descriptions of the Bursum. Similar section, now included in Bursum, was found by Thompson (1942) in Fresnal Canyon in northern Sacramento Mountains where it is 250 feet thick and overlies beds of upper Virgil age. It is overlain with angular unconformity by Abo formation.

L. C. Pray, 1954, New Mexico Geol. Soc. Guidebook 5th Field Conf., p. 93. Shown on composite columnar section, Sacramento Mountains, Otero County, as underlying Abo formation and overlying Holder formation (new). Consists of shale, gray and red sandstone, limestone, and limestone conglomerate. Thickness as much as 350 feet.

M. L. Thompson, 1954, Kansas Univ. Paleont. Contr. 14, Protozoa, art. 5, p. 17–18. Redefined to apply only to pre-Abo (Wolfcampian) Permian rocks of New Mexico. As thus redefined, it takes in uppermost 40 feet of Bruton formation of Thompson (1942). A lower part of Bursum, as defined by Wilpolt and others, is retained in Bruton formation.

F. E. Kottlowski and others, 1956, New Mexico Bur. Mines Mineral Resources Mem. 1, p. 47–49. As redefined by Thompson (1954), formation at its type locality consists of a lower 48 to 65 feet of red beds and limestones and upper massive to nodular limestones about 70 feet thick. Overlies Panther Seep formation (new).

Carel Otte, Jr., 1959, New Mexico Bur. Mines Mineral Resources Bull. 50, p. 25–26. In northern Sacramento Mountains, Thompson's sequence of "transition beds" consists largely of marine sequences of fossiliferous gray shale, limestone, and sandstone, whereas in central New Mexico the Bursum is predominantly red beds that occur interbedded with a few thin fusulinid-bearing limestones. In addition, upper part of "transition beds" occurring north of Tularosa are younger than "Bursum" age. Name Laborcita formation is therefore proposed for strata between top of Holder formation and top of highest marine limestone underlying main mass of Abo red beds.

Type section: Exposures just west of Bursum triangulation point, in SE¼ sec. 1, T. 6 S., R. 4 E., Oscura Mountains, Socorro County.

Burton 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. 182.

R. L. Nace and P. P. Bieber, 1958, West Virginia Geol. and Econ. Survey Bull. 14, p. 17. Shown on table of summary of stratigraphic sections of Dunkard group, Harrison County. Underlies unnamed shale below Ninevah limestone; overlies Hostetter coal and (or) fire clay.

Named for Burton, Wetzel County.

Busby Quartzite[1]

Busby Quartzite or Formation (in Ophir Group)

Lower Cambrian: Western Utah.

Original reference: T. B. Nolan, 1930, Washington Acad. Sci. Jour., v. 20, no. 17, p. 421–432.

H. E. Wheeler, 1948, Nevada Univ. Bull., Geology and Mining Ser., no. 47, p. 28–32, fig. 5. Geographically extended into House Range area where it includes Tatow limestone (Deiss, 1938); in Wah Wah Range includes uppermost 70 feet of beds assigned to Pioche shale by Wheeler (1943, Geol. Soc. America Bull., v. 54, no. 12, pt. 1). Thickness 165 feet in House Range; 450 feet in Deep Creek Range. Overlies Pioche shale; underlies Millard limestone (new). Busby may be tongue extending southward from Prospect Mountain quartzite. Middle Cambrian.

R. E. Cohenour, 1959, Utah Geol. and Mineralog. Survey Bull. 63, p. 12 (table 1), 35, 39–41, pl. 1, measured sections. In Sheeprock Mountains, Busby quartzite or formation included in Ophir group. Comprises 146 feet of beds, mainly quartzites, sandstones, and sandy limestones. Age is lower Middle Cambrian with strong indications that it was deposited only slightly after early Cambrian time.

U.S. Geological Survey currently considers the Busby quartzite to be Lower Cambrian in age. This designation is based on the discovery of *Olenellus* near top of quartzite in Deep Creek Range.

Named for exposures in Busby Canyon, on northeastern slope of Dutch Mountain, Gold Hill district.

Busby Quartzite Member (of Langston Formation)

Middle Cambrian: Southeastern Idaho and northern Utah.

G. B. Maxey, 1955, Dissert. Abs., v. 15, no. 4, p. 558. Incidental mention.

Bushberg Sandstone Member (of Sulphur Springs Formation)[1]

Bushberg Formation (in Sulphur Springs Group)

Lower Mississippian: Central eastern Missouri.

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. 43–46. Prior to 1933, beds here described [Boone County] as Bushberg were called Sylamore and were believed to be equivalent to Sylamore sandstone of Arkansas. Ulrich considered Bushberg to be top member of Sulphur Springs formation. In this report, the Sulphur Springs is classed as a group. In its areal extent, the Bushberg is known to lie upon the Jefferson City, Powell, Joachim, St. Peter, Plattin, Kimmswick, and Callaway formations. In Boone County, overlies Callaway limestone; underlies Chouteau formation. Estimated thickness 2 feet.

M. G. Mehl, 1960, Denison Univ. Jour. Sci. Lab., v. 45, art. 5, p. 69–71. Ulrich described Bushberg as uppermost of three members of Sulphur Springs formation. Term Sulphur Springs is herein abandoned and the Bushberg referred to as formation. Name indicates that vicinity of Bushberg was meant to be type locality, although it is reasonably certain that Ulrich was describing outcrops at Goetz Quarry near Glen Park. Type locality herein designated. Geographically restricted to outcrops in Jefferson County and closely adjacent parts of Franklin and St. Louis Counties. Bushberg provides little useful data by means of which it may be correlated with isolated, widely separated exposures. Early Mississippian age of conodont fauna described as from the "Bushberg" by Branson and Mehl (1933, Missouri Univ. Studies, v. 8, no. 4) is not questioned, but its identification as a Bushberg fauna is not supported by evidence at hand. Fauna from the "Bushberg" described by Branson (1938, Missouri Univ. Studies, v. 13, no. 4) should not be considered valid evidence of age of the Bushberg; sandstone from which fauna came is isolated and far removed from Bushberg as herein restricted, and its relationships are not clear. Average thickness about 10 feet. Unconformable upon Maquoketa, Kimmswick or "Fernvale," Grassy Creek, and Glen Park. Underlies Bachelor formation (new). Tentatively placed in Upper Devonian.

Type locality (Mehl, 1960): Outcrops at head of ravine draining into Mississippi River at Bushberg, formerly station on St. Louis, Iron Monutain, and Southern Railroad, NW¼NE¼NW¼ sec. 8, T. 41 N., R. 6 W., Jefferson County, Mo.

Busseron Sandstone Member[1] (of Shelburn Formation)

Upper Pennsylvanian: Southwestern Indiana.

Original reference: E. R. Cumings, 1922, Handb. Indiana Geology, pt. 4, Sep. Pub. 21, p. 524, 529, chart.

F. E. Kottlowski, 1954, U.S. Geol. Survey Coal Inv. Map C-11. Composed of gray to brown massive sandstone, sandy shale, and shale about 50 to 65 feet thick. Underlies a coal which in turn underlies Maria Creek limestone member; basal member of formation; overlies Coal VII at top of Dugger formation.

Probably named for village of Busseron, Knox County.

Butano Sandstone[1]

Eocene or Oligocene: Southern California.

Original reference: J. C. Branner, J. F. Newsom, and R. Arnold, 1909, U.S. Geol. Survey Geol. Atlas, Folio 163.

E. E. Brabb, 1960, Dissert. Abs., v. 21, no. 5, p. 1163. In Big Basin area, Butano sandstone of late Eocene (Narizian) age is divided into six informal units, which may prove to be members. Thickness about 9,000 feet. Overlies Locatelli formation (new) ; underlies San Lorenzo formation (subdivided).

Named for exposures on Butano Ridge, San Mateo County.

Butcherknife Basalt

Tertiary or younger: Southwestern Texas.

S. S. Goldich and M. A. Elms, 1949. Geol. Soc. America Bull., v. 60, no. 7, p. 1165–1168, pl. 1. Fresh, black, very fine-grained rock with conchoidal fracture. Younger than lowermost Pruett. Although cannot be correlated definitely with either Sheep Canyon basalt or the younger Cottonwood Spring basalt, it is much like them in composition.

Occurs on Butcherknife Hill, Buck Hill quadrangle, west-central Brewster County.

†Butler 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).

Probably named for a Captain Butler, discover of the lode.

Butler Clay Member (of Calvert Bluff Formation)

Butler Clay Member (of Rockdale Formation)[1]

Eocene, lower: Central and southern Texas.

Original reference: F. B. Plummer, 1933, Texas Univ. Bull. 3232, p. 530, 587.

H. B. Stenzel, 1953, *in* Am. Assoc. Petroleum Geologists, Soc. Econ. Paleontologists, Mineralogists, and Soc. Econ. Geologists Joint Mtg. Guidebook, p. 52, 54. Reallocated to member status in Calvert Bluff formation. Forms basal part of formation, but top boundary indistinguishable from remainder of Calvert Bluff. Overlies Simsboro formation.

Typically exposed at town of Butler, Freestone County.

†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 complied by M. G. Wilmarth).

Copper district of Keweenaw Point.

†Butler Limestone (in Allegheny Formation)[1]

Pennsylvanian: Western Pennsylvania.

Original reference: I. C. White, 1878, Pennsylvania 2d Geol. Survey Rept. Q, p. 49.

Present at Butler, Butler County in cut near railroad station, hence name.

Butler Sandstone Member (of Allegheny Formation)[1]

Butler Sandstone (in Allegheny Formation)

Butler Sandstone Member (of Freeport Formation)

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

Original reference: I. C. White, 1878, Pennsylvania 2d Geol. Survey Rept. Q, p. 40–71, 130.

G. H. Ashley, 1926, Pennsylvania Topog. and Geol. Atlas 65, p. 28, pl. 4; M. N. Shaffner, 1946, Pennsylvania Topog. and Geol. Atlas 55, p. 51–65; E. G. Williams, 1960, Jour. Pateontology, v. no. 5, p. 910 (fig. 2). Member of Freeport formation.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 60, 75, fig. 21. Lies about 35 feet below Upper Freeport coal which is considered top of Allegheny group. Thickness 5 to 15 feet. In Fayette County, commonly replaced by sandy shale. Sandstone may lie above or below Bolivar fire clay.

Type locality: Town of Butler, Butler County, Pa., just below Mr. Muntz's, opposite mills of Woldo & Bros., where it has been quarried.

Butlerville quartzites[1]

Cambrian: Utah.

Original reference: C. R. Keyes, 1924, Pan-Am. Geologist, v. 41, p. 38.

Derivation of name not stated.

Buttahatchie Gravel[1]

Quaternary(?): Alabama.

Original reference: R. T. Hill, 1888, Arkansas Geol. Survey Ann, Rept. 1888, v. 2, p. 189.

Butte Formation

Permian (Wolfcampian): Eastern Nevada.

J. S. Berge, April 1960, Brigham Young Univ. Research Studies, Geology Ser., v. 7, no. 5, p. 11 (fig. 3). Butte formation, as shown on correlation chart, underlies Robbers Roost formation (new) and unconformably overlies Ely limestone. Permian (Wolfcampian). Column on chart credited to G. P. Lloyd (1959, unpub. thesis).

H. J. Bissell, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 8, p. 1427 (chart). Name appears on correlation chart accompanying preliminary statement on eastern Great Basin Permo-Pennsylvanian strata. Underlies Murry [formation] (new); stratigraphically above Ely limestone.

Present in White River valley and Moorman Ranch areas.

Butte Gravel Member (of Sutter Formation)

Butte Gravels[1]

Tertiary, upper: Northern California.

Original reference: Howel Williams, 1929, California Univ. Pub., Dept. Geol. Sci. Bull., v. 18, p. 112–129.

Ralph Stewart, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 34, sheet 2. Used in a restricted sense. Top 150 feet of gravels are considered a sporadic basal member of Sutter formation. Upper Tertiary.

Present at Marysville Buttes, Sutter County.

Butte Quartz Monzonite[1]

Upper Cretaceous or Paleocene: Central western Montana.

Original reference: W. H. Weed, 1899, Jour. Geology, v. 7, p. 740–750.

G. E. Becraft, 1960, U.S. Geol. Survey Mineral Inv. Field Studies Maps MF–171 and MF–172. Upper Cretaceous or Paleocene.

Prevailing rock of Butte district.

Butte Creek Basalt

Late Pleistocene and Recent: Northern California.

Howel Williams, 1949, California Div. Mines Bull. 151, p. 45–46. Narrow flow of black vesicular olivine basalt. Thickness 10 to 150 feet. Covered by Alder Creek basalt (new).

Issued from fissure at elevation of approximately 6,000 feet on east wall of Butte Canyon, Macdoel quadrangle. Extends for about 10 miles and ends near Soule Ranch at elevation of about 4,800 feet.

Butte Creek Beds

Oligocene, upper, or Miocene, lower: Northwestern Oregon.

J. E. Allen, 1946, Oregon Dept. Geology and Mineral Industries G.M.I. Short Paper 15, p. 5. Name credited to Harper (1941, unpub. map of Molalla quadrangle). Fossils, both foraminifera and megafossils in Marquam limestone (deposit) indicate Vaqueros age, correlative with Illahe-Mehama formation of Thayer (1939) and Butte Creek beds.

W. D. Lowry, 1947, Geol. Soc. Oregon Country News Letter, v. 13, no. 1, p. 5. Mentioned as containing the Wilhoit coal.

Occurs along Butte Creek about 3 miles east of Scotts Mills, Marion County.

Butte Falls Tuff

Precambrian (Yavapai Series): West-central Arizona.

C. A. Anderson, E. A. Scholz, and J. D. Strobell, Jr., 1955, U.S. Geol. Survey Prof. Paper 278, p. 1, 7, 10–11, pl. 3. Largely massive- to well-bedded metamorphosed water-deposited tuff and possibility includes some flows. Several kinds of rocks have been grouped under the tuff, including quartz-sericite schist, quartz-feldspar-biotite schist, and grayish-white, gray, and purple slate. Thickness more than 2,500 feet. Younger than Bridle formation (new); underlies Hillside mica schist (new) with gradational contact. Intruded by Dick rhyolite and Lawler Peak granite (both new).

Exposed for more than 1 mile along Boulder Creek in vicinity of Butte Falls, for which these rocks have been named; Bagdad area, Yavapai County.

Butte Mountain Formation

Permian: Eastern Nevada and western Utah.

Grant Steele, 1960, Dissert, Abs., v. 20, no. 12, p. 4635. Incidental mention in stratigraphic interpretation of Pennsylvanian-Permian systems of eastern Great Basin. Subsidence continued, accompanied by deposition of

Kaibab, Butte Mountain, Phosphoria, and Gerster formations, until latest Guadalupian times, when westerly positives once again fed minor amounts of chert clastics east and south into western part of Phosphoria-Gerster deposition basin in Nevada.

Type locality and derivation of name not stated.

Butterfield 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 on map legend. Occurs above Knight conglomerate and below Rose Canyon latite-andesite flows.

Mapped in southern part of Salt Lake County. Largest exposure in south of Butterfield Canyon.

Butterfield Limestone Member (of Bingham Quartzite)[1]

Pennsylvanian: Central northern Utah.

Original reference: A. Keith, 1905, U.S. Geol. Survey Prof. Paper 38, p. 37, map, sections.

Exposed in Butterfield Canyon, Bingham district.

Butterly Dolomite (in Arbuckle Group)

Upper Cambrian: Southwestern Oklahoma.

C. E. Decker, 1939, Geol. Soc. America Bull., v. 50, no. 7, p. 1317–1318, table 1; 1939, Oklahoma Geol. Survey Circ. 22, p. 15, 16 (table 1), 22–23. Mostly coarse dolomite with large quartz grains and thin quartz conglomerate in upper part. Color ranges from pink to yellow and gray. Thickness at type locality 286 feet; on west side of East Timbered Hills 374 feet. Overlies Signal Mountain formation: underlies Chapman Ranch member of McKenzie Hill formation. Name Butterly is substituted for Chapman Ranch, and name Chapman Ranch is used for the limestone at the base of the McKenzie because it appears that Ulrich intended the name Chapman Ranch to apply to the limestone rather than the dolomite.

W. E. Ham, 1949, Oklahoma Geol. Survey Circ. 26, p. 58–62. Butterly dolomite in Mill Creek-Ravia area, Johnston County, includes strata 333 to 435 feet thick that lie conformably on Royer dolomite and grade upward into limestone beds of McKenzie Hill formation.

Type section: On east side of U.S. Highway 77 in sec. 18, T. 2 S., R. 2 E., southeast of Chapman Ranch buildings, [Murray County]. Named for ranches owned by John Butterly and Butterly brothers at southeast end of West Timbered Hills, secs. 28 and 29, T. 1 S., R. 1 E.

Buttermilk Falls Limestone (in Onondaga Group)

Buttermilk Falls Limestone Member (of Onondaga Formation)

Lower or Middle Devonian: Northeastern Pennsylvania.

Bradford Willard, 1938, Pennsylvania Geol. Survey, 4th ser., Bull. G–11, p. 5, 6 (fig. 3), 14, 16; 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 144–145. Because of elevation of term Onondaga to group rank, name Buttermilk Falls is introduced for those beds formerly designated as the Onondaga limestone. In Monroe County, consists of heavily bedded dark- or blue-gray limestone; contains nodules and lenses of dark chert, most abundant in middle of formation, but decreasing in upper and lower beds as these pass over respectively in the Marcellus formation and

Esopus shale. Thickness about 200 feet; thins westward to 5 feet in Lehigh River above Palmerton. Middle Devonian.

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.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Onondaga formation as mapped includes Buttermilk Falls limestone member in easternmost part of State.

Crops out low on north side of Godfrey Ridge, at various places in vicinity of the Stroudsburgs, along railroads south of these boroughs, and in nearby quarries. Named for Buttermilk Falls on Marshall Creek, Monroe County. Continues east into Pike County but west only into Carbon County.

Butternut Shale Member (of Skaneateles Formation)

Middle Devonian: Central New York.

G. A. Cooper, 1941, Washington Acad. Sci. Jour., v. 31, no. 5, p. 181–182. Proposed to replace Berwyn of Cooper, 1930 (not Richards and Birk, 1925).

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Correlation chart shows Butternut shale below Chenango sandstone and above Pompey shale and sandstone. Middle Devonian.

[G. A. Cooper], 1955, *in* New York State Geol. Assoc. [Guidebook] 27th Ann. Mtg., p. 10, 11. Dark-gray shale grading upward into Chenango sandstone member. Overlies Pompey member. Thickness 220 to 235 feet.

Type section: In the Cascades formed by branch of Butternut Creek, southeast of Syracuse, Tully quadrangle, Onondaga County.

Butte Valley Basalt

Late Pleistocene and Recent: Northern California.

Howel Williams, 1949, California Div. Mines Bull. 151, p. 44–45. Black vesicular olivine basalt dotted with schollendomes. Thickness 80 feet at Juniper Lodge at bottom of Mount Hebron grade on U.S. Highway 97, where it overlies dark volcanic sand.

P. R. Wood, 1960, U.S. Geol. Survey Water-Supply Paper 1491, p. 19 (table 4), 29–31, pl. 1. Late Pleistocene and Recent.

Occurs at southern end of Butte Valley, around Jerome, Macdoel quadrangle.

Butte Valley Formation

Lower(?) Triassic: Southeastern California.

B. K. Johnson, 1957, California Univ. Pubs. Geol. Sci., v. 30, no. 5, p. 384–385, figs. 1, 3. Consists of impure carbonates and limy argillaceous rocks thermally metamorphosed to very fine grained calc-silicate hornfelses; mostly banded rock of alternating laminae of light- and dark-gray hornfels, but locally includes massive units a few feet thick. About 4,000 feet thick. Contact between Permian Anvil Spring formation (new) and Butte Valley not exposed; east of Striped Butte, underlies Warm Spring formation (new), contact between the two gradational through as much as several hundred feet.

Exposed along east side of Butte Valley, Manly Peak quadrangle in southern Panamint Range, Inyo County.

Butting Ram Sandstone Member (of Talledega Slate)[1]

Pre-Devonian (probably Paleozoic): Eastern Alabama.

Original reference: Charles Butts, 1926, Alabama Geol. Survey Spec. Rept. 14, p. 54, 58, map.

T. N. McVay and L. D. Toulmin, 1945, Alabama Geol. Survey Bull. 55, p. 20. Mentioned in discussion of Talledega series.

Named for fact it is believed to form Butting Ram shoals on Coosa River, on border between Chilton and Coosa Counties, about 10 miles northeast of Clanton.

Buttle Diatomite Member (of Monterey Formation)

Miocene-Pliocene: Central western California.

Y. T. Mandra, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 6, p. 78, 79-81, 88. Proposed for diatomite, about 500 feet thick, in Monterey formation. Overlies typical Monterey cherts, shales, and thinner interbeds of diatomite. Unconformably underlies sandy conglomerate that grades upward into gray-white sandstone that has been mapped as Santa Margarita by some workers and Pancho Rico by other workers. Name Pancho Rico is preferred in this report. Delmontian.

Type locality: Buttle Canyon, in NE¼ sec., 15, T. 24 S., R. 10 E., Mount Diablo base and meridian, approximately 4 miles west southwest of Bradley, Monterey County. Locality is on southwest limb of Hames Valley syncline.

Button Mold Knob Member (of new Providence Formation)

Lower Mississippian: Northern Kentucky and southern Indiana.

J. E. Conkin, 1957, Bulls. Am. Paleontology, v. 38, no. 168, p. 114–116, 120–121. Middle member of New Providence formation, Silver Hill facies. Divisible into lower, middle, and upper parts. Consists largely of green-gray shale with ironstone lenses and concretions, some limestones; crinoidal bioherms. Thickness about 145 feet. Underlies Kenwood sandstone member; overlies Coral Ridge member (new).

Type locality: Button Mold Knob, Bullitt County, Ky. Only lower and middle parts are well exposed here.

Buttrill 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. Typically a graywacke sandstone and shale sequence with a few thin sandy chocolate-weathering flags. Thickness at type locality 370 feet. Underlies Roberts Ranch member (new).

Type locality: Dagger Flat, Brewster County. Exposed along Dagger Flat anticlinorium approximately 1½ miles southeast of Buttrill's ranch.

Buttsgin Formation[1]

Eocene: Southern Texas.

Original reference: R. A. Liddle, 1921, Texas Univ. Bull. 1860, p. 82, map, and columnar section.

Typically exposed in Butts Gin, approximately 6 miles northwest from Yancey, Medina County, in bed and tributaries of branches of Seco Creek.

Butts Ranch Shale Member (of Panoche Group)

Upper Cretaceous: Northern California.

I. F. Wilson, 1943, California Jour. Mines and Geology, v. 39, no. 2, p. 203, 226 (fig. 5), pl. 3. Consists of purplish or brownish calcareous and clay shales, thinly bedded and cut at various angles by sandstone dikes 2 or 3 feet wide; abundantly foraminiferal. Thickness at type locality 200 feet. Underlies Big Oak Flat shale member (new); overlies Call sandstone member (new).

Type locality: Along Paynes Creek 1 mile north of Butts Ranch, San Benito County. Member is exposed only along northeast limb of Butts Ranch syncline.

†Buxton Formation[1]

Pennsylvanian: Southeastern Kansas.

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

Named for Buxton, Wilson County.

Buzzard Rhyolite (in Ash Creek Group)

Precambrian (Yavapai Series): Central Arizona.

C. A. Anderson and S. C. Creasey, 1958, U.S. Geol. Survey Prof. Paper 308, p. 11–12, pl. 1. Outcrops in lower reaches of Black Canyon tinted in shades of red, whereas those in the headwaters are buff to cream. Contorted flow banding and amygdaloidal and vesicular structures common in flows. Fragmental structures common; some represent flow breccia. Thin sandy interbeds in breccia exposed near base of rhyolite west of Ward Pocket and three-fourths of a mile southeast of Allen Spring. Similar interbeds of sedimentary rock exposed near top of rhyolite north of Oak Wash. Megascopically rhyolitic rocks commonly porphyritic. Thickness of complete section in lower part of Black Canyon, where it overlies Gaddes basalt (new) and underlies Shea basalt, estimated at 3,500 feet.

Good exposures in Buzzard Canyon, a tributary to Black Canyon, southeast of Mingus Mountain. Excellent outcrops in Black Canyon, Jerome area, Yavapai County.

Buzzard Peak Conglomerate Member (of Topanga Formation)

Miocene, middle: Southern California.

A. O. Woodford, T. G. Moran, and J. S. Shelton, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 4, p. 515–519. Sandy conglomerate and coarse-grained pebbly sandstone with a few thin beds of white siliceous siltstone. Thickness about 2,000 feet; base not exposed. Overlain with apparent conformity by either the lower member of Puente formation or by a few feet of andesite breccia or massive calcic andesite which in turn is overlain by the Puente.

Crops out in core of Buzzard Peak anticline in San Jose Hills, 5 miles west of Pomona, Los Angeles County.

Byer Member[1] (of Logan Formation)

Mississippian: Central and southern Ohio.

Original reference: J. E. Hyde, 1912, History of Fairfield County, p. 211; 1915, Jour. Geology, v. 23, p. 656, 657, 659, 678, 764–765, 771–775.

F. T. Holden, 1941, Illinois Acad. Sci. Trans., v. 34, no. 2, p. 172–173; 1942. Jour. Geology, v. 50, no. 1, p. 55, 56–58. Included in Pretty Run sandstone facies (new) of formation. Underlies Allensville conglomerate member; overlies Berne conglomerate member.

J. E. Hyde, 1953, Ohio Geol. Survey Bull. 51, p. 3 (table 1), 26–27. Overlies the Berne here included in Cuyahoga formation.

Named for Byer, Jackson County.

Byham limestone member[1]

Mississippian: Northwestern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, table opposite p. 61, p. 134.

In Buchanan's Ravine, north of Shaws School (Buchanan Station) and about 1½ miles north-northwest of Byham School, south of Meadville, Crawford County.

Byram Formation (in Vicksburg Group)

Byram Marl (in Vicksburg Group)[1]

Byram Member (of Vicksburg Formation)

Oligocene: Mississippi, southwestern Alabama, northwestern Florida, and Louisiana.

Original reference: T. L. Casey, 1902, Philadelphia Acad. Nat. Sci. Proc., v. 53, p. 517–518.

F. F. Mellen, 1939, Mississippi Acad. Sci. Jour., v. 1, p. 18. Member at top of Vicksburg formation.

R. O. Vernon, 1942, Florida Geol. Survey Bull. 21, p. 56. Limestone mapped as Suwannee in this report [Holmes and Washington Counties] may represent time interval equivalent to that required for deposition of Glendon limestone, Byram marl, and lower Chickasawhay marl of western Alabama and eastern Mississippi. Not possible to establish mappable units within the Suwannee.

C. W. Cooke, Julia Gardner, and W. P. Woodring, 1943, Geol. Soc. America Bull., v. 54, no. 11, chart 12. Byram limestone, as shown on correlation chart, comprises (ascending) Glendon limestone, Byram marl, and Bucatunna clay members. Vicksburg group.

F. S. MacNeil, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 9, p. 1315 (fig. 1), 1329–1344. Byram formation as herein treated includes, in addition to marl to which name Byram was applied originally, the Glendon limestone member at base and Bucatunna clay member at top. Overlies Marianna limestone; underlies Chickasawhay limestone and Flint River formation.

W. H. Monroe, 1954, U.S. Geol. Survey Bull. 986, p. 80–98, pls. 1, 3, 4, 5. Byram formation including Glendon and Bucatunna member is present in belt across Mississippi from Warren County and southern part of Yazoo County on west to Wayne County on east. Present in western and central Alabama and has been doubtfully identified in Florida. Thickness about 110 feet. Entire section not exposed at any one place. Overlies Marianna limestone; disconformably(?) underlies Catahoula sandstone.

E. C. Tonti, 1955, Dissert. Abs., v. 15, no. 8, p. 1372. In stratigraphic investigation of Vicksburgian deposits in Mississippi, Alabama, and

Florida, two sedimentary cycles were identified. District disconformity marks upper and lower boundary of each unit. Lowermost cycle extends from disconformity at base of Mint Springs-Mariana formation to similar break at top of Byram formation (this report). Uppermost cycle contains Bucatunna marl and clay facies extending to disconformity at base of overlying Catahoula and Chickasawhay formations. Name Vicksburg stage suggested to include these deposits. Name Hennessey Bayou member proposed for lower Bucatunna transgressive unit heretofore included in Byram formation.

Type locality: On right bank of Pearl River, in S½NW¼NW¼ sec. 19, T. 4 N., R. 1 E., Hinds County, Miss. Named for Byram.

Byram Gneiss

Byram Granite Gneiss[1]

Precambrian: Northern New Jersey and eastern Pennsylvania.

Original reference: A. C. Spencer, 1908, U.S. Geol. Survey Geol. Atlas, Folio 161.

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), 187–193. Described in Northampton County, Pa., where it intrudes Franklin formation, Moravian Heights formation (new), and Pochuck gneiss.

W. S. Bayley, 1941, U.S. Geol. Survey Bull. 920, p. 18, 46, 50–51, pl. 5. Gray granitoid gneiss composed of microcline, microperthite, quartz and hornblende, with some pyroxene and biotite. Byram granite gneiss, Losee diorite gneiss, and Pochuck gabbro gneiss grade into one another through intermediate forms which as a rule can be recognized easily in thin sections, although they may not be distinguishable everywhere in the field. With decrease in oligoclase, the Losee phases pass into the Byram phases. Intrudes Franklin limestone and Pickering gneiss.

Bradford Willard *in* Bradford Willard and others, 1959 Pennsylvania Topog. and Geol. Survey Bull. C9, p. 219. Byram gneiss may be upper part of batholith which engulfed all but remnants of Franklin limestone and Pochuck gneiss.

Named for Byram Township, Sussex County, N.J., where good exposures occur in hills northeast of Roseville.

Byron Beds[1]

Byron Dolomite (in Burnt Bluff Group)

Middle Silurian (Niagaran): Southeastern Wisconsin and northern Michigan.

Original reference: T. C. Chamberlin, 1877, Geol. Wisconsin, v. 2, p. 345–348.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Byron dolomite included in Burnt Bluff group.

G. M. Ehlers and R. V. Kesling, 1957, Michigan Geol. Soc. [Guidebook] Ann. Geol. Excursion, p. 2 (table), 9, 13–14. Overlies Lime Island dolomite (new); underlies Hendricks dolomite. Thickness 80 to 155 feet.

Named for Byron Township, Wis.

Byron Schist

Age not stated: West-central Maine.

Kern Jackson, 1953, Maine State Geologist Rept. 1951–1952, p. 53, 64–60. Consists of alternate layers of dark staurolitic schist and light fine-grained quartzite. Contacts between layers are alternately sharp and gradational. Schist lamellae are more readily weathered, creating a "washboard" effect. Thickness about 5,000 feet.

Named for excellent exposures in bed of Swift River in vicinity of Byron, Oxford County.

Caballero Formation

Mississippian (Kinderhook): Central southern New Mexico.

L. R. Laudon and A. L. Bowsher, 1941, (abs.) Tulsa Geol. Soc. Digest, v. 9, p. 73–75; 1941, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 25, no. 5, p. 935; no. 12, p. 2116–2117, 2122–2125, fig. 4. Soft, gray, silty, marly limestone beds which weather to rounded, nodular, rubbly chunks on fresh exposures. Interbedded soft gray shales curve around nodular limestone lumps. Upper portion of section more shaly. Maximum thickness of 60 feet developed in area between Mule and San Andres Canyons in Sacramento Mountains. Thins to about 40 feet in northern part of range and to 28 feet in southernmost part of area. Unconformably underlies Alamogordo member (new) of Lake Valley formation; unconformably overlies various members of Percha formation. Heretofore considered a part of Lake Valley formation.

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; 1945, Jour. Geology, v. 53, no. 4, p. 239. Overlies Contadero formation (new).

L. R. Laudon and A. L. Bowsher, 1949, Geol. Soc. America Bull., v. 60, no. 1, p. 9–10, fig. 5. Thickness varies from featheredge to 60 feet in central southern New Mexico. Basal part in many places contains thin layer of fissile black shale. Georgraphic distribution given.

F. E. Kottlowski and others, 1956, New Mexico Bur. Mines Mineral Resources Mem. 1, p. 32. Summary paper. Extended to southern part of San Andres Mountains.

Type section: In Deadman Canyon, Sacramento Mountains, sec. 3, T. 17 S., R. 10 E., Otero County. Best developed in Sacramento Mountains, occurs in central and southern portion of San Andres Mountains, and locally in Lake Valley area. Missing elsewhere in New Mexico.

Caballo Blanco Rhyolite Tuff

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 for map of Mimbres Valley.

W. E. Elston, 1957, New Mexico Bur. Mines Mineral Resources Bull. 38, p. 17 (table 1), 30–31, 32, pl. 1. Described as white, cream, or light-gray porphyritic rhyolite tuff interpreted as an ignimbrite. Matrix partly pumiceous. Reaches maximum thickness of 325 feet at Caballo Blanco in Dwyer quadrangle; thins to the west and pinches out toward the south near Box Well. According to generalized stratigraphic section Caballo Blanco rhyolite tuff is uppermost unit of eruptive suite termed Lower Volcanic series. Occurs above Rustler Canyon basalt (new). Unconformably underlies Razorback andesite and rhyolite of Upper Volcanic series. Derivation of name.

Name is taken from a mountain in secs. 25 and 36, T. 18 S., R. 11 W. (as shown on pl. 1), Dwyer quadrangle.

Caballos Novaculite[1]

Devonian and Mississippian: Southwestern Texas.

Original reference: J. A. Udden, C. L. Baker, and E. Böse, 1916, Texas Univ. Bur. Econ. Geology and Tech. Bull. 44, p. 39.

P. B. King, 1937, U.S. Geol. Survey Prof. Paper 187, p. 47–55, pls. 23, 24. Subdivided into five members (ascending): lower chert; lower novaculite; middle chert; upper novaculite; upper chert. Name Santiago chert, which had been applied to three upper members, abandoned. Thickness 200 to 600 feet. Overlies Maravillas chert; underlies Tesnus formation.

B. N. Berry and H. M. Nielson, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 9, p. 2254–2259. King's (1937) lower two members of Caballos form one genetic unit and upper three members from another genetic unit; proposed here to revive original terminology of Udden, Baker, and Böse and recognize two distinct formations. Name Caballos is restricted to lower formation which includes lower chert member and lower novaculite member as described by King, and term Santiago chert revived and applied to upper three members.

The U.S. Geological Survey currently designates the age of the Caballos Novaculite as Devonian and Mississippian.

Named for exposures on Horse (Caballos) Mountain, Brewster County.

Cabaniss Formation (in Cherokee Group)

Cabaniss Group

Cabaniss Subgroup (of Cherokee Group)

Pennsylvanian (Des Moines Series): Central and northeastern Oklahoma, southeastern Kansas, and western Missouri.

M. C. Oakes, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 6, p. 1524 (fig. 1), 1526. Defined to include all rocks that crop out above Krebs group (new) and below base of Marmaton group. Extends from northeast flank of Arbuckle Mountains northeastward to Kansas-Oklahoma line and comprises (ascending) Thurman sandstone, Stuart shale, and Senora formation. In northern Oklahoma, top of group is base of Fort Scott limestone; between Arkansas River and Arbuckle Mountains base is Calvin limestone. Thickness 1,000 feet in latitude of Cabaniss; thins southwestward and northeastward due to overlap of lower units by higher as well as thinning within units; about 200 feet along Arbuckle Mountains; 350 feet at Arkansas River; 160 feet at Kansas-Oklahoma line. Krebs and Cabaniss groups together are nearly but not quite the same stratigraphically as Cherokee rocks of southeastern Kansas.

W. V. Searight, 1953, *in* W. B. Howe and M. V. Searight, Missouri Geol. Survey and Water Resources Rept. Inv. 14, pl. 1. Geographically extended into Carroll and Livingston Counties, Mo., where it comprises (ascending) Croweburg, Verdigris, Wheeler, Bevier, Lagonda, and Excello formations.

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 comprising following formations (ascending):

Weir, Tebo, Scammon, Mineral, Robinson Branch (new), Fleming, Croweburg, Verdigris, Bevier, Lagonda, Mulky, and Excello formations. Overlies Krebs group; underlies Marmaton group. Cygnian substage.

W. B. Howe, 1956, Kansas Geol. Survey Bull. 123, p. 22 (fig. 5), 44–46. Term Cherokee group readopted, and Cabaniss reduced to rank of subgroup. In southeastern Kansas, Cabaniss succession extended from top of Seville limestone in Krebs subgroup to base of Blackjack Creek limestone, which is lower Marmaton. Thickness about 200 feet.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. Shown on chart as formation in Cherokee group. Includes Tiawah limestone, Chelsea sandstone, Verdigris limestone, and Breezy Hill limestone together with several coals. Overlies Krebs formation; underlies Fort Scott limestone of Marmaton group.

Named from village of Cabaniss, in T. 6 N., R. 12 E., northwestern Pittsburg County, Okla.

Cabes Point Conglomerate lithofacies (of Louisenhoj Formation)

Upper Cretaceous: Virgin Islands.

T. W. Donnelley, 1960, Dissert. Abs., v. 20, no. 7, p. 2756; 1960, Caribbean 2d Geol. Conf. Trans., Mayagüez, Puerto Rico, p. 153. Intercalated conglomerates containing pebbles and cobbles of Water Island formation (new). Louisenhoj formation considered of Cenomanian age.

Report discusses geology of St. Thomas and St. John Islands.

Cabezon Fanglomerate[1]

Quaternary: Southern California.

Original reference: F. E. Vaughan, 1922, California Univ. Pub., Dept. Geol. Sci. Bull., v. 13, no. 9, p. 344, 387–392, map.

C. R. Allen, 1957, Geol. Soc. America Bull., v. 68, no. 3, p. 324 (fig. 2), 325 (table 1), 331, pls. 1, 3. Described in San Gorgonio Pass area as a gray to tan ill-sorted conglomerate rich in clasts of pegmatitic and granitic rocks. Maximum thickness about 1,500 feet. Unconformably underlies Heights fanglomerate; unconformably overlies Painted Hill formation, angular unconformity on wall of Stubby Canyon is tentatively regarded as the contact, although it may be a local angular unconformity within the Cabezon section. Type area suggested.

Type area apparently in foothills north of Cabazon, Riverside County. Fanglomerate appears to be continuous from Millard Canyon east to Whitewater and thence northward around flank of range. Post office is now spelled Cabazon, but Vaughan used the Indian spelling Cabezon and this is retained as formational name.

Cabin Shale[1]

Lower Cambrian: Western Utah.

Original reference: T. B. Nolan, 1930, Washington Acad. Sci. Jour., v. 20, no. 17, p. 421–432.

K. F. Bick, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 5, p. 1066. In Deep Creek Mountains area, name Cabin shale dropped in favor of Pioche, which has priority.

Named for exposures in Cabin Gulch, south of North Pass Canyon, Gold Hill quadrangle.

Cabin Creek Sandstone[1]

[Pennsylvanian]: Oklahoma.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 99. Abandoned by Oklahoma Geological Survey. Name used in error by Weidman (1932, Oklahoma Geol. Survey Bull. 56, p. 23) for Little Cabin sandstone. Croneis had used name in 1930 for sursurface sandstone in Arkansas.

Cabin Hill Member (of Rose Hill Formation)

Silurian: Central Pennsylvania.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 28. In lower part of Rose Hill formation. Name credited to Miller (unpub. ms.).

Type locality and derivation of name not stated.

Cable Formation (or lake beds)[1]

Quaternary(?): Southern California.

Original reference: A. C. Lawson, 1906, California Univ. Pub., Dept. Geol. Bull., v. 4, p. 431–462.

Named for town of Cable, Kern County.

Cable Canyon Sandstone Member (of Montoya Dolomite)

Cable Canyon Member (of Second Value Formation)

Cable Canyon Sandstone (in Montoya Group)

Upper 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 50 feet. Underlies Jornada limestone (new); overlies Bat Cave limestone (new). Montoya group.

V. C. Kelley and Caswell Silver, 1952, New Mexico Univ. Pubs. in Geology 4, p. 57–59, fig. 4. Coarse-grained granulitic sandstone, medium gray on fresh exposure and contains grains of white, gray, pale-rose, smoky, and blue-gray quartz, gray chert, and dolomite. Texture ranges from well-sorted medium-grained sand to unsorted small-pebble and granule conglomerate. Latter texture more characteristic. It is everywhere one single bed, 17 to 35 feet in thickness. Its appearance at a distance is always as a dark band above the light-colored cliffs of Bat Cave formation. Conformably underlies Upham dolomite (new). Type locality and derivation of name given.

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. 2287–2296. Disconformably overlies El Paso dolomite and underlies Upham dolomite in Sacramento Mountains. Montoya group.

Type locality: Cable Canyon section from which it takes its name, opposite Sierrite mine in NW¼ sec. 10, T. 16 S., R. 4 W., Caballo Mountains.

Cabo Rojo Agglomerate Member (of San Germán Formation)

Upper Cretaceous: Southwestern Puerto Rico.

R. C. Mitchell, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 12, p. 2972. Incidental mention.

P. H. Mattson, 1960, Geol. Soc. America Bull., v. 71, no. 3, p. 340–341. Agglomerate member of San Germán formation. Thickness about 50 meters. Stratigraphically below Cotui member. Upper Cretaceous. Mitchell (1954) tentatively considered member Upper Jurassic(?) because of erroneous correlation of two different outcrops of Cotui limestone with entire Cretaceous of Puerto Rico.

Type locality: In steep-walled, narrow roadcut at km. 10.1 on Route 4, 3.5 km. south of Cabo Rojo.

Cabo Rojo Stage[1]

Pleistocene: Puerto Rico.

Original reference: B. Hubbard, 1923, New York Acad. Sci., Scientific survey of Porto Rico and Virgin Islands, v. 2, pt. 1, p. 96.

J. D. Weaver, 1956, *in* R. Hoffstetter and others, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2b, p. 318. Term introduced for late Pleistocene deposits of western Puerto Rico.

Lares district.

Cabot Head Shale Member (of Cataract Formation)[1]

Cabot Head Shale (in Cataract Group)

Cabot Head Shale (in Medina Group)

Lower Silurian: Ontario, Canada, and northern Michigan and western New York.

Original reference: A. W. Grabau, 1913, Geol. Soc. America Bull., v. 24, p. 438, 460.

D. W. Fisher, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 9, p. 1981 (fig. 2), 1982 (fig. 3), 1990–1991. Discussion of stratigraphy of Medinan group in New York and Ontario. Cabot Head shale, overlies Manitoulin dolomite and underlies Grimsby sandstone. Although name Cataract holds priority, Cabot Head has become firmly entrenched in Canadian literature, and it seems unwise to attempt to replace the name. Unit is about 75 feet at type locality; 60 feet in vicinity of Hamilton; about 50 feet at Stoney Creek. Upper 27 feet of Power Glen formation (Bolton, 1953, Canada Geol. Survey Paper 52–23) at DeCew Falls is interpreted as Cabot Head shale and 8 to 10 feet of Cabot Head shale crops out in Niagara Gorge. This is most eastward exposure of unit, for isochronous Grimsby sandstone beds replace Cabot Head east of Niagara River. In restored stratigraphic cross section (fig. 2) of Medinan group datum is Manitoulin-Cabot Head contact, the line along which dominant transgression changed to dominant regression; hence this contact most closely approaches a true time-line.

G. M. Ehlers and R. V. Kesling, 1957, Michigan Geol. Soc. [Guidebook] Ann. Geol. Excursion, p. 2 (table), 4 (fig. 1), 6. Formation in Cataract group. Cabot Head in Northern Peninsula is recognized almost entirely from well samples. Only two outcrops are known; both occur in eastern Delta County. Thickness 13 to 18 feet near Isabella. Overlies Manitoulin dolomite; underlies Moss Lake formation (new). Alexandrian series.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. Included in Medina group. Overlies Rumsey Ridge shale herein given formational rank.

Named for exposures at Cabots Head on Manitoulin Islands, Ontario.

Cabotian[1] [Lavas, Red Rock, and Gabbro]

Precambrian: Eastern Minnesota.

Original reference: N. H. Winchell, 1899, Minnesota Geol. Nat. History Survey Final Rept., v. 4, p. xiv-xx, 215, 295–298.

Named for mountain range that appears at Duluth and eastward.

Cabresto Metaquartzite

Precambrian: Central northern New Mexico.

P. F. McKinlay, [1955?], New Mexico Bur. Mines Mineral Resources Bull. 42, p. 8–10, pl. 1. Gray to cream-colored massive quartzite; in places layers of mica gneiss and graphite mica gneiss. Quartzite usually composed of 2- to 10-foot layers of coarsely crystalline glassy to milky quartz. Thickness ranges from 200 to over 1,000 feet.

Named from exposures along Cabresto Canyon, along south edge of Costilla quadrangle, Taos County.

Cacapon Sandstone Member (of Clinton Formation)[1]

Middle Silurian: Western Virginia and northern West Virginia.

Original reference: N. H. Darton and J. A. Taff, 1896, U.S. Geol. Survey Geol. Atlas, Folio 28.

Charles Butts, 1940, Virginia Geol. Survey Bull., 52, pt. 1, p. 238, 242, 243, 246. Referred to as Cacapon division of the Clinton. Included in lower part of Iron Gate facies (new). In colloquial use, term Cacapon for the part of the Clinton carrying red or iron sandstone is permissible. Thickness of division about 157 feet.

Named for exposures on slopes of Cacapon Mountain, Winchester quadrangle, Virginia and West Virginia.

†Cacaquabic granite[1]

Precambrian: Minnesota

Original reference: J. M. Clements, 1903, U.S. Geol. Survey Mon. 45.

Exposed on shores and islands of Kekekabic Lake.

Cache Formation[1]

Pliocene or Pleistocene: Northern California.

Original reference: G. F. Becker, 1888. U.S. Geol. Survey Mon. 13, p. 219.

J. C. Brice, 1953, California Div. Mines Bull. 166, p. 12 (fig. 2), 30–34, pls. 1, 2, 7. Described in Lower Lake quadrangle. Fresh-water deposits of gravel, silt, and clay, except near top of section where tuffaceous sediments, marl, limestone, and diatomite predominate. Thickness 300 to 6,500 feet. In some areas, overlies serpentine and sediments of Knoxville group. Shown on columnar section as underlying Clear Lake volcanic series and unconformably overlying Tejon formation.

Occurs east of Clear Lake, about North Fork of Cache Creek, Lake County.

Cachenian Stage

Late Cretaceous: California.

P. P. Goudkoff, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 7, p. 960 (table 1), 991–993, 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 Weldonian stage (new) above and Delevanian stage (new) below.

Occurs in the Great Valley in both surface and subsurface. Well developed in surface section of Cache Creek, T. 12 N., R. 4 W., Yolo County.

Cache Valley Formation (in Salt Lake Group)

Cache Valley Group[1]

Miocene and Pliocene: Southeastern Idaho and northeastern Utah.

Original reference: A. C. Peale, 1879, U.S. Geol. and Geog. Survey Terr. 11th Ann. Rept. p. 603–606, 634, 635, 640, 641.

Neal Smith, 1953, Intermountain Assoc. Petroleum Geologists Guidebook 4th Ann. Field Conf., p. 73, 75 (fig. 2). Formation at top of Salt Lake group. Overlies West Spring formation (new). Thickness 1,000 to 2,000 feet. Middle and upper Pliocene.

R. D. Adamson, C. T. Hardy, and J. S. Williams, 1955, Utah Geol. Soc. Guidebook 10, p. 1, 2, 6–7. Redefined to include West Spring formation. Thickness 7,674 feet. Overlies Collinston conglomerate; underlies Mink Creek conglomerate (new). Miocene and Pliocene.

Well exposed on north side Cache Valley, northeastern Utah and southeastern Idaho, and on Bear River below middle canyon.

Cactus Granite[1]

Cactus Quartz Monzonite

Jurassic or Cretaceous: Southern California.

Original reference: F. E. Vaughan, 1922, California Univ. Pub. Dept. Geol. Sci. Bull., v. 13, no. 9, p. 344, 364–365.

R. B. Guillou, 1953, California Div. Mines Spec. Rept. 31, p. 5 (fig. 2), 12–13, pl. 1. Redescribed as Cactus quartz monzonite. Differentiated into three facies (in order of age of emplacement from oldest to youngest): aplite, quartz diorite, and quartz monzonite. Intrudes Baldwin gneiss and truncates the Chicopee formation (new) and Furnace limestone.

Named for Cactus Flat, San Bernardino Mountains, San Bernardino County.

Cactus Point Granite

Jurassic-Cretaceous: Central California.

D. C. Ross, 1958, California Div. Mines Spec. Rept. 53, p. 14, pl. 1. Commonly light gray on fresh exposures; weathered rock commonly has yellow tint. May be correlative with Big Baldy granite (new).

Crops out in area of about 5 square miles around Cactus Point, a small knob northeast of Ash Mountain Park headquarters, Sequoia National Park.

Caddell Formation (in Jackson Group)

Caddell Clay[1]

Eocene, upper: South-central Texas.

Original reference: E. T. Dumble, 1915, Geol. Soc. America Bull., v. 26, p. 462.

D. H. Eargle, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 11, p. 2624 (fig. 1), 2626–2627. Formation at base of Jackson group. Consists of glauconitic very fine sand, silt, and clay; calcareous and ferruginous concretions near base; marine beds locally interbedded with chocolate lignitic clays and sands. Underlies Wellborn sandstone. Type locality designated. Dumble's locality not located with certainty.

Type locality: Cuts along Highway 147 just west of relocated bridge, 4 miles west of site of Caddell, San Augustine County.

Caddo Limestone[1]

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

Original reference: J. A. Taff, 1902, U.S. Geol. Survey Geol. Atlas, Folio 79.

L. W. Stephenson and others, 1942, Geol. Soc. America Bull., v. 53, no. 3, chart 9. Correlation chart shows Caddo limestone above Kiamichi formation and below Bokchito formation.

Named for Caddo, Bryan County.

†Caddo Shale[1]

Lower and Middle Ordovician: Southwestern Arkansas.

Original reference: A. H. Purdue, 1909, Geol. Soc. America Bull., v. 19, p. 557.

Caddo Creek Formation (in Canyon Group)[1]

Caddo Creek Group

Upper Pennsylvanian: Central and central northern Texas.

Original reference: F. B. Plummer and R. C. Moore, 1922, Jour. Geology, v. 30, p. 24, 31, 35.

C. O. Nickell, 1938, Texas Univ. Bur. Econ. Geol. Pub. 3801, p. 108, 115. Formation consists of Hog Creek shale member, whose type locality is in northern Brown County, and overlying Home Creek limestone of northern Brown County, which has been correlated with limestone also called "Home Creek" occurring at same horizon in Brazos River basin in Palo Pinto County. Although these members are distinguishable in northern Brown County and in area along river, it is not practicable to separate them in much of intermediate area, for the reason that the Home Creek is broken into a number of relatively thin limestone beds interbedded with shale with no obvious dividing line between them. Thickness 69 feet. Overlies Brad formation (redefined); underlies Graham formation of Cisco group (restricted).

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 88. Rank raised to group. Includes Hog Creek shale below and Home Creek limestone. Underlies Graham group; overlies Brad group.

Robert Roth, 1956, North Texas Geol. Soc. Field Guidebook, May 25–26, fig. 2. Generalized columnar section shows group including Hog Creek shales and sandstone, Home Creek limestone, and lower part of Gonzales shale.

John Kay, 1956, North Texas Geol. Soc. Field Guidebook, May 25–26, fig. 4. Generalized columnar section shows group including unnamed strata below Ranger limestone up to base of Salem School limestone.

D. H. Eargle, 1958, San Angelo Geol. Soc. Guidebook, Apr. 17–18, p. 51. Shown on columnar section of Brown and Coleman Counties as Caddo Creek formation. Includes Colony Creek shale member below and Home Creek limestone member above. Thickness about 50 feet. Underlies Graham formation; overlies Brad formation.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 67. As originally defined, formation included Drake's Hog Creek shale below Home Creek limestone member above. Because of miscorrelations in past, name Hog Creek shale should be replaced. As redefined here, formation includes (ascending) Home Creek limestone member and Colony Creek shale member. Thickness about 55 feet along Colorado River; about 75 feet in central Brown County.

Named for tributary of Brazos River in Stephens County, Brazos River region.

Caddo Gap Novaculite[1] (in Arkansas Novaculite)

Devonian(?): Southwestern Arkansas.

Original reference: C. L. Cooper, 1933, Geol. Soc. America Bull., v. 44, no. 1, p. 211.

W. H. Hass, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 12, p. 2532. Incidental mention in discussion of age of Arkansas novaculite.

Named for Caddo Gap, Montgomery County.

Caddo Pool Formation (in Kickapoo Creek Group)

Caddo Pool Formation (in Smithwick 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. 5), 86. Proposed for middle formation of Smithwick group. Consists principally of about 200 feet of dense black spicular limestone with some thin sandstones in lower part. Occurs between depths of 3,820 and 3,960 feet in type well. Overlies Eastland Lake formation (new); underlies Parks formation (new).

M. G. Cheney, 1947, Jour. Geology, v. 55, pt. 2, no. 3, p. 209. Stratigraphic section assigned to Kickapoo Creek group (new) includes the Rayville (new), Parks and Caddo Pool formations.

Some reports place the Kickapoo Creek Group in the Strawn Series.

Type well: Anzac Oil Corp. *et al.* E. S. Graham No. 1, in Allen Hines Survey, Abstract 135, central Young County. Discovery well of Caddo Pool of eastern Stephens County was completed in this black limestone which is colloquially known as the "Caddo lime"; hence the name.

Cades Sandstone

Cades 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. 955 (table 1), 960–961. Cades sandstone is adapted from Cades conglomerate of Keith (1895) who mapped the Cades north and south of Cades Cove and widely elsewhere in mountains. Term is here restricted to rocks mainly north and west of the cove and beneath Green-briar fault. Sandstone lies in a similar position to rocks of Webb Mountain and Big Ridge. Around most of its periphery, the Cades is thrust over adjacent rocks but may lie with sedimentary contact on Metcalf phyllite (new) to south; its strata are inverted over wide areas. Total thickness unknown; as much as 4,000 feet exposed in some sections. Predominantly a coarse-grained feldspathic sandstone, in graded beds as much as 3 feet thick, commonly containing chips of dark fine-grained rock and pebbles of leucogranite but no grains of blue quartz; dark-gray argillaceous and silty rocks form partings between sandstone beds as well as a few units nearly 1,000 feet thick; also contains beds 10 to 50 feet thick of conglomerate characterized by well-rounded cobbles of quartzite, granite, and gneiss.

Named for exposures near Cades Cove, Blount County, Tenn.

Cadillac Granite

Mississippian: Southeastern Maine.

G. H. Chadwick, 1938, (abs.) Geol. Soc. America Proc. 1937, p. 73. Coarse-grained red granite; lighter in color and finer grained at contacts with country rocks.

G. H. Chadwick, 1942, (abs.) Geol. Soc. America Bull., v. 53, no. 12, pt. 2, p. 1796, 1797. Name is synonymous with undefined Cadillac Mountain granite. Younger than Prettymarsh diorite (new) which is post-Lower Devonian in age.

G. H. Chadwick, 1944, New York Acad. Sci. Trans., ser. 2, v. 6, no. 6, p. 175, 176–177. Age tentatively considered Mississippian.

Composes central massif of Mount Desert Island, Hancock County.

Cadiz Beds[1]

Upper Devonian: Western New York.

Original reference: G. H. Chadwick, 1934, Geol. Soc. America, Prelim. list of titles and abstracts of papers to be offered at 47th Ann. Mtg., Rochester, N.Y., Dec. 27–29, 1934, p. 12.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 2, chart 4. Shown on correlation chart between Cuba sandstone below and Hinsdale sandstone above.

Occurs on Genesee-Olean meridian in Genesee River region.

Cadiz Formation[1]

Lower and Middle Cambrian: Southeastern California.

Original reference: J. C. Hazzard and J. F. Mason, 1936, Geol. Soc America Bull., v. 47, no. 2, p. 229–240.

H. E. Wheeler, 1948, Nevada Univ. Bull., Geology and Mining Ser., no. 47, p. 31, 32, 35. Lyndon limestone geographically extended into California where it consists of member 5E of Cadiz formation (Hazzard, 1937, California Jour. Mines and Geology, v. 33, no. 4); Chisholm shale also extended into area where it includes member 5F and 5G of the Cadiz (Hazzard, 1937).

J. C. Hazzard, 1954, California Div. Mines Bull. 170, chap. 4, table 1. Redefined to include all beds between top of Lower Cambrian Chambless limestone and base of Middle Cambrian Bonanza King formation. This redefinition made because, as originally defined, lower limit of formation had been established on faunal basis and not on lithology.

As redefined, formation is mappable lithologic unit in both Marble and Providence Mountains. Thickness about 690 feet.

Type section: Measured in west-east direction up west front of high limestone ridge about 2 miles north of National Old Trails Highway where it crosses Marble Mountains about 3 miles north of Cadiz, San Bernardino County.

Caesar Canyon Formation

Ordovician: Central Nevada.

Marshall Kay, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 12, p. 97 (fig. 2), 98 (fig. 3). In central Nevada. Overlies Antelope Valley formation; underlies Gatecliff formation (new).

Toquima Range, Nye County.

Cagle Silt

Pleistocene (Kansan): Southwestern Indiana.

W. J. Wayne, 1958, Jour. Geology, v. 66, no. 1, p. 8, 9 (fig. 1), 10. Proglacial loess; conformably underlies Kansas stage till; overlies Pennsylvanian Mansfield formation. Consists of silt, grayish-brown, mottled locally; calcareous and abundantly fossiliferous, becoming less so in lower 1.0 foot; wood, peat, and humus common at upper contact; lenticular, pinching out toward west. Thickness 3 feet.

Type locality: Emergency spillway Cagles' Mill Reservoir, SE¼NE¼ sec. 13, T. 12 N., R. 5 W., Putnam County.

Cahil Sandstone Member (of Franciscan Formation)

Cahil Sandstone (in Franciscan Group)[1]

Jurassic and Cretaceous: Western California.

Original reference: A. C. Lawson, 1914, U.S. Geol. Survey Geol. Atlas, Folio 193.

U.S. Geological Survey currently classifies the Cahil Sandstone as a member of the Franciscan Formation on the basis of a study now in progress.

Named for exposures on Cahil Ridge, San Mateo County.

Cahuenga Beds

Cretaceous(?): Southern California.

G. J. Neuerburg, 1953, California Div. Mines Spec. Rept. 33, p. 6 (table 1), 19–20, 21 (fig. 11), pl. 1. Consists of five unnamed units: basal sedimentary breccia, coarse sandy boulder conglomerate, lens of conglomeratic sandstone, sandy pebble conglomerate, and well-bedded conglomeratic sandstone. Thickness about 5,300 feet. Except for boulder conglomerate, beds are confined to Cahuenga Peak fault block; some boulder conglomerate is exposed in southwestern part of Griffith block and in Ferndell block. A thick section of Cahuenga beds is missing at base of Topanga formation, which rests unconformably on the conglomerate in Cahuenga Peak and Ferndell blocks. Overlies Griffith beds (new); contact not exposed. Cahuenga beds are folded into broad anticline in Cahuenga Peak fault block.

Occurs in Griffith Park area, city of Los Angeles. Area is bounded on west by Cahuenga Pass and Dark Canyon. Cahuenga Peak is near western end of Santa Monica Mountains.

Caimito Formation[1]

Oligocene and Miocene: Panamá

Original reference: D. F. MacDonald, 1913, Geol. Soc. America Bull., v. 24, p. 709.

A. A. Olsson, 1942, 8th Am. Sci. Cong. Proc., v. 14, Geol. Sci., p. 234 (chart). As shown on correlation chart, comprises (ascending) Chilibrillo, Caimito, and Alajuela.

[T. F. Thompson], 1943, Panama Canal Spec. Eng. Div. 3d Locks Proj., pt. 2, chap. 3, p. 18–19, fig. 3–2. MacDonald (1913) considered the Caimito to overlie immediately the Emperador formation. Recent studies have indicated that this is incorrect and that the formation bears closer affinity to the Panamá tuff. These two formations overlap many of the Oligocene beds within the Pacific area of the Canal Zone, locally lying upon the Emperador and thin only because of transgressive overlap. Gradational with overlying Panamá tuff.

W. P. Woodring and T. F. Thompson, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 2, p. 232–236, 246 (fig. 2). Formation name was introduced by MacDonald (1913) but was not properly defined then or later (MacDonald, 1919, U.S. Natl. Mus. Bull. 103). Type region was not specified. Most of MacDonald's brief description of formation is description of strata on Pacific side of Canal Zone now assigned to La Boca formation. MacDonald's statement that the Caimito overlies Emperador limestone—now assigned to member rank in Culebra formation—was based on misidentification of limestone in the La Boca formation and in the Caimito itself. Caimito formation and Emperador limestone member of Culebra are nowhere in contact. On account of these confusing formation assignments, published data on fossils of Caimito and Culebra formations and Emperador limestone member are misleading or erroneous. In Madden basin, formation comprises (ascending) unnamed calcareous sandstone-siltstone, unnamed pyroclastic clay, Chilibrillo limestone, unnamed calcareous sandstone, and Alhajuela sandstone members. In Quebrancha syncline, comprises (ascending) Quebrancha limestone member and calcareous siltstone member. In Gatún Lake area and Caribbean coast, Canal Zone, comprises three unnamed members. Thickness as much as 1,000 feet. Overlies Bohío formation. Formation in Madden basin includes considerable time span—late Oligocene to late early Miocene, or possibly early middle Miocene.

Type region (Woodring and Thompson): Assumed to be region that furnished the name. Caimito, or Caimito Junction, was located on the present alignment of Panamá Railroad and Darién.

Cairo glaciation

Cairo till[1]

Pleistocene (pre-Nebraskan): North America.

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

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

Cajalco Quartz Monzonite[1]

Late Mesozoic: Southern California.

Original reference: P. H. Dudley, 1935, California Jour. Mines and Geology, v. 31, no. 4, p. 491, 502, map.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 481, table 4. Late Mesozoic. In plutonic series of area, the Cajalco is considered younger than the La Posta quartz diorite and older than Lakeview quartz monzonite.

E. S. Larsen, Jr., 1948, Geol. Soc. America Mem. 29, p. 76. Rocks called Cajalco quartz monzonite by Dudley (1935) belong to Woodson Mountain granodiorite, which is considered Cretaceous.

Covers large areas in Riverside County between Monument Peak and Arlington Mountain, including Cajalco Canyon.

Cajon Formation

Age not stated: Southern California.

R. E. Wallace, 1949, Geol. Soc. America Bull., v. 60, no. 4, p. 790. Incidental mention.

Mapped area is approximately 20 miles long and 5 miles wide along San Andreas rift between Palmdale and Elizabeth Lake, Los Angeles County.

Calais 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 Calais, Calais Township, Washington County, in quadrangle adjoining Montpelier quadrangle on east.

Calamity Formation

Pleistocene, upper: Southwestern Texas.

C. C. Albritton, Jr., and Kirk Bryan, 1938, (abs.) Geol. Soc. America Bull., v. 49, no. 12, pt. 2, p. 1863. On basis of disconformities in valley-fill complex, the Quaternary (late Pleistocene) has been divided into (ascending) Neville, Calamity, and Kokernot formations.

C. C. Albritton, Jr., and Kirk Bryan, 1939, Geol. Soc. America Bull., v. 50, no. 9, p. 1434–1441, 1443–1445, 1449–1450, 1453, strat. section. At type locality, consists of silt and sand with interbedded gravel and subordinate amounts of silty, humic clay. A foot of pebble and cobble gravel composed of fragments of Cretaceous limestone and Tertiary volcanic rocks marks base of section. This grades upward into 4 feet of pebbly, clayey silt and sand whose upper half is dark with humus. Upper part of section is essentially a duplication of this sequence with a second, somewhat darker, humic zone at top. Contains artifacts, buried hearths, and human skeletons. Of several cultures represented, one is Pecos River Cave dweller. Thickness at type locality 11½ feet; elsewhere along Sheep Creek and upper segment of Calamity Creek, thickness ranges from 12 to 16 feet; maximum thickness 30 feet along intermediate segment of Calamity Creek. Disconformably overlies Neville formation; disconformably underlies Kokernot formation.

C. B. Hunt, 1952, U.S. Geol. Survey Bull. 996–A, p. 6. Proposed Pleistocene-Recent boundary would be at unconformity between Neville and Calamity formations.

Type locality: Along bank of Sheep Creek, directly south of Terlingua-Alpine road crossing, Brewster County. Well exposed along banks of Sheep Creek, along Calamity Creek from Neville's House to southern end of Elephant Mountain, and along intermediate segment of Calamity Creek.

Calapooya Formation[1]

Eocene, upper, and Oligocene: Southwestern Oregon.

Original reference. F. G. Wells and A. C. Waters, 1934, U.S. Geol. Survey Bull. 850.

V. T. Allen, J. S. Loofbourow, Jr., and R. L. Nichols, 1951, U.S. Geol. Survey Circ. 143, p. 2, 3 (fig. 2). Uncomformably overlies Umpqua formation. Consists of lava flows, tuffs, breccias, mud flows, and water-laid clays, shales, sandstones, and conglomerates. Contains silicified wood, charcoal, and leaves. Thickness several thousand feet. Deposited in continental environment probably during late Eocene time.

U.S. Geological Survey currently considers the Calapooya Formation to be late Eocene and Oligocene in age.

Named for occurrence along crest of Calapooya Mountain.

Calaveras Formation[1]

Calaveras Group[1]

Upper Paleozoic (Permian in places): Northern California.

Original reference: H. W. Turner, 1893, Am. Geologist, v. 11, p. 307–324, 425.

N. L. Taliaferro, 1943, California Div. Mines Bull. 125, p. 280–282, 283. Calaveras is name given to pre-Mesozoic bedrock of the Sierra Nevada, south of Taylorsville region. Name is catchall for Paleozoic rocks of Sierra Nevada and, hence, has no stratigraphic significance. In central part of Sierra Nevada, most of the Calaveras lies to east of the Mother Lode, which represents a late Jurrasic thrust fault which brought Calaveras westward over Jurassic rocks. West of Mother Lode country, Calaveras is brought up in the midst of Jurassic along a large compound, often highly faulted, anticline. In places, as along Cosumnes River, there is a single belt of Calaveras flanked by Amador [group], but in other places, as on Calaveras River, there are several narrow belts of Calaveras repeated by faulting. The complex anticline that exposes the Calaveras west of the Mother Lode, plunges southward from Calaveras River. On Stanislaus River, there is only a narrow faulted belt of Calaveras in the midst of the Amador and Mariposa. South of Stanislaus River, the western belt of Calaveras plunges beneath Jurassic rocks and is not again exposed. Amador group is younger than Calaveras and older than Mariposa. Uncomformably underlies Cosumnes formation (new) of Amador group.

J. H. Eric, A. A. Stromquist, and C. M. Swinney, 1955, California Div. Mines Spec. Rept. 41, p. 7–9, pls. 1–4. The wide age span for the so-called catchall Calaveras is a result of the fact that no description exists for a type section of the formation. As a result, many different types of rocks have been mapped as Calaveras by various geologists. Term Calaveras formation is used in this report [Angels Camp and Sonora quadrangles] as it was originally defined by Turner; that is, it includes all rocks that are shown to be Paleozoic in age on basis of paleontologic or geologic evidence. In mapped area, some rocks previously assigned to Calaveras are excluded from that formation because no valid evidence of Paleozoic age has been found. Some of the rocks previously mapped as Calaveras are assigned to Cosumnes formation of Amador group.

Cordell Durrell, 1959, California Univ. Pubs. Geol. Sci., v. 34, no. 3, p. 177. Underlies Penman formation in Blairsden quadrangle.

Named for prominent development in Calaveras County.

†Calciferous Formation[1]

Lower Ordovician: Northwestern Michigan.

Original reference: A. C. Lane, 1907, Michigan Miner, v. 9, no. 2, p. 9.

Named for Calciferous Creek, a branch of Au Train River, Marquette region.

†Calciferous mica schist[1]

Ordovician and Silurian: Western New Hampshire and Vermont.

Original references: C. H. Hitchcock, 1870, Geol. and Min. New Hampshire 2d Ann. Rept., geol. map; 1873, Am. Assoc. Adv. Sci. Proc., v. 21, p. 134–135; 1877, Geology New Hampshire, pt. 2, p. 658–675; 1896, Jour. Geology, v. 1, p. 44–62; 1896, Geol. Soc. America Bull., v. 7, p. 510–512; 1906, Vermont Geol. Survey 5th Rept., p. 86, 115.

Southwestern New Hampshire.

Calder Creek Member (of Wells Formation)

Pennsylvanian (Springeran-Morrowan): 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 Heglar Canyon member (new); overlies Milligen formation.

Present in Sublett Mountain area.

Calderwood Formation[1]

Cambrian(?): Central southern Maine.

Original reference: G. O. Smith, 1896, Geology Fox Island, Maine, p. 12, 28–29.

Vinalhaven Island, Knox County.

Caldwell sediments

Pleistocene, upper: Southwestern Idaho.

C. N. Savage, 1958, Idaho Bur. Mines and Geology County Rept. 3, p. 20 (table 1), 27, 41, 42, 48, figs. 3, 4. Clay, silt, sand, and fine gravel, chiefly nonconsolidated. Some caliche. Thickness as much as 50 feet. Underlies Recent Snake River eruptives; overlies Nampa sediments (new).

In Boise Valley, generally below 2,500 feet elevation, Ada and Canyon Counties.

Caldwell Canyon Volcanics

Tertiary (post-Oligocene?): Northwestern Wyoming.

J. D. Love, 1939, Geol. Soc. America Spec. Paper 20, p. 85–86, pl. 17. Consists, for most part, of glassy laminated white, red, orange, pink, yellow, gray, and black flows. In lower part of sequence are soft buff flow breccias or lithic tuffs. Upper part consists of very fine grained laminated flows of latite or possibly rhyolite. Maximum thickness of sequence about 300 feet. Uncomformably overlies Wiggins formation (new). Youngest extrusives in region.

Name derived from Caldwell Canyon, just southwest of Wiggins Peak in southern end of Absaroka Range. Caldwell Canyon volcanic rocks of this area confined to Wiggins Peak and vicinity. Other occurrences may be present north of mapped area.

Caldwell Knob Member (of Rockdale Formation)

Caldwell Knob Member (of Seguin Formation)[1]

Eocene, lower (Wilcox): 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 Rockdale formation. As originally defined, Seguin formation straddles Midway-Wilcox boundary; a disconformity occurs within Solomon Creek member, which is here restricted to beds below the disconformity; Caldwell Knob is extended below to include all oyster and sand beds down to the disconformity. Where it is possible to recognize divisions as redefined, Caldwell Knob beds should be regarded as basal member of Rockdale 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: Caldwell Knob 10 miles north of Bastrop and about 2 miles south of Colorado River in Bastrop County.

Caledonia Conglomerate[1] (in Bohemian Range Group)

Precambrian: Northern Michigan.

Original reference: A. C. Lane, 1911, Michigan Geol. and Biol. Survey Pub. 6, geol. ser. 4, p. 576, 580, 588, 593, 612, 957.

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

Calef Member (of Eliot Formation)

Probably Ordovician and Silurian: Southeastern New Hampshire.

Jacob Freedman, 1950, Geol. Soc. America Bull., v. 61, no. 5, p. 453 (fig. 2), 456, pl. 1. Chiefly black phyllite with some green quartz-chlorite phyllite. Maximum thickness 800 feet. Occurs at top of Eliot formation of Silurian(?) age. Underliies Berwick formation.

M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000): U.S. Geol. Survey. Probably Ordovician and Silurian.

Exposed in narrow belt in Mount Pawtuckaway quadrangle between villages of Epping, Rockingham County, and Lee, Stafford County. Named from Calef Road.

Calera Limestone Member (of Franciscan Formation)

Calera Limestone Member (of Cahil Sandstone)[1]

Jurassic and Cretaceous: Western California.

Original reference: A. C. Lawson, 1902, Science, new ser., v. 5, p. 416 (table).

H. E. Thalman, 1943, (abs.) Geol. Soc. America Bull., v. 45, no. 12, pt. 2, p. 1827. Paleontological evidénce indicates Upper Cretaceous age.

U.S. Geological Survey currently classifies the Calera Limestone as a member of the Franciscan Formation on the basis of a study now in progress.

Named for exposures in sea cliffs at lower end of Calera Valley, San Mateo County.

Calhoun Coal Member (of Mattoon Formation)

Pennsylvanian: Central and southeastern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 40, 51 (table 1), 82, pl. 1. Name applied to coal immediately below Bonpas limestone member (new), Stratigraphically above Trowbridge coal member (new). Thickness 16 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: NE¼NE¼NE¼ sec. 6, T. 2 N., R. 14 W., Richland County. Name derived from village of Calhoun, 2 miles west of type exposure.

†Calhoun Limestone[1]

Pennsylvanian: Eastern Kansas and northwestern Missouri.

Original reference: J. W. Beede, 1898, Kansas Acad. Sci. Trans., v. 15, p. 28.

Name for Calhoun Bluffs, about 3 miles northeast of Topeka, Kans.

Calhoun Limestone

Pennsylvanian: Southeastern Illinois.

J. M. Weller, L. G. Henbest, and C. O. Dunbar, 1942, Illinois Geol. Survey Bull. 67, p. 27 [1943]. Lenticular bed with maximum thickness of about 3 feet which overlies persistent coal in Richland and Lawrence Counties. Light gray, more or less argillaceous, and locally grades laterally into calcareous sandy shale. Provisionally correlated with Omega limestone.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 41. Replaced by Bonpas limestone member of Mattoon formation (both new). Name Calhoun restricted to underlying coal.

Named from Calhoun, Richland County.

Calhoun Shale (in Shawnee Group)

Calhoun 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. 29.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 22. Formation is 2 to 3 feet thick in Weeping Water Valley; about 10 feet at Kansas line. Overlies Deer Creek formation; underlies Hartford limestone (Wolf River) member of Topeka formation.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 18. Calhoun formation is a succession of shale beds which separates Deer Creek formation from overlying Topeka formation. Jones Point shale, Sheldon limestone, and Iowa Point shale members, previously included in the Calhoun, have been found to lie above rather than below the Hartford ("Wolf River") limestone and are included in Topeka formation. Shawnee group.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 65. Included in Shawnee group. Clayey and sandy shale with minor amount of limestone and one or more coal beds. In northern Kansas a thin coal bed and much sandstone, a part of which fills channels, occur near top of formation. Dark-gray silty fossiliferous shale comprises lower part, and plant remains occur in sandy part. In southern Kansas, shale diminishes in thickness and is locally absent near Oklahoma line. Maximum thickness about 45 feet, near Kansas River. Overlies Deer Creek formation; underlies Topeka limestone.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 17, fig. 5. Dark-gray to bluish-green shale; fossiliferous. Thickness 1½ to about 3 feet. Overlies Ervine Creek limestone member of Deer Creek formation; underlies Hartford limestone member of Topeka formation. Shawnee group.

Named for Calhoun Bluffs, about 3 miles northeast of Topeka, Shawnee County, Kans.

Calico Amygdaloid[1] (in Central Mine Group)

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Copper district of Keweenaw Point.

Calico 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.

Calico Formation

Miocene: Southern California.

C. W. Chesterman, 1956, California Div. Mines Bull. 174, p. 85. Pumice deposits northwest of Barstow occur in a thick series of volcanic rocks of Calico (Miocene) formation. The volcanic rocks consist mostly of tuffs and rhyolite flows; strike northwest and dip moderately to the southwest. Thickness about 270 feet (at Williams Brothers quarry). Name credited to T. W. Dibblee, Jr. (unpub. map).

Typical section exposed on steep hillside a few hundred feet east of Williams Brothers pumice quarry, 18 miles northeast of Barstow, San Bernardino County.

Calico phase (of Amargosa chaos)

Post-Miocene(?): Southern California.

L. F. Noble, 1940, (abs.) Geol. Soc. America Bull., v. 51, no. 12, pt. 2, p. 1936. Listed as a phase of Amargosa chaos, as assemblage of blocks on overthrust plate of Amargosa thrust.

L. F. Noble, 1941, Geol. Soc. America Bull., v. 52, no. 7, p. 965, 968–972, pl. 3. Mosaic of fault blocks composed mostly of rhyolitic lava and tuff; a kaleidoscopic mixture of light and dark—the light shades yellowish white to buff, and dark shades dull pinkish to red; rocks are almost wholly Tertiary in age. Exposed thickness a little more than 1,000 feet. Overlies Virgin Spring phase except at two places where it forms the sole of the thrust. Contact with the Virgin Spring is sinuous and roughly parallel with outcropt of Amargosa thrust; Calico phase is folded with the Virgin Spring just as if the two units were beds in a sedimentary series. Calico and Jubilee phases are not in contact in the area, and their relative position is not known.

Occurs in Virgin Spring area near Death Valley. Name is derived from Calico Peaks in northeastern part of area. Calico phase covers about 10 square miles in area mapped.

Calico Bluff Formation[1]

Upper Mississippian: Central eastern Alaska.

Original reference: A. H. Brooks and E. M. Kindle, 1908, Geol. Soc. America Bull., v. 19, p. 292.

Helmuth Wedow, Jr., 1954, U.S. Geol. Survey Circ. 316, p. 3, pl. 1. Consists of about 1,500 feet of alternating beds of shale and limestone in Eagle-Nation area. Underlies unnamed shale, argillite, slate, and chert unit intermediate between Calico Bluff and Nation River formation.

Exposed at Calico Bluff and other points on Upper Yukon River, also on Porcupine River, Nation River region.

Calico Peak Porphyry[1]

Tertiary: Southwestern Colorado.

Original reference: W. Cross and A. C. Spencer, 1900, U.S. Geol. Survey 21st Ann. Rept., pt. 2, pl. 22, map.

Occurs on north slope and elsewhere in vicinity of Calico Peak, about 4 miles northwest of Rico, Dolores County.

Calico Rock Sandstone Member (of Everton Formation)[1]

Middle Ordovician: Central northern Arkansas.

Original reference: G. C. Branner, 1929, Geologic map of Arkansas: Arkansas Geol. Survey.

U.S. Geological Survey currently designates the age of the Everton Formation and its members as Middle Ordovician.

Named for outcrops in river bluffs east and west of town of Calico Rock, on White River, in western part of Izard County.

Caliente Formation

Caliente Red Beds

Miocene, lower and middle: Southern California.

T. W. Dibblee, Jr., *in* Chester Stock, 1948, Southern California Acad. Sci. Bull., v. 46, pt. 2, p. 84. Coarse gray conglomerate, gray sands, and red clays; continental. Underlie Apache formation (new).

W. E. Ver Planck, 1952, California Div. Mines Bull. 163, p. 35, 36 (fig. 7), 37. Described in connection with gypsum deposits in Ventura County as Caliente red beds.

I. T. Schwade, 1954, California Div. Mines Bull. 170, map sheet 1. Formation noted as occurring on eastern margin of Cuyama Valley where it overlies lower Miocene marine beds [Painted Rock formation] and in southeastern part of the valley in proximity to upper(?) Miocene nonmarine strata.

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), 2993–2995. On northeast flank of southeastern Caliente Range, Branch Canyon sandstone (new) and upper part of Painted Rock sandstone member of Vaqueros grade laterally eastward into continental redbeds; these continental beds of middle and lower Miocene are here designated as Caliente formation. At type locality, consists predominantly of claystone, sandstone, and conglomerate, with some basalt flows; thickness about 4,200 feet; lower 1,000 feet grades abruptly westward into Painted Rock sandstone; overlying 1,100 feet grades laterally northwest into Branch Canyon sandstone; underlies Quatal formation with accordant contact. In northern Cuyama Badlands area, about 3,000 feet thick and rests on beds of the Vaqueros or on Simmler redbeds; farther southeast, lies on granitic rocks. In Cuyama Badlands, formation made up of brilliantly varicolored red and green claystone, arkosic sandstone, and incoherent conglomerates of terrestrial deposition; they form the picturesque badland topography. West of Cuyama River, beds apparently grade westward into Branch Canyon and Vaqueros formations, although relationships are obscured by structural complexities; here the redbeds were mapped by English (1916) as Pato red member of Vaqueros formation.

Type locality: Caliente Range, in Midway Peak Southwest and Elkhorn quadrangles.

California Granite[1]

Precambrian: Northwestern New York.

Original reference: A. F. Buddington, 1929, New York State Mus. Bull. 281, p. 52, 61–65.

Forms California phacolith, Lake Bonaparte quadrangle and extends into Antwerp quadrangle. Derivation of name not stated.

Call Sandstone Member (of Panoche Group)

Upper Cretaceous: Northern California.

I. F. Wilson, 1943, California Jour. Mines and Geology, v. 39, no. 2. p. 200, 202–203, 226 (fig. 5), pl. 3. Mainly massive brownish concretionary sandstone and some interbedded siltstones and gray clay-shale. Fairly persistent conglomerate, about 100 feet thick, occurs at base of member on northeast side of Butts Ranch syncline. Thickness 2,600 to 2,900 feet on northeast side of Butts Ranch syncline; 1,200 feet thick on southwest side of syncline. Overlies Paynes shale and sandstone member (new); underlies Butts Ranch shale member (new) on northeast side of syncline; unconformably underlies Big Oak Flat shale and sandstone member (new) on southwest limb of syncline; the unconformity cuts out about 1,200 feet of the Call within a horizontal distance of 1½ miles.

Type locality: Section exposed through Call Mountains on Paynes Creek 2 miles north of Butts Ranch, San Benito County.

Callahan Flow

Recent: Northern California.

M. A. Peacock, 1931, Geog. Review, v. 21, no. 2, p. 269–270. Recent flow in Modoc Lava field.

C. A. Anderson, 1941, California Univ. Dept. Geol. Sci. Bull., v. 25, no. 7, p. 370. Discussed as one of three flows grouped under term Modoc basalt. Covers area of about 10 square miles.

Occurs in Modoc Lava field.

Callaway Limestone[1]

Middle Devonian: East-central Missouri.

Original reference: C. R. Keyes, 1894, Missouri Geol. Survey, v. 4, p. 30, 43.

A. G. Unklesbay, 1952, Missouri Geol. Survey and Water Resources, 2d ser., v. 33, p. 30–39. Formation described in Boone County, where it consists of three limestone facies: Cooper, Callaway, and Ashland. Underlies Bushberg formation of Sulphur Springs group; overlies Jefferson City formation.

M. G. Mehl, 1960, Denison Univ. Jour. Sci. Lab., v. 45, art. 5, p. 100 (fig. 3). Underlies Turpin sandstone member (new) of Grassy Creek formation.

Named for development in Callaway County.

Calliham Sandstone Member (of Whitsett Formation)

Calliham Sand[1]

Eocene, upper: South-central Texas.

Original reference: A. C. Ellisor, 1933, Am. Assoc. Petroleum Geologists Bull., v. 17, no. 11, p. 1302, 1315.

D. H. Eargle, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 11, p. 2624 (fig. 1), 2626 (table 1), 2633. Termed sandstone member of Whitsett. At type locality, about 22 feet of medium-grained irregularly cross-bedded sandstone is exposed in south bank of river; upper 10 feet shows concretionary induration; about 2 feet from top is fossiliferous lens containing *Corbula*-type pelecypods. Elsewhere sand is coarse grained and conglomeratic; southwest of Fashing, consists of two layers of fossiliferous very fine grained sandstone separated by 10 feet or more of silty clay; in gently sloping area around Fashing, becomes indistinguishable from Dubose member below and Fashing clay member above.

Type locality: About 0.6 mile north-northeast of village of Calliham where old Whitsett-Calliham Road crosses Frio River. Named for village of Calliham, which is near Frio River in McMullen County about 1 mile west of Live Oak County line on Farm Road 63 from Three Rivers to Tilden.

Call Mill Slate[1]

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, 138–140. Fine-grained argillaceous dark-purple or nearly black usually fissile slate. Maximum thickness about 100 feet. Underlies Pinnacle graywacke; overlies Tibbit Hill schist.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, pl. 1. Geographically extended to northwestern Vermont. Precambrian(?).

V. H. Booth, 1950, Geol. Soc. America Bull., v. 61, no. 10, p. 1135–1136. If present in Vermont, beds are included in Pinnacle formation.

Best exposed in gorge below Call Mill, Sutton quadrangle, Quebec.

Calloway Limestone

See **Callaway Limestone,** correct spelling.

Calls Fort Shale Member (of Bloomington Formation)

Middle Cambrian: Northwestern Utah.

G. B. Maxey, 1958, Geol. Soc. America Bull., v. 69, no. 6, p. 649, 651–652, 659–660, 672. Occurs at or near top of formation. High Creek section, Bear River Range, shows unit consists of limestone and shale 180 feet thick; 200 feet in Calls Fort section, Wasatch Range. Name credited to Norman Denson. (unpub. thesis).

Type locality: West side of Wellsville Mountain, near Calls Fort Monument, about 7 miles north of Brigham City, Box Elder County.

Callville Limestone[1]

Upper Mississippian, Pennsylvanian, and Lower Permian: Southeastern Nevada and northwestern Arizona.

Original references: C. R. Longwell, 1921, Am. Jour. Sci., 5th, v. 1, p. 47; 1928, U.S. Geol. Survey Bull. 798.

C. R. Longwell, 1949, Geol. Soc. America Bull., v. 60, no. 5, p. 930. Gray limestone, commonly thin bedded, with interbedded shale in upper part. Thickness about 2,000 feet. Underlies unnamed Permian red beds; overlies Bluepoint limestone. Pennsylvanian and Permian(?).

A. H. McNair, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 3, p. 520–523. Restricted to Pennsylvanian limestones below Permian dolomitic beds. Where exposed in boundary area between Nevada and Arizona, contains two members: lower consists of thick-bedded cliff-forming commonly oolitic limestones which terminate by wedging beneath Shivwits Plateau; upper consists of silty, in many places crossbedded limestones that weather into subdued slopes. These limestones grade laterally and intertongue with lower Supai formation of Grand Canyon area. Thickness 277 to 673 feet. Sections show Callville overlies Rogers Spring limestone and Redwall limestone; underlies Pakoon limestone (new) in Grand Wash Cliffs.

Ben Bowyer, E. H. Pampeyan, and C. R. Longwell, 1958, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–138. As mapped in Clark County, Nev., includes Pakoon limestone of McNair (1951). Pennsylvanian and Permian.

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, Nev., overlies Illipah formation.

U.S. Geological Survey currently designates the age of the Callville Limestone as Late Mississippian, Pennsylvanian, and Early Permian on the basis of a study now in progress.

Named for exposures in Callville Mountain, Clark County, Nev.

Caloosahatchee Marl[1] **or Formation**

Pliocene, middle: Southern and northern Florida.

Original reference: W. H. Dall, 1887, Am. Jour. Sci., 3d, v. 34, p. 161–170.

W. C. Mansfield, 1939, Florida Geol. Survey Bull. 18, p. 8, 10 (fig. 2). Overlies Tamiami formation (new). Pliocene.

R. O. Vernon, 1952, *in* A summary of the geology of Florida and a guidebook to the Cenozoic exposures of a portion of the state: Florida Geol. Survey, p. 58, 59. Prior to 1942, Pliocene series in Florida was composed of Citronelle formation, Tamiami limestone, Buckingham marl, Bone Valley gravel, Alachua formation, Charlton formation, and Caloosahtchee marl. Vernon (1942, Florida Geol. Survey Bull. 21) dated part of Citronelle as possibly early Nebraskan and the rest as Pleistocene alluvium. This fieldwork cast some doubt on dating of the "Pliocene" beds in south peninsula. Cooke (1945, Florida Geol. Survey Bull. 29) continued to recognize Alachua formation, Bone Valley formation, Buckingham marl, Caloosahatchee formation, Citronelle formation, and Tamiami as Pliocene. Presence of fresh-water mollusks in top of Caloosahatchee (as presently defined by U.S. Geological Survey) casts doubt on its present age assignment.

Recognition of upper Miocene beds in the peninsula eliminated all Pliocene beds in southern Florida except Caloosahatchee marl and Bone Valley formation. It is hoped that future fieldwork will definitely place these beds into Miocene or Pleistocene, or definitely prove them to be Pliocene in age.

J. R. DuBar, 1957, Illinois Acad. Sci. Trans., v. 50, p. 187–193; 1958, Gulf Coast Assoc. Geol. Soc. Trans., v. 8, p. 133–135, 139–144. Subdivided to include (ascending) Fort Denaud, Bee Branch, and Ayers Landing members (all new). Unconformably overlies Tamiami formation; unformably underlies Fort Thompson formation (Okaldakoochee member, new). Thickness of exposed deposits commonly less than 10 feet, but base of formation visible in only a few places; test holes show thickness of 50 to 60 feet or more east of La Belle. Pleistocene (Sangamonian). Age determination based on vertebrate fossils.

J. R. DuBar, 1958, Florida Geol. Survey Bull. 40, p. 34–37, 41 (fig. 7), 49–64, 76–82, pls. Marl is exposed almost continuously in banks of Caloosahatchee River between Fort Denaud and Fort Thompson. Thickness commonly less than 10 feet. Base exposed only in few places. Exposed beds divided into (ascending) lower marine marl, *Cyrtopleura costata* zone, oyster biostrome, brackish-water marl, Bee Branch member, and upper shell bed. Unconformably overlies Tamiami formation; unconformably underlies Fort Thompson formation. Pleistocene, primarily on basis of vertebrate fauna and to lesser degree on molluscan fauna and stratigraphic relationships.

Named for exposures on Caloosahatchee River, Lee County, especially between Labelle and Olga.

Caloso Formation

Mississippian (Kinderhook): Northern and central New Mexico.

V. C. Kelley and Caswell Silver, 1952, New Mexico Univ. Pubs. in Geology 4, p. 83, 86–87. Limestone unit with maximum thickness of 86 feet. Name credited to Noble (unpub. thesis).

A. K. Armstrong, 1955, New Mexico Bur. Mines Mineral Resources Circ. 39, p. 3, 32. Term Caloso formation, as used in this paper, restricted to lower 28 feet of sandstone, shales, and dense gray limestones which contain a small Kinderhook fauna. Disconformably underlies Kelly formation; unconformably overlies Precambrian gneiss and schist.

Louise Fillman, chm., Lexicon Committee, 1958, Lexicon of pre-Pennsylvanian stratigraphic names of West Texas and southeastern New Mexico: Midland, West Texas Geol. Soc., p. 30. As defined by Noble (unpub. thesis), comprises lower member chiefly of arkose and locally conglomeratic basal sandstone or shale, and shaly limestone beds; middle member of massive or thick-bedded resistant limestone with brown-weathering cherty gray limestone bed at top; and upper member, which thins northward, generally a medium-gray medium-bedded limestone containing many nodules and lenses of white and gray chert, and in certain zones is made up largely of white coquina.

A. K. Armstrong, 1958, New Mexico Bur. Mines Mineral Resources Mem. 5, p. 3, 5–7, 9, 11–12, 14–15. Age discussion and regional correlations.

Type locality: Along Caloso Arroyo in T. 2 N., R. 2 W., Ladron Mountains.

Calumet Amygdaloid[1] (in Portage Lake Lava Series)

Precambrian (Keweenawan): Northern Michigan.

Original reference: A. C. Lane, 1907, Lake Superior Min. Inst. Proc., v. 12, p. 89–92.

E. S. Davidson and others, 1955, U.S. Geol. Survey Geol. Quad. Map GQ–54. Included in Portage Lake lava series.

Named for occurrence at Calumet mine, Houghton County.

†Calumet Conglomerate[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: A. C. Lane, 1907, Lake Superior Min. Inst. Proc., v. 12, p. 89–92.

T. M. Broderick, C. D. Hohl, and H. N. Eidemiller, 1946, Econ. Geology, v. 41, no. 7, p. 678 (fig. 1). Name used on geologic section of Michigan copper district.

Named for occurrence in Calumet mine, Houghton County.

Calumet 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.

Calumet Granodiorite

Eocene, lower: Colorado.

C. H. Behre, Jr., E. F. Osborn, and E. H. Rainwater, 1936, Econ. Geology, v. 31, no. 8, p. 786–792. Irregular mass of granodiorite with local differentiates that intrudes Paleozoic rocks in vicinity of Calumet mine. Hand specimens show a gray medium-grained crystalline rock generally equigranular with crystals unoriented but locally trachitoid to gneissic.

Occurs at abandoned iron mine at Calumet, Chaffee County.

Calumet and Hecla Conglomerate[1] (in Portage Lake Lava Series)

Precambrian (Keweenawan): Northern Michigan.

Original reference: L. L. Hubbard, 1895, Michigan Geol. Survey, v. 5, pt. 1, p. 117, footnote.

W. S. White, H. R. Cornwall, and R. W. Swanson, 1953, U.S. Geol. Survey Geol. Quad. Map GQ–27. Included in Portage Lake lava series.

Named for occurrence in Calumet & Hecla mine, Houghton County.

Calvert Ash Bed (in Ash Hollow Member of Ogallala Formation)

Calvert Ash Bed (in Valentine Member of Ogallala Formation)

Pliocene: Northwestern Kansas.

J. S. Carey and others, 1952, Kansas Geol. Survey Bull. 96, pt. 1, p. 9–11, 24–27. Name applied to volcanic ash bed. Thickness about 22 feet. Lies in lower half of Ash Hollow member and stratigraphically lower than Reager ash bed (new).

Ada Swineford, J. C. Frye, and A. B. Leonard, 1955, Jour. Sed. Petrology, v. 25, no. 4, p. 244 (fig. 1), 251. Reallocated to Valentine member of Ogallala formation.

Name derived from pit of Wyandotte Chemicals Corp., at Calvert, northeastern Norton County.

Calvert Formation[1] (in Chesapeake Group)

Miocene, middle: Eastern Maryland, Delaware, and Virginia.

Original reference: G. B. Shattuck, 1902, Science, new ser., v. 15, p. 906.

Lincoln Dryden and R. M. Overbeck, 1948, Maryland Dept. Geology, Mines and Water Resources [Rept.] Charles County, p. 53–61. Described in Charles County, where it includes Fairhaven diatomaceous earth member and Plum Point marls member. Overlies Nanjemoy formation; underlies Pleistocene deposits.

H. F. Ferguson, 1953, Maryland Dept. Geology, Mines and Water Resources Bull. 11, p. 35. In St. Marys County, formation is silty to sandy diatomaceous clay containing some thin shell beds in upper part. Basal part, Fairhaven diatomaceous earth member, consists of thick bed of yellowish-gray clay containing many diatoms. Thickness (in wells) 110 to 140 feet. Overlain by Pleistocene sediments in northern and western parts of county and by lithologically similar Choptank formation in central and southern parts. Chesapeake group.

Named for exposures in Calvert County, Md., especially in Calvert Cliffs, bordering Chesapeake Bay.

Calvert Bluff Clay Beds (of Rockdale Formation)[1]

Calvert Bluff Formation (in Wilcox group)

Eocene, lower: Central and southern Texas.

Original reference: F. B. Plummer, 1933, Texas Univ. Bull. 3232, p. 530, 585, 586, etc.

H. B. Stenzel, 1953, *in* Am. Assoc. Petroleum Geologists, Soc. Econ. Paleontologists Mineralogists, and Soc. Econ. Geologists Joint Mtg. Guidebook, p. 53 (geol. map), 54. Rank raised to formation. Includes Butler clay member (reallocated). Overlies Simsboro formation.

Type locality: Calvert Bluff on Brazos River, Jesse Webb League, Robertson County.

Calvertian 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 Calvert formation, type exposure of which is considered exemplary of the substage. In sequence, the Calvertian is followed by Choptankian substage.

†Calvin Sand Series[1]

Pennsylvanian: Central Oklahoma (subsurface and surface).

Original reference: A. I. Levorsen, 1927, Am. Assoc. Petroleum Geologists Bull., v. 1, no. 7, p. 658–682.

Seminole County.

Calvin Sandstone[1] (in Marmaton Group)

Pennsylvanian (Des Moines Series): Central and southern 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. 26–30. In Okfuskee County, divided into three unnamed members: basal sandstone, thick, middle shale, and upper sandstone. Thickness about 245 feet. Underlies Wetumka shale; overlies Senora formation. Marmaton group.

Type locality: Town of Calvin, Hughes County.

Camargo Formation

Ordovician (Richmond): South-central Tennessee.

C. W. Wilson, 1948, Geol. Soc. America Bull., v. 59, no. 8, p. 742–743. Proposed by M. G. Mehl (1928, unpub. ms.) for channel-filling sediments which he considered to be Silurian. Consists predominantly of greenish-blue to olive or light-brown arenaceous shales and shaly sandstones. Locally basal members consist of considerable thickness of limestone conglomerate and heavy-bedded coarse brown sandstone; lower members are distinctly valley fills. Coarse limestone blocks of talus along valleys of pre-Camargo surface now constitute Camargo conglomerates that are plastered across eroded edges of Fernvale, Leipers, and Catheys; this conglomerate grades laterally toward center of old valleys into coarse sandstones and even shales; succeeding the fills proper is a considerable thickness of light-brown to olive or green arenaceous shale that is widespread; locally this part of formation rests directly on the Fernvale or older rocks, but, in regions where lower fill is present, there is no evident break between the two parts of the formation. Thicknesses vary between 30 feet and something more than 100 feet and are measured from lowest exposure to highest adjacent Fernvale outcrop. Ordovician (Richmond).

Well exposed in Good Hollow and branches, about 2 miles southwest of Camargo, Lincoln County. Also about one-half mile west of Coldwater on Coldwater-Blanche Road.

†Camargo Schist[1]

Precambrian and Lower Cambrian: Southeastern Pennsylvania.

Original reference: A. I. Jonas and E. B. Knopf, 1921, Washington Acad. Sci. Jour., v. 11, p. 447.

Named for village of Camargo, near Quarryville, Lancaster County.

Camas Basalt[1]

Tertiary: Northeastern Washington.

Original reference: C. E. Weaver, 1920, Washington Geol. Survey Bull. 20, p. 99, map.

South side of Camas Prairie, Stevens County.

Cambridge Limestone Member (of Conemaugh Formation)[1]

Pennsylvanian: Eastern Ohio, western Pennsylvania, and West Virginia.

Original reference: E. B. Andrews, 1873, Ohio Geol. Survey, v. 1, p. 262.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 95 (table 11), 116–118. Included in Wilgus cyclothem, Conemaugh series. Occurs above Wilgus coal and underclay member and below Bakerstown shale and sandstone member of Anderson cyclothem. Member has also been called Upper Cambridge limestone and Pine Creek limestone, the latter a name which is still used in Pennsylvania.

Named for exposures near Cambridge, Guernsey County, Ohio.

Cambridge Red Bed (in Conemaugh Formation[1] or Group)

Pennsylvanian: Northwestern West Virginia and southwestern Pennsylvania.

Original reference: C. K. Swartz, 1922, Maryland Geol. Survey, v. 11, p. 61, pl. 6.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C-26, p. 78, fig. 21. In Fayette County, occurs 230 to 250 feet above top of Upper Freeport coal, which is base of Conemaugh group. Lies below Upper Bakerstown coal and above Woods Run limestone. Thickness as much as 12 feet.

First described near Wheeling, Ohio County, W. Va.

Cambridge Slate[1] (in Boston Bay Group)

Cambridge Argillite

Devonian or Carboniferous: Eastern Massachusetts.

Original reference: N. S. Shaler, 1871, Boston Soc. Nat. History Proc., v. 13, p. 173-175.

M. P. Billings, F. B. Loomis, Jr., and G. W. Stewart, 1939, Geol. Soc. America Bull., v. 50, no. 12, p. 1875, 1876, 1882. Referred to as argillite. Described as gray somewhat arenaceous argillite and slate. Carboniferous. Overlies Roxbury conglomerate, but latter is thrust over Cambridge in northern part of Hingham area.

Best exposed at Cambridge. Other occurrences also in Boston basin area.

Camden Chert[1]

Camden Formation

Lower or Middle Devonian: Western Kentucky and western Tennessee.

Original reference: J. M. Safford and C. Schuchert, 1899, Am. Jour. Sci., 4th, v. 7, p. 429-430.

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. 310-312. Camden formation consists of two contemporaneous phases of limestone and chert. Thickness 14 to 164 feet. Unconformably overlies Harriman formation; unconformably underlies Pegram formation at exposure near mouth of Standing Rock Creek and at the Whirl of Buffalo River; elsewhere underlies Chattanooga shale or Eutaw sand.

E. M. Luttrell and Ann Livesay, 1952, Kentucky Geol. Survey, ser. 9, Bull. 11, p. 5. Only known exposure of Camden chert in Kentucky is in narrow northeastward trending fault block one-fourth mile long, 0.4 mile south of Little Bear Creek on west side of Kentucky Lake, and 4½ miles above Kentucky Dam, near Aurora.

Named for exposures along Cypress Creek, southeast of Camden, Benton County, Ky.

†Camden series[1]

Upper Cretaceous and Eocene: Arkansas, Louisiana, southeastern Oklahoma, and eastern Texas.

Original reference: R. T. Hill, 1888, Arkansas Geol. Survey Ann. Rept. for 1888, v. 2, p. 49-65, 177, 188.

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

Camelback Formation

Tertiary(?): South-central Arizona.

D. A. Holm, 1938, Oil possibilities of Arizona: Arizona State Land Dept., p. 32-33. Series of red arkosic conglomerates and sandstones. Consists of three members on Camelback Mountain (ascending): dark-maroon arkose, lying unconformably on older granite, about 100 feet thick; middle member of lighter color, composed of coarser material, with great angular boulders, about 200 to 300 feet thick; and dark-red arkose, in part conglomeratic, with sand matrix, well-defined bedding and ripple marks, at least 200 feet thick.

Occurs on west end of Camelback Mountain in Phoenix region, Maricopa County.

Camels Hump Group

Lower Cambrian and Cambrian(?): North-central Vermont.

W. M. Cady, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–79. Composed chiefly of schist, quartzite, and gneiss. Intergrades with overlying Ottauquechee formation. Overlies Precambrian interbedded gneiss, quartzite, and greenstone unconformably.

A. L. Albee, 1957, U.S. Geol. Survey Geol. Quad. Map GQ–102. Described in Hyde Park quadrangle. Belvidere Mountain amphibolite is considered upper formation of group in northern part of quadrangle.

R. A. Christman, 1959, Vermont Geol. Survey Bull. 12, p. 23–37, geol. map. In Mount Mansfield quadrangle, occurs above Tibbet Hill schist and below Ottauquechee formation.

Typical section exposed in gorge of Winooski River west of and downstream from Waterbury. Named for wide occurrence on and near Camels Hump, a peak about 7 miles west of village of Waterbury in adjacent Camels Hump quadrangle. Traced about 30 miles southwestward from exposures in northwest part of Montpelier quadrangle.

Cameo Member (of Price River Formation)

Upper Cretaceous (Montana): Central western Colorado.

R. G. Young 1955, Geol. Soc. America Bull., v. 66, no. 2, p. 188, 191, fig. 2. In Neslen facies. Uppermost coal-bearing rocks of formation; upper limit placed at boundary between coal-bearing rocks of this member and non-coal-bearing rocks of Farrer facies. The massive white-capped medium-grained cliff-forming basal littoral marine sandstone caps Mount Garfield near Palisade, first appearing near Hunter Canyon and continuing south beyond Grand Mesa; grades downward into tongue of Mancos shale, which lies disconformably on coal measures of Cozzette member (new). Above basal sandstone, near Mount Garfield, lies about 250 feet of coal-bearing rocks consisting of sandstone, sandy shale, carbonaceous shale, and coal at base of which is Cameo coal zone (C. E. Erdmann, 1934, U.S. Geol. Survey Bull. 851). About 60 feet above base of Cameo coal zone is Carbonera coal zone.

Named for exposures near town of Cameo, Mesa County.

Cameron Beds (of Tolchaco Gravels)

Quaternary: Central northern Arizona.

Parry Reiche, 1937, Am. Jour. Sci., 5th ser., v. 34, no. 200, p. 131–133, pl. 1. Medium member of Tolchaco gravels (new). Dominantly argillaceous. Partial section of upper-middle part of member, three-eights of a mile southeast of Graben Wash, is representative of bulk of beds there and to the northwest. Consists of red clays with occasional fine sand laminae; interbedded red and gray clays and buff loose massive silty very fine sands; and gray and pink bedded clays with silt partings. Individual beds range from 1 to 10 inches in thickness. Ranges in thickness up to as much as 65 feet.

In Cameron district of the Plateau Province. Lies at elevations about 170 feet above Little Colorado River profile.

Cameron Red Shale Member (of Greenbrier Series)[1]

Mississippian: Northwestern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 142.

Exposed in Cameron County.

Cameron Sandstone Member (of McAlester Formation)[1]

Pennsylvanian (Des Moines Series): Eastern Oklahoma.

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

C. C. Branson, 1957, Geology Notes, v. 17, no. 11, p. 106. Abandoned by Oklahoma Geological Survey on the basis of the fact that name is preoccupied by Mississippian Cameron red shale in Pennsylvania. No replacement of Oklahoma name has been made.

Named for exposures west and northwest of Cameron, T. 8 N., R. 26 E., LeFlore County.

Cameron Creek Formation (in Big Snowy Group)

Cameron Creek Member (of Tyler Formation)

Mississippian or Pennsylvanian: Central Montana.

H. D. Hadley and P. J. Lewis, 1956, Billings Geol. Soc. Guidebook 7th Ann. Field Conf., p. 142. Varicolored shale with occasional thin limestones and irregular white to ferruginous sandstones. Thickness 50 to 300 feet. Overlies Heath shale and underlies Alaska Bench limestone. Name credited to L. S. Gardner.

L. S. Gardner, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 2, p. 233 (fig. 2), 334 (fig. 3), 335, 336 (fig. 4), 339, 343, 347. Included in Big Snowy group. Thickness at type locality herein designated 222 feet. Underlies Alaska Bench limestone; overlies Heath formation. Reasons for using Cameron Creek in preference to Tyler formation presented.

R. P. Willis, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 1942 (fig. 2), 1952–1953. Rank reduced to member status in Tyler formation; overlies unnamed lower member; includes Bear Gulch tongue.

Type locality: Canyon of one of tributaries of south-draining Cameron Creek, a few hundred feet north of Stonehouse Ranch headquarters in sec. 31, T. 11 N., R. 21 E., Golden Valley, Mont., on southeast side of Big Snowy Mountains.

Camillus Shale (in Salina Group)

Camillus 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. Formation in Salina group. Occurs above Syracuse salt and below Bertie waterline. Cayugan series.

D. W. Fisher and L. V. Rickard, 1953, New York State Mus. Circ. 36, p. 7, fig. 1. Discussion of age of Brayman shale. Proposed that name Brayman be applied to undifferentiated strata of Camillus and Bertie age in area from Vanhornesville, Herkimer County, to Gallupville, Schoharie County. Term Camillus as used herein is restricted to strata lying beneath Fiddlers Green dolomite and above Vernon shale.

L. V. Rickard, 1955, New York State Geol. Assoc. Guidebook 27th Ann. Field Conf., p. 7. Upper Silurian Cayugan series (revised) contains two formations, the Salina and Bertie. Salina consists of two facies: Vernon red shales near base and the Camillus gray calcareous shales and dolomites with salt and gypsum beds above.

W. P. Leutze, 1956, Am. Assoc. Petroleum Geolgists Bull., v. 40, no. 7, p. 1694 (fig. 1). Stratigraphic column of middle Salina group in Onondaga County shows Camillus shale, 160 to 190 feet, above Syracuse formation (where recognized in outcrop). Underlies Bertie waterline. Prior to this study, most publications listed fossils from Syracuse formation as coming from Camillus shale.

W. L. Kreidler, 1957, New York State Mus. Bull. 361, p. 5. Formation contains Syracuse salt member at base.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. In Salina group. At top of Canastotan stage (new).

Named for exposures at Camillus, Onondaga County.

Camino Cielo Sandstone Member (of Juncal Formation)

Eocene, middle: Southern California.

B. M. Page, J. G. Marks, and G. W. Walker, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 8, p. 1730 (fig. 2), 1733 (fig. 3), 1734 (fig. 4), 1751–1752. Light-gray massive arkosic lenticular sandstone. Thickness at type locality 2,300 feet; 2 miles distant, at western boundary of map area, thickness is 300 feet; and at eastern boundary, 5½ miles distant, thickness is 1,700 feet. Occurs about middle of formation; present only on southside of Santa Ynez fault.

Type section: In roadcuts of Camino Cielo and Romero Canyon Roads, from 2,900 feet N. 21° W. to 1,400 feet S. 47° W. of Romero Saddle Guard Station on crest of Santa Ynez Range, Santa Barbara County. Extends westward parallel with crest of range, past western limit of map area; north and east of type locality is interrupted by Romero Saddle fault and the Franciscan "intrusive" mass, but continues again and extends past eastern limit of map area.

Camp Member (of Denmark Formation)

Middle Ordovician (Trentonian): Northwestern New York.

P. A. Chenoweth, 1952, Geol. Soc. America Bull., v. 63, no. 6, p 530, 531. Name given to basal member of Denmark formation. At type locality, consists of thick hummocky beds of rubbly weathering blue-gray nodular argillaceous calcilutite and shale with thinner intercalated beds of hard pure calcilutite, calcisiltite, and a few calcarentites. Maximum thickness 12 feet. Underlies Glendale member (new); overlies Shoreham formation.

Type section: Exposures extending for more than 1 mile on banks of Mill Creek, 1 mile east of Sackets Harbor, between New York State Highway 3 and New York Central Railroad bridge. Named for Camp Mills 2 miles east of Sackets Harbor, Jefferson County.

Campagrande Limestone

Campagrande Formation (in Trinity Group)[1]

Lower Cretaceous (Comanche Series): Western Texas.

Original reference: G. B. Richardson, 1904, Texas Univ. Min. Survey Bull. 9, p. 47.

P. B. King, 1953, *in* P. B. King and P. T. Flawn, Texas Univ. Bur. Econ. Geology Pub. 5301, p. 99–100, pls. 1, 3. Referred to as Campagrande limestone. In Van Horn area, made up of several beds of massive ledge-making light-gray limestone, in part sandy or conglomeratic, and of nodular limestone and marl; at base is conglomerate containing chert and limestone fragments largely derived from the Hueco limestone. Thickness in Streeruwitz Hills 100 to 140 feet; in other areas 30 to 60 feet. Underlies Cox sandstone.

Named for Campagrande Draw, in Finlay Mountains, El Paso County.

Campbell Creek (Lower) Sandstone (in Kanawha Formation)[1]

Pennsylvanian: Southern West Virginia.

Original reference: C. E. Krebs and D. D. Teets, Jr., 1916, West Virginia Geol. Survey Rept. Raleigh and western Mercer and Summers Counties, p. 327.

Campbell Creek Limestone (in Breathitt Formation)

Campbell Creek Limestone (in Kanawha Formation[1] or Group)

Pennsylvanian: West Virginia and southeastern Kentucky.

Original reference: I. C. White, 1885, The Virginias, v. 6, p. 7–16.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 42, 60, 79, pl. 6. Slightly fossiliferous limestone 30 to 40 feet thick above Campbell Creek coal. In Kanawha group.

R. E. Hauser, 1953, Kentucky Geol. Survey, ser. 9, Bull. 13, p. 11 (fig. 2), 14–16. Zone of doorknob-shaped dense blue limestone concretions; individual concretions average 18 inches in thickness and 4½ feet in diameter. Zone occupies position near middle of a 35-foot brown shaly siltstone which locally contains lenses of sandstone. Occurs about 20 feet below Campbell Creek coal and 35 to 40 feet above Howard coal. Occurs in Paintsville quadrangle.

Named for exposures along Campbell Creek, Kanawha County, W. Va.

Campbell Mountain Rhyolite[1] (in Alboroto Group)

Miocene: Southwestern Colorado.

Original reference: W. H. Emmons and E. S. Larsen, 1923, U.S. Geol. Survey Bull. 718.

E. S. Larsen, Jr., and Whitman Cross, 1956, U.S. Geol. Survey Prof. Paper 258, p. 93 (table 18). Alboroto rhyolite described in San Juan district. Lower part consists of tridymite rhyolite which includes Campbell Mountain and Willow Creek rhyolites and probably Outlet Tunnel quartz latite [all included in Alboroto group] of Creede district.

Named for Campbell Mountain, Creede district.

Campbells Ledge Black Slate (in Pottsville Formation)[1]

Pennsylvanian: Northeastern Pennsylvania.

Original reference: I. C. White, 1883, Pennsylvania 2d Geol. Survey Rept. G_7, p. 37–42.

At Campbell's Ledge, near Coxton, Lackawanna County.

Camp Branch Sandstone Member (of Pottsville Formation)[1]

Lower Pennsylvanian: Northern central Alabama.

Original reference: C. Butts, 1910, U.S. Geol. Survey Geol. Atlas, Folio 175.

Named for exposures along south bluff of Camp Branch, Birmingham district.

Camp Colorado Limestone Member (of Pueblo Formation)[1]

Camp Colorado Formation (in Pueblo Group)

Permian: Central and central northern Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 387, 418.

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. Overlies Stockwether formation; underlies "Dothan" formation of 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 limestone member of Pueblo formation. Consists of irregularly bedded fine- to medium-grained gray limestone, which commonly weathers brownish, and intervening thin beds of shale; at type locality and farther south, basal beds consist of fossiliferous shale interbedded with earthy discontinuous limestone layers; dark-blue to nearly black chert occurs commonly as nodules in upper limestone beds. Thickness 5 to 25 feet. Overlies Salt Creek Bend shale member; underlies Watts Creek shale member of Moran formation.

P. T. Stafford, 1960, U.S. Geol. Survey Bull. 1081–G, p. 269–270, pl. 11. Extended into Brazos River valley. Thickness 10 to 25 feet. Overlies Salt Creek Bend shale member; top of member not easily distinguished from overlying Watts Creek shale member of Moran formation.

Named for Camp Colorado, northeast of Coleman, Coleman County.

Camp Creek Group[1]

Camp Creek Series

Precambrian (Belt Series): Central western Montana.

C. D. Walcott, 1906, Geol. Soc. America Bull., v. 17, p. 3–6, 18 (table). Upper subdivision of Algonkian in Camp Creek, Mission Range section. Series consists of (descending) gray sandstones, 1,762 feet; reddish sandstones, 1,560 feet; greenish sandstones and shales and reddish sandstones 4,491 feet; gray sandstone, 700 feet; siliceous limestone, 198 feet; gray and reddish sandstones, 975 feet; and interbedded gray and reddish sandstones, 2,041 feet. Overlies Blackfoot series (new).

F. L. Ransome and F. C. Calkins, 1908, U.S. Geol. Survey Prof. Paper 62, p. 27 (chart). Thickness over 5,000 feet in Phillipsburg district.

As group in Belt series: See Idaho correlation chart complied by M. G. Wilwarth, 1932.

Described from Mission Range.

Camp Creek Shale Member (of Pueblo Formation)[1]

Permian: Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept. pt. 1, p. 387, 416.

R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80, sheet 2. Consists of red and gray shale, a little sandstone and several thin beds of gray limestones; species of *Schwagerina* occur in zones from base to top. Average thickness about 80 feet. Lowermost subdivision is shale which attains thickness of 8 to 12 feet in McCulloch County, but thins to 1 or 2 feet north of Colorado River, so as to bring overlying limestone beds of Camp Creek shale member close to Saddle Creek limestone; these limestone beds of the Camp Creek have been included with the Saddle Creek in eastern Coleman County and northward. Underlies Stockwether member. *Artinskia lilianae* Miller and Unklesbay, collected in northwestern McCulloch County, 20 feet above base of member, represents stratigraphically lowest known occurrences of this genus in North America. *Artinskia* is judged to indicate post-Pennsylvanian age of beds in which it occurs.

Named for Camp Creek, Coleman County.

Camp Davis Formation

Camp Davis Conglomerate

Pliocene, lower: Western Wyoming and southeastern Idaho.

A. J. Eardley and others, 1944, Hoback—Gros Ventre-Teton Field Conf., [geologic map]. Privately printed. Consists of conglomerates, fanglomerates, rhyolitic and andesitic flows, breccia and tuffs, and fresh-water limestone. Overlies Pass Peak conglomerate (new). Uppermost Miocene or lowermost Pliocene.

J. C. Bayless, 1950, Michigan Acad. Sci., Arts, and Letters, Papers, v. 34, p. 211 (fig. 1), 212 (table 1), 213–215. Formation geographically extended into Snake River Plains, Idaho. Includes several thousand feet of calcareous conglomerates, fanglomerates, sandstones, and fresh-water limestones. Near Alpine, contains beds of tuff, and in Calamity Point area is cut by two andesite sills 1,200 and 300 to 1,000 feet thick. Unconformably overlies Paleozoic and Mesozoic formations. At north end of Caribou Range, interbedded with or overlain by rhyolitic flows. Term Camp Davis replaces name Salt Lake formation as previously used in area. Conglomerates of map area probably correlate in age with Payette formation, and this name for the formation has priority over name Camp Davis. However, the conglomerates are lithologically similar to Camp Davis formation of western Wyoming, and name Camp Davis is herein retained. Miocene and Pliocene(?).

H. R. Wanless, R. L. Belknap, and Helen Foster, 1955, Geol. Soc. America Mem. 63, p. 75–76, pls. In lower Hoback Valley, formation consists of (ascending) gray conglomerate which forms bold escarpments much of way from mouth of Camp Creek north to beyond Game Creek in southern Jackson Hole; interval of poorly indurated tuffaceous sand; white-weathering fresh-water limestone about 50 feet thick; upper red conglomerate at least 2,000 feet thick, best displayed on north side of lower Horse Creek about 1½ miles above Snake River. Thickness several thousand feet. Term has been extended to similar conglomerates and associated tuffs in Star, Grand, and Swan Valleys, Idaho. Late Miocene or early Pliocene. Type exposure noted.

J. D. Love, 1956, Wyoming Geol. Assoc. Guidebook 11th Ann. Field Conf., p. 89–90. At type section, only basal 450 feet of several thousand is adequately exposed. In Horse Creek section, formation is more than 5,600 feet thick. Formation rests with slight angular unconformity on Lower Cretaceous rocks. Two thrust sheets composed of Triassic, Jurassic, and Cretaceous rocks involve conglomerate of Camp Davis formation. Lower thrust sheet attains maximum development between forks of Horse Creek and thins northward, wedging out in cliff face on north side of Horse Creek. Both bottom and top contacts are exposed. Upper thrust sheet thickens northward and cuts across upper half of formation. Hoback normal fault, part of which is of Pleistocene or Recent age, has downdropped the Camp Davis between 6,000 and 10,000 feet, thereby giving the rocks a strong northeast dip. Believed to be early Pliocene; age assignment based partly on fossils and partly on structural relations.

Type section (Love, 1956): Along east side of U.S. Highway 187 in sec. 29, T. 39 N., R. 115 W., Teton County. Named after Camp Davis, University of Michigan camp along Hoback River.

Camp Ground Member (of Deese Group)

Pennsylvanian (Desmoinesian): Central southern Oklahoma.

C. L. Ramay, 1957, (abs.) Ardmore Geol. Soc. Criner Hills Field Conf., p. 45. Member mentioned in discussion of Desmoinesian stratigraphy in Pleasant Hill syncline of Criner Hills.

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. 33. Named credited to I. C. Hicks (oral commun., 1953), who applied it primarily to uppermost of major ridge-making sandstones of Deese group in Lake Murray State Park below Williams member—about 500 feet below that member and 1,600 feet or more above Rocky Point conglomerate. Fusulinid limestone a few inches thick present locally near base. Type locality stated.

Type locality: On east line NE¼SE¼ sec. 20, T. 5 S., R. 2 E., at east end of principal tent camp in park, Murray County.

Campito Formation

Campito Sandstone[1]

Precambrian(?) and Lower Cambrian: Eastern California.

Original reference: E. Kirk, 1918, U.S. Geol. Survey Prof. Paper 110.

C. R. Longwell, 1950, Geol. Soc. America Bull., v. 61, no. 5, pl. 1. Overlies Deep Spring formation; underlies Silver Peak group.

U.S. Geological Survey currently designates the age of the Campito Formation as Precambrian(?) and Lower Cambrian on the basis of a study now in progress.

Named for prominent exposures on Campito Mountain, Inyo Range.

Campitoan series

Precambrian (Protozoic): Eastern California.

C. R. Keyes, 1942, Pan-Am. Geologist, v. 77, no. 4, p. 307 (chart). Series, consisting of 3,600 feet of sandstones. Unconformable below Barrelian series and above Deepian series.

Occurs in Death Valley region.

Camp Jenkins Schist or Formation

Lower Devonian: Central Connecticut.

G. P. Eaton and J. L. Rosenfeld, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 2, p. 170 (fig. 1), 181 (table 1). Lead gray staurolite-garnet, biotit-muscovite schist with thin interbedded "sugary" micaceous quartzites. Overlies Mine Brook formation (new). Previous workers with the exception of Percival (1842, Report on the Geology of the State of Connecticut: New Haven), grouped the sequence of rocks from Collins Hill schist through Camp Jenkins schist as a single formation, and believed it to be intruded by Glastonbury, Maromas, and Haddom gneisses. Present work shows that these rocks represent four distinct formations, with unconformity separating Collins Hill from the others.

Camp Jenkins [now Ranger Headquarters of Meshomasic State Forest] is in Middle Haddam quadrangle, Middlesex County.

Camp Nelson Limestone[1] (in High Bridge Group)

Camp Nelson Member (of High Bridge Limestone)

Middle Ordovician: Central Kentucky.

Original reference: A. M. Miller, 1905, Kentucky Geol. Survey Bull. 2, p. 9, 12.

A. C. McFarlan, 1943, Geology of Kentucky: Lexington, Ky., Kentucky Univ., p. 12; D. K. Hamilton, 1948, Econ. Geology, v. 43, no. 1, p. 40–41. Lowermost formation in High Bridge (Highbridge) group. Underlies Oregon limestone. Essentially a lithographic type limestone, but contains recognizable masses of magnesian limestone. Thickness about 300 feet.

J. L. Rich, 1951, Geol. Soc. America Bull., v. 62, no. 1, p. 18. Referred to as member of High Bridge limestone.

Named for Camp Nelson, Jessamine County.

†Campobello Group[1]

Silurian: Southeastern Maine.

Original reference: N. S. Shaler, 1886, Am. Jour. Sci., 3d. v. 32, p. 47–60.

Named for development on Campobello Island, off southwest coast of New Brunswick, adjacent to southeastern part of Washington County.

Camp Springs Conglomerate[1]

Triassic: Northwestern Texas.

Original reference: D. D. Christner, 1926, Texas Univ. Bull. 2607, p. 16–17.

Well exposed at Camp Springs, near center of east line of Scurry County.

Camp Supply Beds[1]

Lower Cretaceous: Western Oklahoma.

Original reference: R. T. Hill, 1895, Am. Jour. Sci., 3d, v. 50, p. 227.

Near Camp Supply, G (now Custer) County.

Campus Formation[1]

Pleistocene: Western California.

Original reference: A. C. Lawson and C. Palache, 1902, California Univ. Pub., Dept. Geol. Bull., v. 2, p. 398, map.

Named because of its occurrence within limits of University Campus, Berkeley [on a hill behind the area now covered with buildings].

Camp Williams unit (in Salt Lake Group)

Post-early Oligocene and pre-late Pliocene: North-central Utah.

L. W. Slentz, 1955, Utah Geol. Soc. Guidebook 10, p. 23, 24 (fig. 6), 26–27. Salt Lake group, in Lower Jordan Valley, is divided into (ascending) Traverse volcanics, Jordan Narrows unit, Camp Williams unit, Harkers fanglomerate, and Travertine unit. Camp Williams is mostly mudstones and siltstones that are poorly consolidated and lesser amounts of impure sandstone; basal conglomerate, primarily of igneous detritus, also present. Characteristically red to tan. Thickness at least 100 feet; not completely exposed in most places.

Name derived from Camp Williams military reservation. Areal extent limited and confined to Jordan Narrows and immediate vicinity. Lower Jordan Valley defined as that part of Jordan Valley northward from Traverse Mountains to Great Salt Lake. Travertine unit, as much as 20 feet thick in places; overlies both Camp Williams and Jordan Narrows units.

Camulos formation[1]

Pliocene, middle or upper: Southern California.

Original reference: C. R. Keyes, 1925, Pan-Am. Geologist, v. 43, p. 316.

Named for railway hamlet of Camulos, a few miles directly west of Saugus Junction, Santa Clara Valley, Los Angeles and Ventura Counties.

†Canaan Formation[1]

Mississippian: West Virginia and western Maryland.

Original reference: N. H. Darton and J. A. Taff, 1896, U.S. Geol. Survey Geol. Atlas, Folio 28.

Named for exposures in Canaan Mountain, Tucker and Grant Counties, W. Va.

†Canaan Limestone or Dolomite[1]

Cambrian and Ordovician: Connecticut.

Original references: J. D. Dana, 1872, Am. Jour. Sci., 3d, v. 4, p. 370; 1874, Am. Assoc. Adv. Sci. Proc; W. H. Hobbs, 1893, Jour. Geology, v. 1, p. 717–736, 780–802.

Canaan Mountain Fire Clay[1]

Pennsylvanian: Northeastern West Virginia.

Original reference: D. B. Reger, 1923, West Virginia Geol. Survey Rept. Tucker County, p. 190, 191, 444.

Top of Canaan Mountain, Tucker County.

Canaan Mountain Schist

Pre-Triassic: Northwestern Connecticut.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Described as predominantly schist; composed of quartz, oligoclase or andesine, biotite, garnet and sillimanite.

Named for Canaan Mountain in town of Canaan, Litchfield County.

Canada Hill Granite[1]

Canada Hill granite phase (of Hudson Highlands Complex)

Precambrian: Southeastern New York.

Original reference: C. P. Berkey and Marion Rice, 1919, New York State Mus. Bulls. 225–226, maps and passim.

K. E. Lowe, 1950, Geol. Soc. America Bull., v. 61, no. 3, p. 143–144. In place of Canada Hill, Reservoir, and Mahopac granites described by Berkey and Rice (1919), term Canada Hill granite phase of Hudson Highlands complex is used to include all rocks representative of granitic igneous activity in Hudson Highlands after Pochuck diorite phase and earlier than Storm King granite intrusion. Such generalization is necessary because of difficulty of distinguishing the three similar granite types in the field. Typical representative of Canada Hill phase is medium-gray medium-grained biotite granite.

Type locality: Kings quarry, south of Garrison, Canada Hill, Putnam County, is in midst of granite area.

Canadaway Formation (in Arkwright Group or Chautauqua Group)

Canadaway Group[1]

Upper Devonian: Southwestern New York and northwestern Pennsylvania.

Original reference: G. H. Chadwick, 1933, Geol. Soc. America, Preliminary list of titles and abstracts of papers to be offered at 46th annual meeting, Chicago, Ill., Dec. 28–30, p. 19, 82, 83, 84.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1748–1749, chart 4. Chadwick suggests limiting Canadaway group to Dunkirk and Gowanda formations and introducing a new group name for the beds—Laona, Westfield, Shumla, and Northeast—between the Canadaway and Conneaut.

I. H. Tesmer, 1954, Dissert. Abs., v. 14, p. 2317–2318. Discussion of stratigraphy of Cherry Creek quadrangle, New York. Canadaway group is reduced to formational status in Chautauqua group. Formation comprises (ascending) Dunkirk, South Wales, Forestville (new name to replace Gowanda), Laona, Westfield, Shumla, and Northeast members. Underlies Chadakoin formation.

I. H. Tesmer, 1954, Hobbies, v. 35, no. 2, p. 30, 31–32. Basal formation in Arkwright group (new). Underlies Chadakoin formation. Average thickness about 1,050 feet in Chautauqua County. Chautauquan series.

I. H. Tesmer, 1955, New York State Mus. Sci. Service Circ. 42, p. 9, 10 (fig. 1). Formation, at type locality, consists of strata which lie between base of Dunkirk shale and base of Dexterville member of Chadakoin formation. Here the Canadaway consists of about 1,000 feet of strata, the lower part of which contains interbedded black and gray shale with limy concretions while upper part is composed of interbedded gray shale and siltstone. In Chautauqua County, contact between Canadaway and Chadakoin is marked by first appearance of brachiopod *Pugnoides duplicatus* in basal Dexterville. As this form does not continue eastward into Cattaraugus County, the Canadaway-Chadakoin contact is placed there at the last appearance of *Tylothyris mesacostalis* which occurs in "Machias" and Cuba members of Canadaway but which does not continue into younger Chadakoin. In type area, comprises (ascending) Dunkirk, South Wales, Gowanda, Laona, Westfield, Shumla, and Northeast members. Overlies Chemung. Perrysburg formation of Pepper and de Witt (1951) is not used in this paper because upper boundary of unit is indeterminable east of Perrysburg.

L. V. Rickard, 1957, New York Geol. Assoc. Guidebook 29th Ann. Mtg., p. 15–18. Group, in Wellsville area, comprises (ascending) Dunkirk shale, South Wales shale, Canaserage sandstone, Hume shale, Caneadea shale, Rushford sandstone, "Machias" shale, and Cuba sandstone. Underlies Chadakoin group. Chautauquan series. Term Perrysburg not used because the Laona or its correlate has not been traced into Wellsville region.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Formation, as mapped in western

Pennsylvania, includes "Portage" formation of northwestern Pennsylvania.

Type section: Along Canadaway Creek, near Dunkirk, Chautauqua County, N.Y.

†Canadian Series[1]

†Canadian Period[1] or System[1]

Lower Ordovician: North America.

Original references (Period or System): J. D. Dana, 1874, Am. Jour. Sci., 3d, v. 8, p. 214; 1875, Manual of geology, 2d ed., p. 142, 163, 182; E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, p. 647–679, pl. 27.

E. O. Ulrich and G. A. Cooper, 1938, Geol. Soc. America Spec. Paper 13, p. 1–321. Canadian [system] zoned for brachiopods. Canadian consists of lower, middle, and upper divisions. The Canadian follows the Ozarkian and precedes the Ordovician.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2. As shown on correlation chart, the Canadian is lowermost series of Ordovician system. It is succeeded by Champlainian series. Stages have not yet been established in the Canadian. Generalized standard section includes (ascending) Gasconade, Roubidoux, Jefferson City, Cotter-Smithville, and Black Rock formations.

R. H. Flower, 1957, New Mexico Bur. Mines Mineral Resources Mem. 2, p. 17–18. Believed that recognition of Canadian as distinct system would simplify problem of early Paleozoic stratigraphy. The Canadian would be a four part system, and this would leave remainder of Ordovician to be resolved in terms of Chazyan, Mohawkian, and Cincinnatian. Ordovician as thus restricted would begin with Cooper's Whiterock stage. Tentative classification of units in Canadian suggested: Gasconadian, Demingian, Jeffersonian, and Cassinian. Classification based principally on cephalopod distribution.

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

Named from development in Canada.

Canajoharie Shale[1] (in Trenton Group)

Middle Ordovician: Eastern New York.

Original reference: J. M. Clarke, 1911, New York State Mus. Bull. 149, p. 10–12.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 267 (fig. 11), 268–271. Formation comprises the older shales of Mohawk Valley; these overlie the lowest Sherman Fall Shoreham limestone, are of about Denmark (Sherman Fall) age, and are overlain by similar shales of Utica formations. At type section, formation includes Minaville member (new) and Fairfield member. Overlies Glens Falls formation. The Canajoharie thickens eastward, and it is believed that the Snake Hill represents an eastern more sandy facies of the Canajoharie and consists of the initial deposits of clastic rocks resulting from Vermontian (middle Trenton) orogeny; upper part of Schenectady formation contains characteristic upper Canajoharie (Fairfield) graptolites. Southward and eastward from upper West Canada Creek valley, the Denmark member (new) of Sherman Fall formation passes through the Dolgeville interbedded facies into the Canajoharie shale.

Named for outcrop at Canajoharie, Montgomery County.

Canal Limestone[1]

Pennsylvanian: Northeastern Pennsylvania.

Original reference: C. A. Ashburner, 1886, Pennsylvania 2d Geol. Survey Ann. Rept 1885, p. 445.

Crops out on southeastern band of the canal, 800 feet southwest of mouth of Mill Creek, Luzerne County.

†Canandaigua Shale[1]

Middle Devonian: Central and western New York.

Original reference: J. M. Clarke, 1903, New York State Mus. Handb. 19, p. 22 [p. 67, 1912 ed.].

R. G. Sutton, 1951, Rochester Acad. Sci. Proc., v. 9, nos. 5–6, p. 364, 369. Incidental mention in discussion of Ledyard and Tichenor members of Ludlowville formation.

Canary Ironstone

Pennsylvanian (Allegheny Series): Southeastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 49 (table 7), 58. Typically calcareous concretionary ironstone. Included in Clarion cyclothem and lies below Clarion underclay member and above Clarion shale and (or) sandstone member.

Present in Athens County.

Canas Gypsum Member (of Yeso Formation)

Permian: Central New Mexico.

C. E. Needham and R. L. Bates, 1943, Geol. Soc. America Bull., v. 54, no. 11, p. 1660. Commonly pure white gypsum; locally, thin silt partings and thin limestone beds. Thickness 96 feet at Lomo des las Canas, 52 feet in Yeso type section, 80 feet in southern Chupadera Mesa, and 115 feet at Bent, Otero County. Disappears a short distance north of Yeso type section. Occurs above middle evaporite unit of Yeso; underlies Joyita sandstone member (new).

R. H. Wilpolt and others, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 61. Overlies Torres member (new).

Name taken from the Loma de las Canas, a range of hills 9 miles due east of Socorro, Otero County.

Cañas Arriba Formation

Oligocene, lower: Puerto Rico.

R. C. Mitchell, 1954, Puerto Rico Univ. Agr. Expt. Sta. Tech. Paper 13, p. 36 (table 2), 54. Name adopted to replace Río Descalabrados series (Hodge, 1920) for the following reasons: Hodge's term referred to Eocene, not Oligocene; name not well chosen as no outcrops occur along river in question; and strata are distinctive enough from those of Rio Jueyes and Coamo Springs to merit separate name. Estimated thickness 2,000 feet. Locally underlies Juana Díaz formation; near town of Juana Díaz, lower Oligocene is in contact with middle Oligocene Juana Díaz formation; towards southwest, the Cañas Arriba is overlain by Quaternary deposits.

Named for occurrence in Barrio Cañas Arriba, north of Cuarto Calles Coamo-Guayama district.

Canaseraga Sandstone[1] Member (of Perrysburg Formation)

Canaseraga Member (of Canadaway Formation)

Canaseraga Sandstone (in Canadaway Group)

Upper Devonian: West-central New York.

Original reference: G. H. Chadwick, 1923, Geol. Soc. America Bull., v. 34, p. 69.

W. H. Bradley, J. F. Pepper, and G. B. Richardson, 1938, U.S. Geol. Survey Bull. 899–A, p. 17, pl. 3. Unit termed Dunkirk sandstone in this report was named Canaseraga by Chadwick. Later he found the Canaseraga to be a sandy phase of the Dunkirk. He now recommends dropping term Canaseraga; this recommendation is herein followed.

J. F. Pepper and Wallace de Witt, Jr., 1951, U.S. Geol. Survey Oil and Gas Inv. Chart OC–45. Revived and redefined as sandstone member of Perrysburg formation (new). These siltstones and sandstones are a definite unit around Canaseraga in central part of State and are not represented in rock sequence in vicinity of Dunkirk in western New York. At type exposure, member consists mainly of thin-bedded to massively bedded siltstones and some interbedded silty gray shale containing a few thin layers of black shale near base; top not exposed. Toward the west in Genesee River valley, upper siltstone of Canaseraga thins and grades laterally into black, dark-gray, and blackish-gray shale of Hume member (new). East of Dalton, upper part of member becomes more massive as siltstone increases in thickness and interbedded shale decreases. In Bath and Woodhull quadrangles, underlies Canisteo member (new); underlies and interfingers with South Wales member (new) to west. Thickness 163 to about 308 feet.

I. H. Tesmer, 1955, New York State Mus. Sci. Service Circ. 42, p. 10 (fig. 1), 12. Member of Canadaway. Overlies South Wales member; underlies Hume member.

L. V. Rickard, 1957, New York Geol. Assoc. Guidebook 29th Ann. Mtg., p. 17 (table 2), 18. Formation in Canadaway group.

Type exposure: On Slader Creek, south of Canaseraga, Allegany County.

Canastotan Stage

Upper Silurian (Cayugan): North America.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser., no. 1. Cayugan series is divided into Canastota(n) and Murder(ian) stages. Canastota stage contains all of Salina group from base of Vernon shale to top of Camillus—Lower Cayugan of previous usage. About 850 feet of Canastotan rocks present in type area.

Type area: Sullivan, Lincoln, Oneida, and Vernon Townships near Canastota. Chittenango and Oneida quadrangles, New York.

Cañazas Formation[1]

Miocene(?): Panamá.

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. 328–329.

Occurs near Cañazas, Veraguas Province.

Canby Latite[1]

Oligocene(?) or Miocene(?): Southwestern Colorado.

Original reference: W. Cross and E. Howe, 1905, U.S. Geol. Survey Geol. Atlas, Folio 120.

Named for prominence in Canby Mountain, Silverton quadrangle.

Candelaria Formation[1]

Lower Triassic: Southwestern Nevada.

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

H. G. Ferguson, S. W. Muller, and S. H. Cathcart, 1953, Geology of the Coaldale quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–23]. Described in Coaldale quadrangle where it consists largely of dark tuffaceous sandstone with thin conglomerate lenses and some shale; locally as much as 2 feet of basal conglomerate with fragments from Palmetto formation. Unconformable above Diablo formation (new); not in contact with Middle Triassic(?) Excelsior formation, and it is presumed that the two are present on different plates of major thrust. Thickness 3,225 feet at type locality.

Type locality: About 2 miles southeast of Candelaria, Mineral County.

Candler Formation (in Evington Group)

Candler Phyllite and Schist

Paleozoic(?): South-central Virginia.

W. R. Brown, 1951, (abs.) Geol. Soc. America Bull., v. 62, no. 12, pt. 2, p. 1547. Incidental mention of phyllite and schist.

W. R. Brown, 1953, Kentucky Geol. Survey, ser. 9, Spec. Pub. 1, p. 91 (fig. 1), 93. Formation described as lustrous gray-green phyllite and fine- to coarse-grained schists. Some quartzites and greenstone volcanics(?). Garnet- staurolite- and chloritoid-bearing facies widespread in eastern areas. Thickness 1,500 to about 4,000 feet. Underlies Joshua schist (new); both in Evington group (new) of Paleozoic(?) age. Overlies Catoctin greenstone. Type locality designated.

G. H. Espenshade, 1954, U.S. Geol. Survey Bull. 1008, p. 14–16, pl. 1. Thin lenses of white quartzite and white marble and lenses of blue marble locally interbedded with phyllite.

W. R. Brown and H. C. Sunderman, 1954, (abs.) Geol. Soc. America Bull., v. 65, no. 12, pt. 2, p. 1356. Includes Esmont slate facies (new).

W. R. Brown, 1958, Virginia Div. Mineral Resources Bull. 74, p. 8 (fig. 2), 31–33, 48, pl. 1. Age shown on columnar section as Lower Paleozoic(?).

Type locality: Candler Mountain 2 miles south of Lynchburg, Campbell County, Lynchburg quadrangle.

Caneadea Member (of Perrysburg Formation)

Caneadea Member (of Canadaway Formation)

Caneadea Shale[1] (in Canadaway Group)

Upper Devonian: Southwestern New York.

Original reference: G. H. Chadwick, 1933, Pan-Am. Geologist, v. 60, no. 3, p. 200.

J. F. Pepper and Wallace de Witt, Jr., 1951, U.S. Geol. Survey Oil and Gas Inv. Chart OC–45. Rank reduced to member status in Perrysburg formation (new). Restricted to all rocks between top of Hume shale member (new) and base of Luther's Rushford sandstone which is exposed in Caneadea Gorge 3.3 miles east of Rushford. Lower part of member consists of gray siltstone ranging in thickness from 1 to 20 inches, which is interbedded with gray silty shale. Middle part is largely shale containing some siltstone. Upper part, which is exposed along Caneadea Creek below Rushford Dam, is shale containing many thin beds of siltstone. No complete exposure present. Estimated thickness 280 feet. Figure 4 shows that Caneadea, Canisteo (new), and Gowanda members, although closely related in time of deposition, are not strictly correlative throughout.

I. H. Tesmer, 1955, New York State Mus. Sci. Service Circ. 42, p. 10 (fig. 1), 12. Member of Canadaway formation. Overlies Hume member; underlies Rushford member.

L. V. Rickard, 1957, New York State Geol. Assoc. Guidebook 29th Ann. Mtg., p. 17 (table 2), 18. Formation in Canadaway group. Overlies Hume shale; underlies Rushford sandstone.

Well exposed in Caneadea Gorge, west of town of Caneadea in Angelica quadrangle, Allegany County. This is same locality as that given by Chadwick "on Caneadea Creek, just below the power dam."

Canebrake Conglomerate

Pliocene: Southern California.

T. W. Dibblee, Jr., 1954, California Div. Mines Bull. 170, chap. 2, p. 22 (fig. 1), 23, pl. 2. Defined as the coarse marginal conglomerate facies of Palm Spring and Imperial formations. Thickness at type section about 7,000 feet. Most westerly exposures are fanglomerate that laps onto and against crystalline "basement" rocks. Southeastward along strike, lower 4,000 feet of conglomerate grades into Imperial and Palm Spring formations; upper 3,700 feet persists basinward into Carrizo Valley as a gray pebble and cobble conglomerate that rests on Palm Springs formation; this conglomerate thins to about 2,500 feet on south side of Coyote Mountains. In Indio Hills, Canebrake is difficult to distinguish from overlying Ocotillo conglomerate (new). In Mecca Hills, overlaps onto Orocopia schist; southeast of Box Canyon, overlies Dos Palmas rhyolite (new); southward from Salton Sea, Truckhaven rhyolite (new) wedges into the Canebrake.

Type section: At southeastern base of Vallecito Mountain, 3 miles west of Fish Creek Wash, Imperial County. Name derived from Canebrake Wash.

Cane Creek Formation

Middle Ordovician (Mohawkian): Southwestern Virginia and northeastern Tennessee

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 51, chart 1 (facing p. 130). Mostly thin-bedded gray to dove limestone weathering to light gray; limestone layers often separated by thin shale partings. Sequence contains several bentonites; two thick ones near top. Greenish mudstone bed 30 feet thick near base. Total thickness 150 feet. Overlies Hardy Creek formation. Name attributed to B. N. Cooper and G. A. Cooper.

Type section: Along L. and N. Railroad east of Cane Creek and approximately one-half mile west along railroad from Ben Hur Station, Ben Hur quadrangle, Lee County, Va.

Cane Hill 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. 1938–1939, 1948 (fig. 2). Name applied to lower member of Hale formation. Composed of silt, silty sandstone, and fine-grained sandstone; locally calcareous. Bedding is generally shaly or thin and sheety, or consists of shaly siltstone alternating with thin hard beds of sandstone. Thickness ranges from thin edge to 65 feet. Unconformably underlies Prairie Grove member (new); overlies Pitkin limestone or, where the Pitkin has been removed by erosion, the Fayetteville shale.

Typically exposed in southern part of Washington County, Ark., in vicinity of Cane Hill. Well exposed beside Arkansas State Highway 59 for 3 miles along the road south of Evansville in SE¼ sec. 35, T. 13 N., R. 33 W. Extends westward a short distance into Oklahoma.

Canelo Redbeds

Cretaceous(?): Southeastern Arizona.

J. H. Feth, 1948, Am. Assoc. Petroleum Geologists Bull. v. 32, no. 1, p. 83, figs. 1, 2. Post-Permian, probably Cretaceous, sandstones, shales, conglomerates, quartzites, and thin-bedded limestones. Thickness of 1,360 feet in northern Canelo Hills. Underlie unnamed fanglomerate of Tertiary(?) age; overlie unnamed sandstones and conglomerates of Cretaceous(?) age.

Named for their characteristic occurrence in canyons of the northern Canelo Hills, approximately 25 miles northeast of Nogales and 60 miles by road southeast of Tucson.

Cane River Formation (in Claiborne Group)[1]

Eocene, middle: Western Louisiana, southern Arkansas, and eastern Texas.

Original reference: W. C. Spooner, 1926, Am. Assoc. Petroleum Geologists Bull., v. 10, no. 1, p. 7; no. 3, p. 220, 224, 227, 235–236.

D. B. Tait, R. C. Baker, and G. A. Billingsley, 1953, U.S. Geol. Survey Circ. 241, p. 7. Geographically extended into southern Arkansas where it crops out about 5 miles north of Columbia County line.

R. F. Dinnean, 1958, Louisiana Geol. Survey Geol. Summ. no. 1, p. 5, pl. 1. Formation crops out in southwestern part of Chestnut salt dome area, Natchitoches Parish. Composite section obtained partially from auger holes on south side of dome is 107½ feet thick. Includes a lower 13-foot noncalcareous sequence of sandy blue-green and brown clay, a middle 27-foot calcareous fossiliferous member of blue-gray, green, and dark-brown glauconitic marl, and an upper 67-foot noncalcareous sequence with few glauconite beds. Overlies Carrizo formation; underlies Sparta formation. Claiborne group.

Type locality: Baden Hill on Cane River, one-half mile north of Natchitoches, Natchitoches Parish, La.

Cane Spring 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]. Massive dolomite and limestone, with thin-bedded impure limestone and shale in lower part. Thin lava flow near base and 20-foot lens of dark-brown siliceous conglomerate 100 feet above base. Total thickness more than 1,000 feet. Conformably underlies Osobb formation (new); conformably overlies Augusta Mountain formation (new).

Type locality: Summit and southeast slope of Augusta Mountain in vicinity of Cane Spring, 2 miles south of quadrangle boundary.

Caney Shale[1]

Mississippian: Central southern and southeastern Oklahoma.

Original reference: J. A. Taff, 1901, U.S. Geol. Survey Geol. Atlas, Folio 74.

J. C. Barker, 1951, Tulsa Geol. Soc. Digest, v. 19, p. 173–178. Formation in Lawrence uplift area has two facies, a lower calcareous siltstone phase and an upper black shale unit. Subsurface stratigraphers have referred to calcareous phase as "Mayes." This phase is exposed in only three localities, and it was not feasible to map it as separate unit; it is here referred to as "Ada Mayes." Thickness 350 to 720 feet. Unconformably overlies Welden limestone; underlies "Springer" shale.

M. K. Elias, 1956, *in* Ardmore Geol. Soc. Petroleum geology of southern Oklahoma, a symposium, v. 1: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 57–75. Mississippian Caney shale, in northern Arbuckle Mountains, is divided into (ascending) Ahlosa (Ahloso), Delaware Creek, and Sand Branch members (new). Term Ahlosa (Ahloso) is introduced for unit commonly referred to as "Mayes" or "Ada Mayes." Overlies Welden limestone; underlies Rhoda Creek formation (new). In this area is Meramec and Chester. In southern Arbuckle Mountains, Caney shale (previous usage) contains Delaware Creek and possibly upper part of Ahloso; underlies Goddard shale.

Jerome Westheimer, 1956, *in* Ardmore Geol. Soc. Petroleum geology of southern Oklahoma, a symposium, v. 1: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 392–393. Proposed that term Caney be restricted to those Mississippian sediments around Arbuckle Mountains overlying Sycamore limestone and that a new name be assigned to post-Caney, pre-Springer sediments. Goddard shale is now known to be time equivalent of upper part of Caney shale as developed on northeast flank of Arbuckles and is of essentially same age as Elias' lower and upper Sand Branch members of the Caney.

M. K. Elias and C. C. Branson, 1959, Oklahoma Geol. Survey Circ. 52, p. 3–24. Caney shale is established in region in which it was originally described by designating a type section in Arbuckle Mountain area. Five measured sections in adjacent ravines west of Viola townsite are so designated, and type sections of three members are likewise established there. Original type locality is abandoned except as source of name, and the shales which there contain exotic boulders are left under name of Johns Valley shale. Thickness at type locality about 381 feet; top of shale not preserved in type section. Shale is Mississippian consisting of Meramecian Ahloso member, Delaware Creek member (later Meramecian and early Chesterian), and late Chesterian Sand Branch member. Sycamore sandstone exposed below Caney type section is unlike Sycamore of its type area and may be facies of grading into Ahloso member, Summary of history relative to confusion in use of term Caney.

J. D. Prestridge, 1959, *in* Ardmore Geol. Soc., Petroleum Geology of southern Oklahoma, a symposium, v. 2; Tulsa, Am. Assoc. Petroleum Geologists. p. 158 (fig. 2), 161. Overlies Worthey member (new) of Sycamore formation.

Type section (Elias and Branson): Sec. 14, T. 2 S., R. 7 E., Johnston County.

Caney Creek Member (of Brodhead Formation)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. Spec. Paper 22, p. 76, 157, 159–160, 202, pls. 6, 15. Predominantly siltstone and shale. As much as 72 feet thick. Underlies Clementsville member (new); overlies unnamed shaly member. Included in Liberty facies (new) of formation.

Type locality: A prominent knob, at head of Caney Creek, 2 miles east of Lebanon, Marion County.

Caney Point Marl Member (of White Bluff Formation)

Eocene (Jacksonian): Southeastern Arkansas.

H. S. Puri, 1952, Jour. Paleontology, v. 26, no. 2, p. 202, 209. Mentioned in a list of fossil localities.

L. J. Wilbert, Jr., 1953, Arkansas Div. Geology Bull. 19, p. 39, 56–70. One of three marine facies of formation. Typically calcareous glauconitic clay containing a varied invertebrate fauna; includes the more calcareous elements of the formation. Thickness 11 to 20 feet. Occurs in basal part of formation; stratigraphically equivalent with Pastoria sand member; underlies Rison clay member in Drew and Lincoln Counties, contact gradational; sharply separated from underlying Claiborne beds by a contact that shows evidence of disconformity. Type locality designated.

Type locality: Caney Point, on Saline River, approximately 5½ miles northwest of crossroads at Rye, Cleveland County. Outcrops are largely restricted to the upland which parallels the Saline River on the west, extending from east-central Bradley County to northwestern Cleveland County.

Caneyville Limestone (in Wabaunsee Group)[1]

Pennsylvanian (Virgil Series): Eastern Kansas, southeastern Nebraska, and northeastern Oklahoma.

Original references: R. C. Moore, M. K. Elias, and N. D. Newell, 1934, Stratigraphic section of Pennsylvanian and "Permian" rocks of Kansas River valley: Kansas Geol. Survey, issued Dec.; R. C. Moore, 1935, Rock formations of Kansas *in* Kansas Geol. Soc. [Am. Assoc. Petroleum Geologists 20th Ann. Mtg.]. Mar. 21–23, Wichita; R. C. Moore, 1935, Kansas Geol. Survey Bull. 20, table facing p. 14.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 172; R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 58. Consists of three limestones and separating shales in southern part of outcrop area; two limestones and a shale elsewhere. In northern Kansas where no discernible boundary between Caneyville and Pony Creek is found, strata from base of Nebraska City limestone to base of Brownville limestone are designated Caneyville-Pony Creek, or may be called Wood Siding formation, which is defined by Nebraska Geological Survey to have limits that correspond exactly to Caneyville-Pony Creek. Thickness about 21 feet. Comprises (ascending) Nebraska City limestone member, unnamed shale, limestone, shale sequence, and Grayhorse limestone member. Underlies Pony Creek shale; overlies French Creek shale.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 13. In Nebraska Caneyville shale is a poorly defined member of Wood Siding formation;

thickness 6 to 10 feet. Underlies Pony Creek shale member with boundary indefinite; overlies Nebraska City limestone member.

Type locality: Sec. 11, T. 32 S., R. 8 E., Chautauqua County, Kans. Name derived from Caneyville Township.

Caneyville Shale [1] Member (of Wood Siding Formation)

Pennsylvanian: Northeastern Kansas and southeastern Nebraska.

Original reference: G. E. Condra, 1935, Nebraska Geol. Survey Paper 8, p. 9.

See Caneyville Limestone (in Wabaunsee Group).

Type locality: Sec. 11, T. 32 S., R. 8 E., Caneyville Township, Chautauqua County, Kans.

Canisteo Shale Member (of 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 190 feet of soft bluish-gray to olive-drab shale that overlies Canaseraga sandstone member in Greenwood, Hornell and Woodhull quadrangles. This is basal part of sequence which according to Bradley (Bradley and Pepper, 1938, U.S. Geol. Survey Bull. 899–A) was named Gowanda by Chadwick and traced by him from vicinity of Gowanda to vicinity of Canisteo. Absence of definite top to Gowanda member east of Gowanda and presence of thin layers of siltstone and shale at base of Canisteo member and top of Canaseraga between Wiscoy and Hornell indicate that the Canisteo, Caneada, and Gowanda members, although closely related in time of deposition, are not strictly correlative throughout. Above Canisteo is thick unnamed sequence of silty shale, siltstone, and sandstone; the Canisteo grades upward into this unit, which probably contains upper part of Caneadea member.

Named for occurrence in vicinity of Canisteo, Steuben County.

Canjilon Till

Quaternary: 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. Named as oldest of seven Quaternary formations in area. Underlies Canones andesite (new); Quaternary formations overlie pre-Quaternary rocks with angular unconformity.

Occurs in Abiquiu quadrangle, Rio Arriba County.

Cannelton Limestone (in Kanawha Formation[1] or Group)

Pennsylvanian: Southern West Virginia.

Original reference: I. C. White, 1885, The Virginias, v. 6, p. 8, 15.

H. R. Wanless, 1939, Geol. Soc. America Special Paper 17, p. 79. Slightly fossiliferous marine limestone; occurs near middle of Kanawha group, between Brownstown sandstone (above) and Matewan coal.

Occurs in vicinity of Cannelton, Fayette County.

Cannelton Sandstone (in Pottsville Group)[1]

Pennsylvanian: Southwestern Indiana.

Original reference: T. C. Hopkins, 1896, Indiana Dept. Geology and Nat. Resources 20th Ann. Rept. p. 314.

Quarried at Cannelton, Perry County.

Cannelton Shale (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. 151–152, 170.

Canning Ridge Quartz Monzonite

Tertiary: Western Texas.

Hugh Hay-Roe, 1957, Texas Univ. Bur. Econ. Geology Geol. Quad. Map 21. Name applied to quartz monzonite occurring in stock on Canning Ridge.

Occurs at south end of Wylie Mountains, Culberson County.

Canning Ridge Trachyte

Tertiary: Western Texas.

Hugh Hay-Roe, 1957, Texas Univ. Bur. Econ. Geology Geol. Quad. Map 21. Name applied to trachyte occurring in stock on Channing Ridge.

Occurs at south end of Wylie Mountains, Culberson County.

Cannon Limestone[1]

Cannon facies (of Bigby-Cannon Limestone)

Middle Ordovician: Central and eastern Tennessee and southwestern Virginia.

Original reference: E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, p. 417, 418, 429, pl. 27.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 2 (fig. 1), 80, 126–134. Bigby limestone grades laterally into Cannon limestone; the two are contemporary facies of unit here termed Bigby-Cannon limestone which overlies Hermitage formation and underlies Catheys formation. All included in Nashville group.

Well exposed southwest of Kettle Creek pool, Cannon County, Tenn.

Cannonball Member (of Fort Union Formation)

Cannonball Formation (in Fort Union Group)

Cannonball Marine Member (of Lance Formation)[1]

Paleocene: Southwestern North Dakota and northwestern South Dakota.

Original reference: E. R. Lloyd, 1914, U.S. Geol. Survey Bull. 541, p. 248, 249.

W. M. Laird and R. H. Mitchell, 1942, North Dakota Geol. Survey Bull. 14, p. 18–20. Formation in Fort Union group. Comprises upper 250 to 300 feet of old Lance formation. Typically exposed along Cannonball River. To west, intergrades with underlying Ludlow formation; in mapped area [southern Morton County], overlies and is gradational with the Ludlow. Conformably underlies Tongue River formation.

S. K. Fox, Jr., and R. J. Ross, Jr., 1942, Jour. Paleontology, v. 16, no. 5, p. 660–673. Analysis of 64 species of foraminifera from Cannonball beds of North Dakota indicates their Midway (Paleocene) age. This supports recent evidence from paleobotany and from vertebrate paleontology, but is contrary to former belief, based on Cannonball mollusks and corals, that the Cannonball is of late Cretaceous age.

O. A. Seager and others, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 8, p. 1414, 1415, 1417. Fort Union in North Dakota represented by three members: Tongue River, Cannonball, and Ludlow. The Cannonball and Ludlow are interfingering contemporaneous sediments of early Paleocene age.

R. E. Stevenson, 1954, Areal geology of the Morristown quadrangle (1:62,500); 1957, Geology of Ralph quadrangle (1:62,500); 1957, Geology of the McIntosh quadrangle (1:62,500); South Dakota Geol. Survey. Formation mapped in Morristown, Ralph, and McIntosh quadrangles. Thicknesses: 60 to 75 feet, 95 feet, and 170 feet in respective quadrangles. In Morristown quadrangle is top of section; interfingers with underlying Ludlow formation; in Ralph quadrangle, includes Giannonatti facies at top, interfingers with underlying Ludlow formation, and underlies Tongue River formation; top of section in McIntosh quadrangle and interfingers with underlying Ludlow.

N. H. Darton, 1951, Geologic map of South Dakota (1:500,000): Mapped as Cannonball formation.

Typically exposed in bluffs of Cannonball River, Tps. 132 and 133 N., R. 8 W., Morton County, N. Dak.

Cano Member (of Mesaverde Formation)

Upper Cretaceous: North-central New Mexico.

C. E. Stearns, 1953, Geol. Soc. America Bull., v. 64, no. 4, p. 463 (fig. 2), 466, pl. 1. Massive sandstone interbedded in Mancos shale. First massive sandstone characteristic of Mesaverde in area. Thickness increases southward from 25 feet in Arroyo Pinovetito to at least 225 feet southeast of Hogan.

H. E. Wheeler and V. S. Mallory, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 10, p. 2415–2416. By use of map patterns and symbols, Stearns (1953) implies that an unexposed cutoff separates Cano member from undifferentiated Mesaverde. Yet this so-called Mesaverde member occurs only as part of Mancos shale, with no indication that it occurs anywhere in vertical sequence as recognized part of formation of which it is a designated member.

Present only in Tongue Valley.

Canoas Siltstone Member (of Kreyenhagen Shale)

Canoas Silt

Eocene: Central California.

B. L. Clark, 1943, California Div. Mines Bull. 118, pt. 2, p. 189 (fig. 72) [preprint 1941]. Shown on correlation chart as Canoas silt underlying "Kreyenhagen" proper and overlying the Domengine.

J. A. Cushman and S. S. Siegfus, 1942, San Diego Soc. Nat. History Trans., v. 9, no. 34, p. 390–391. Consists of greenish-gray soft crumbly clayey siltstone, with a few thin beds of light-gray fine sand. Thickness 110 feet. Basal member of Kreyenhagen; conformably overlies Avenal sandstone.

Type locality: In Garza Creek, Kings County.

Canon (Canyon) Rhyolite[1]

Miocene (Barstovian): Northwestern Nevada and southeastern Oregon.

Original reference: J. C. Merriam, 1910, California Univ. Dept. Geology Bull., v. 6, no. 2, p. 29, 30, 31–33.

D. O. Cochran, 1959, Oregon Dept. Geology and Mineral Industries Bull. 50, p. 10 (chart), 11. Canyon rhyolite listed with Cenozoic formations of Oregon. A highly silicic dense rhyolite with characteristics suggesting welding in some areas and with flow structures present elsewhere. Thickness about 400 feet. Overlies Steens basalt; underlies Virgin Valley formation.

Type area: Virgin Valley, Nev. Name derived from Thousand Creek Canon (Canyon), Humboldt County, Nev.

Canones Andesite

Quaternary: North-central New Mexico.

H. T. U. Smith, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 103. Named as second of seven Quaternary formations in area. Younger than Canjilon till (new); older than Vallecito basalt (new).

H. T. U. Smith, 1938, Jour. Geology, v. 46, p. 937 (fig. 4), 959. In sequence listed, Canones andesite is younger than Canjilon till and older than Hinsdale(?) and Lobato basaltic lavas (new).

Occurs in Abiquiu quadrangle, Rio Arriba County.

Canter Limestone[1]

Mississippian: Southern Ohio.

Original reference: E. B. Andrews, 1871, Ohio Geol. Survey Rept. Prog. 1870, p. 158, 163.

In Hamilton Township, Jackson County.

Canterbury Gneiss

Canterbury Granite Gneiss[1]

Pre-Pennsylvanian: Eastern Connecticut and southern Massachusetts.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 115, 136, 142, map.

W. G. Foye, 1949, Connecticut Geol. Nat. History Survey Bull. 74, p. 54–55. Referred to as an orthogneiss. Same as Ayer granite of Thompson Township, Windham County, Conn., which extends into Massachusetts. Age considered Upper Carboniferous.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Outcrop in Thompson Township here mapped as Canterbury granitic gneiss. Pre-Triassic. Derivation of name given.

U.S. Geological Survey currently designates the age of the Canterbury Gneiss as pre-Pennsylvanian on the basis of a study now in progress.

Named for town of Canterbury, Windham County, Conn.

Cantinas Sandstone (in Asuncion Group)

Upper Cretaceous: West-central California.

N. L. Taliaferro, 1943, California Div. Mines Bull. 118, pt. 2, p. 132 [preprint 1941]. Forms upper part of Asuncion group (new) in southern Santa Lucia Range. Overlies Godfrey shales (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.

Canton Phacolithic Complex[1]

Precambrian: Northwestern New York.

Original reference: A. F. Buddington, 1929, New York State Mus. Bull. 281, p. 65–76.

Occurs in Canton, Gouverneur, and Ogdensburg quadrangles.

Canton Schist[1] or Formation

Precambrian: Northwestern Georgia.

Original reference: W. S. Bayley, 1928, Georgia Geol. Survey Bull. 43, p. 43–46, map.

G. W. Crickmay, 1936, Geol. Soc. America Bull., v. 47, p. 1379. Canton formation is here regarded as part of the Carolina gneiss or series, which is considered Precambrian.

Well exposed in vicinity of Canton, southwestern part of Tate quadrangle, Cherokee County.

Canton Shale Member (of Carbondale Formation)[1]

Canton Shale (in Carbondale Group)

Pennsylvanian: Central and western Illinois.

Original reference: T. E. Savage, 1921, Illinois Geol. Survey Extr. from Bull. 38.

Leland Horberg, 1950, Illinois Acad. Sci. Trans., v. 43, p. 171, 174. In Henry County, underlies Tertiary gravels which generally have been referred to Lafayette formation.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 106–107, 190, 195, 196, 197. Consists of upper and lower part separated by limestone bed 4 inches to 1 foot thick. Total thickness as much as 35 feet. Underlies Cuba sandstone; overlies St. David limestone. Included in St. David cyclothem.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 35, 47 (table 1), 66, pl. 1. Carbondale redefined as formation. Canton shale member underlies Vermilionville limestone member which replaces preoccupied name Cuba sandstone.

Type locality: Center sec. 9, T. 6 N., R. 4 E., Fulton County. Named from exposures near Canton.

Cantua Sandstone Member (of Lodo Formation)

Cantua Sandstone Member (of Arroyo Hondo Formation)

Cantau Sandstone Member[1] (of Martinez? Formation)

Eocene: Southern California.

Original reference: R. Anderson and R. W. Pack, 1915, U.S. Geol. Survey Bull. 603, p. 33, 59–63, map.

R. T. White, 1938, (abs.) Geol. Soc. America Proc. 1937, p. 256–257. Assigned to member status in Lodo formation (new). Overlies Cerros member (new); underlies Arroyo Hondo member.

H. E. Vokes, 1939, New York Acad. Sci. Annals, v. 38, p. 27, 28. Assigned to member status in Arroyo Hondo formation. Lies entirely within Ragged Valley shale member; a basal portion of Ragged Valley shale, approximately 100 feet thick, appears to underlie the Cantua throughout area.

M. C. Israelsky, 1951, U.S. Geol. Survey Prof. Paper 240–A, p. 1–2. Restricted to the sandstone unit, thus excluding about 100 feet of fine-grained strata underlying the sandstone and originally included in the Cantua.

Named for fact it reaches greatest development at head of west branches of Cantua Creek, Fresno County.

†Cantua Shale[1]

Eocene or Oligocene: Southern California.

Original reference: C. C. Church, 1930, Pan-Am. Geologist, v. 54, no. 1, p. 79.

Phoenix Canyon, near Coalinga, Coalinga region.

Cantwell Formation[1]

Lower Cretaceous: Southern Alaska.

Original reference: G. H. Eldridge, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 16, map.

R. W. Imlay and J. B. Reeside, Jr., 1954, Geol. Soc. America Bull., v. 65, no. 3, p. 235, chart 10d (column 23). Consists of several thousand feet of continental deposits and some interbedded lavas and graywacke.

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 Cretaceous and Jurassic rocks undifferentiated.

Clyde Wahrhaftig, 1958, U.S. Geol. Survey Prof. Paper 293–A, p. 8–9, pls. 1, 3, 9. Formation occupies large synclinorium in center of Alaska Range. On the north, it is bounded by vertical fault which forms its contact with Birch Creek schist. Eldridge designated locality on Nenana River then known as Cantwell River as type locality.

Type locality: On Nenana River (formerly Cantwell River) about 3 or 4 miles above its junction with the Yanert Fork.

Canutillo Formation.

Middle Devonian: Texas.

L. A. Nelson, 1937, Colorado Univ. Studies, v. 25, no. 1, p. 89. Stratigraphic section in Franklin Mountains includes Devonian Canutillo formation which lies between Mississippian Helms formation and Silurian Fusselman limestone.

L. A. Nelson, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 163 (fig. 3), 164, 170 (fig. 5). About 175 feet of sediments consisting of cherty limestone, light brown in color, immediately overlying Fusselman; thin beds of fossiliferous gray limestone; thin bed of dense, almost black sandstone, which weathers brown; and about 40 feet of black shale, fissile shale at top of formation. Middle Devonian.

F. V. Stevenson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 18, p. 22–23. Most limited in areal extent of all Devonian formations in New Mexico. Basal part consists chiefly of massive calcareous siltstone that is overlain by thin beds of varicolored shale interbedded with massive thick beds of calcareous brown siltstone. Average thickness 25 to 30 feet. Most complete exposure, 88 feet thick, is in San Andres Canyon, San Andres Mountains. Overlies Fusselman limestone; underlies Sly Gap formation. Fauna and geologic history of southwest indicate that formation is probably early Late Devonian.

F. V. Stevenson, 1945, Jour. Geology, v. 53, no. 4, p. 221–222. Sediments below Sly Gap in Sacramento and San Andres Mountains, hitherto called Canutillo from supposed correlation with Canutillo formation in Franklin Mountains of Texas, are herein named Onate formation.

L. R. Laudon and A. L. Bowsher, 1949, Geol. Soc. America Bull., v. 60, no. 1, p. 36, 37 (fig. 17). In Franklin Mountains, Tex., formation consists of approximately 15 feet of soft thin-bedded gray siltstone. Separated from underlying Fusselman by 42 feet of cherty limestone, probably Devonian; overlain by 57 feet of soft flaky gray-black shale identical in character with part of Percha shale of Lake Valley area.

Named from town of Canutillo, Tex., on Santa Fe Railroad about 13 miles north of El Paso.

Canville Limestone[1] Member (of Dennis Limestone)

Canville Limestone Member (of Hogshooter Formation)

Upper Pennsylvanian (Missouri Series): Eastern Kansas, southwestern Iowa, northwestern Missouri, and northeastern Oklahoma.

Original reference: R. C. Moore, 1932, Kansas Geol. Guidebook 6th Ann. Field Conf., p. 91, 97.

R. C. Moore, 1937, Kansas Geol. Soc. Guidebook 11th Ann. Field Conf., p. 40, 42. Rank reduced to member status in Dennis limestone.

R. C. Moore, 1949, Kansas Geol. Survey Bull. 83, p. 68 (fig. 14), 90–91. Canville limestone member of Dennis formation; underlies Stark shale member; overlies Galesburg formation. This is classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma. In Kansas, locally, a single layer about 1 foot thick; where thickness is greater, up to maximum of 3 feet, two or three beds may occur; member thins southward from type region.

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 formerly included in it by Missouri Geological Survey.

M. C. Oakes, 1940, (abs.) Tulsa Geol. Soc. Digest, v. 9, 51; 1952, Oklahoma Geol. Survey Bull. 69, p. 59, 60, 61. Present locally in northeastern Oklahoma where it is basal member of Hogshooter formation.

T. L. Welp, L. A. Thomas, and H. R. Dixon, 1957, Iowa Acad. Sci. Proc., v. 64, p. 418 (fig. 1), 421. In measured section near Winterset, Madison County, Canville member of Dennis formation is a bluish-gray discontinuous nodular band about 8 inches thick.

Named from exposures on Canville Creek, Neosho County, Kans.

Canyon Conglomerate[1]

Pliocene: Yellowstone National Park.

Original reference: W. H. Weed, 1896, U.S. Geol. Survey Geol. Atlas, Folio 30.

Named for occurrence in Grand Canyon of Yellowstone River.

Canyon Group[1]

Canyon Formation[1]

Canyon Series

Upper Pennsylvanian: Central northern and central Texas.

Original reference: W. F. Cummins, 1891, Texas Geol. Survey 2d Ann. Rept., p. 361–374.

N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 387–402 (repr. 1917 as Texas Univ. Bull, 1755). Canyon division comprises (ascending) Coral limestone, Rochelle conglomerate, Brownwood, Adams Branch limestone, Cedarton, Clear Creek, bed no. 7, cherty bed, Hog Creek, Home Creek, Bluff Creek, and *Campophyllum* beds. Overlies

Strawn division, with Ricker bed at top; underlies Cisco division, with Trickham bed at base.

F. B. Plummer and R. C. Moore, 1921, Texas Univ. Bull, 2132, p. 87–120; 1922, Jour. Geology, v. 30. Canyon group comprises (ascending) Graford formation (with Rochelle conglomerate, at base, Capps limestone lentil, Brownwood shale, and Adams Branch limestone); Brad formation (with Cedarton shale at base, Clear Creek limestone, Placid shale, and Ranger limestone); and Caddo Creek (with Hog Creek shale, below, and Home Creek limestone, above). Overlies Strawn group (Ricker bed at top), underlies Cisco group.

C. O. Nickell, 1938, Texas Univ. Bur. Econ. Geology Pub. 3801, p. 94–118. Group includes (ascending) Palo Pinto, Graford, Brad, and Caddo Creek formations.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 87–90. Rank raised to series. Comprises (ascending) Whitt (new), Graford, Brad, and Caddo Creek groups. Includes sediments above disconformity (unconformity in more positive areas) at top of Strawn series (base of Lake Pinto sandstone at Mineral Wells) and below disconformity marked by Kisinger channel (base of Cisco series) of southeast Young County. Village Bend limestone is top member of East Mountain shale of Lone Camp group (new) in Strawn series. Subdivision is thought to be approximately equivalent to Missouri series of Kansas.

R. C. Moore and M. L. Thompson, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 3, p. 288 (fig. 1), 299. Rocks of Kawvian series (new) are widespread in North America. In north-central Texas, include the Canyon and Cisco.

R. J. Cordell and D. A. Zimmerman, 1954, Abilene Geol. Soc. Guidebook Field Trip Nov. 19–20, p. 46 (fig. 38), 47–49. In Palo Pinto County, Canyon-Strawn contact has for several years been placed at base of Lake Pinto sandstone (top of East Mountain shale). Position and correlation of Village Bend limestone (within East Mountain shale) has been used as evidence for unconformity at base of Lake Pinto sandstone. In general area of its type locality, the Village Bend occurs at variable intervals below beds identified as Lake Pinto. This variability of interval provided some postulation of erosional surface at top of East Mountain shale. Also inferring from statements by Cheney and Goss (1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 12) typical Strawn fossils, such as *Fusulina*, *Prismopora*, and *Mesolobus*, were not known above base of Lake Pinto at time of their publication. Believed from data available that logical Canyon-Strawn contact should be at base of Turkey Creek sandstone in Palo Pinto County. Turkey Creek sandstone is immediately overlain by Keechi Creek shale near top of which *Triticites* (post-Strawn age) has been found. Also concluded that lower Brownwood of Brown County is probably late Strawn age and that the 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 about 125 feet, at expense of Canyon.

J. W. Shelton, 1958, Geol. Soc. America Bull., v. 69, no. 12, pt. 1, p. 1515, 1524, pl. 1. Strawn-Canyon boundary in north-central Texas is evaluated from surface studies in Colorado River and Brazos River valleys. Zonation based on fusulinids is best criterion for defining boundary. Strawn series is characterized by genus *Fusulina* and Canyon series by *Triticites*. Brachiopod *Mesolobus* and bryozoan *Prismopora* are not persistent in outcrop area; boundary is placed at three different stratigraphic positions so that locally prominent surfaces, which agree with paleontological evidence, may be used as the contact. In Colorado River valley, boundary is considered to be top of Capps limestone, which is continuous to north through Comanche County and most of Eastland County. In southern part of Brazos River valley, boundary is placed at top of "boulder" bed (of other investigators). This bed, which is present in northeastern Eastland County and southwestern Palo Pinto County, lies about 20 feet above Capps limestone. It is correlated with, and designated as, Village Bend limestone of central Palo Pinto County. In eastern Palo Pinto County, boundary is placed at base of Lake Pinto sandstone, which overlies Village Bend limestone.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 58 (table 1), 62–68, pl. 27. Sequence of rocks now assigned to Canyon group includes most of the rocks assigned to Milburn shales and Brownwood division by Tarr (1890, Texas Geol. Survey 1st Ann. Rept.) and to Brownwood-Ranger series by Dumble (1890, Texas Geol. Survey 1st Ann. Rept.). Tarr's Brownwood division and Dumble's Brownwood-Ranger series were described as overlying their Milburn shales (later called Brownwood shale) and as including rocks that are barren of coal and that consist chiefly of limestone. Upper limit of this sequence was not definitely identified but appears to have been top of Gunsight limestone member of Graham formation, Cisco group, of presesnt classification. Drake (1893), adopting Cummins' (1891) divisions of rocks in Brazos River valley, applied term Canyon to prominent beds of limestone and intervening beds of shale of Colorado River valley, to which he gave local names and which he classified as beds. He considered base of Canyon to be top of his Coral limestone bed (Capps limestone lentil of Plummer and Moore) and top of Canyon to be his *Campophyllum* bed (Gunsight limestone member of present usage). Plummer and Moore (1921) raised Canyon to group rank, divided it into formations named for Brazos River valley localities, and further divided these into members bearing nomenclature of Drake's beds. This terminology is still widely used, though some renaming, reorganization, and redefining of units has been accomplished. Following nomenclature is recommended for formations and members (ascending): Graford formation, with Brownwood shale, Adams Branch limestone, and Cedarton shale members; Winchell limestone with lower and upper unnamed limestone members: Brad formation with Placid shale and Ranger limestone members; and Caddo Creek formation with Colony Creek shale and Homewood limestone members. Thickness about 600 feet in area of this report [Brown and Coleman Counties].

Named for Canyon, Palo Pinto County.

Canyon City Group[1]

Upper Cretaceous (Montana): Southeastern Colorado.

Original reference: F. V. Hayden, 1869, U.S. Geol. Survey Colorado and New Mexico 3d Ann. Rept. p. 89–91.

Near Hardscrabble Creek, a small branch running into Arkansas River just below Canyon City, Canyon City region.

Canyon Creek Member (of San Juan Tuff)[1]

Miocene(?): Southwestern Colorado.

Original reference: W. S. Burbank, 1930, Colorado Sci. Soc. Proc., v. 12, p. 186.

Along Canyon Creek just below Camp Bird mill, Ouray district.

†Canyon Largo 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. for 1875, pls. 35, 38.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 16, pl. 1. Term resurrected to replace San Juan "Wasatch." Tiffanian, Clarkforkian(?), and Wasatchian, of San Juan Basin, northwestern New Mexico and narrow fringe of southwestern Colorado.

G. G. Simpson, 1948, Am. Jour. Sci., v. 246, no. 5, p. 276–282. Discussion of proposal by Wood and others to reinstate term Canyon Largo and also discussion of conflicts in usage of term by early workers, Newberry, Holmes, and Keyes. It is concluded that no acceptable name for formation generally known as San Juan Basin "Wasatch" is available in previous literature. Hence, name San Jose formation is proposed.

Named for Canyon Largo, in northeastern part San Juan County and west part of Rio Arriba County, N. Mex.

Canyon Largo Sandstone[1]

Eocene: Northwestern New Mexico.

Original reference: C. R. Keyes, 1906, Geol. Soc. America Bull., v. 17, p. 725.

G. G. Simpson, 1948, Am. Jour. Sci., v. 246, no. 5, p. 273–280. Discussion of conflicts in usage of term Canyon Largo by early workers, Newberry, Holmes, and Keyes, Keyes proposed use of Canyon Largo for a part, only, of the New Mexico "Wasatch" of most other writers. He credited term to Newberry and not to Holmes. Keyes' proposal is a definitely published proposal which is valid as far as priority has any bearing. Keyes used name repeatedly in publications over a span of years, and his is most nearly continued and established use in literature. Import of Keyes' publications depends on whether Newberry or Holmes is considered as having originally established the name. Because of this confusion, no acceptable name for formation generally known as San Juan basin "Wasatch" is available in previous literature and San Jose is proposed.

Derivation of name not given.

Canyon Springs Sandstone Member (of Sundance Formation)

Canyon Springs Sandstone Member (of Rierdon Formation)

Upper Jurassic: Northwestern Wyoming and southwestern South Dakota.

R. W. Imlay, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 2, p. 247–251, geol. sections. At type section, consists of about 26 feet of soft fine-grained calcareous fossiliferous white sandstone that underlies Stockdale Beaver member (new) and overlies Gypsum Spring formation. Thickness ranges from featheredge to about 45 feet; thickens and thins considerably in short distances, and is recognizable as a member only along southern and western margins of Black Hills.

J. A. Peterson, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 4, p. 466 (table 2), 475. Reallocated to member status in Rierdon formation herein assigned to Sundance group.

Type locality: Conical butte about 4 miles west of Horton, Weston County, Wyo., one-fourth mile north of road from Horton to Upton, and near center sec. 23, T. 48 N., R. 62 W. Named for Canyon Springs Prairie immediately east of type locality.

†Cap au Gres standstone[1]

Lower Ordovician: Western Illinois, southeastern Iowa, and northeastern Missouri.

Original reference: C. R. Keyes, 1898, Iowa Acad. Sci. Proc., v. 5, p. 59, 60.

Typically developed at Cap au Gres, a headland on Illinois side of Mississippi River in Calhoun County, Ill.

Capay Formation[1]

Capay Stage

Eocene, lower: Northern California.

Original reference: T. H. Crook and J. M. Kirby, 1935, Geol. Soc. America Proc. 1934, p. 334–335.

B. L. Clark and H. E. Vokes, 1936, Geol. Soc. America Bull., v. 47, no. 6, p. 853 (fig. 1), 858–861. Referred to as stage based on faunal assemblages. Spans interval between Meganos stage below and Domengine stage above. Strata referable to this stage have been incorrectly correlated by Clark (1921, Jour. Geology, v. 29, no. 2) with those containing fauna of division D of Meganos group.

C. W. Merriam and F. E. Turner, 1937, California Univ. Pubs., Dept. Geol. Sci. Bull., v. 24, no. 6, p. 91–113. Discussion of middle Eocene Capay stage of northern California. Check list of species of stage in Capay Valley and Vacaville areas is given. Deposits of stage represent in several areas a discrete transgressive overlapping of marine conditions as shown by fact that beds rest both upon the Meganos and upon earlier formations. At type section of Meganos, on north side of Mount Diablo, Capay stage is either missing or represented by coal beds which have offered little or no fossil evidence of their immediate age. Locality which had yielded most of the fossils lies on west side of Capay Valley, Yolo County, and west of Tancred Station, in south-central part of sec. 28, T. 11 N., R. 3 W., Mount Diablo base and meridian.

Boris Laiming, 1940, 6th Pacific Sci. Cong., v. 2, p. 535–568. Discussion of character and distribution of smaller foraminifera in marine Eocene deposits of California. Correlation of foraminiferal zones is shown with faunal "stages" already established by paleontologists on basis of mollusca. Correlation chart shows 12 foraminiferal zones in Eocene as compared to 6 stages on basis of mollusca. Foraminiferal zones (ascending) C, B–4, B–3, and B–2 correlate with Capay stage of Clark and Vokes (1936).

A. M. Keen and Herdis Bentson, 1944, Geol. Soc. America Spec. Paper 56, p. 21 (fig. 4). Chart shows age of Capay formation as lower Eocene.

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 17 (table 3), 52–56, pls. Eocene sedimentary rocks of California have been separated faunally and stratigraphically into six units (Clark and Vokes, 1936). By local geologists these units are referred to (ascending) as Meganos, Capay, Domengine, Transition, Tejon, and Gaviota stages. Three of these are recognized in area mapped [Coast Ranges immediately north of San Francisco Bay region]. U.S. Geological Survey recognizes, for this paper, Tejon, Domengine, and Meganos formations and Capay shale. Name Capay shale, already in literature, was recommended for adoption in this paper with reservation that it should be pointed out that this unit may be facies of the Meganos. Name Capay formation was used by Crook and Kirby (1935) for marine sediments exposed on west side of Capay Valley, Yolo County, and near Tancred Station in sec. 28, T. 11 N., R. 3 W. The section is over 600 feet thick and rests upon Upper Cretaceous beds. It is composed of invertebrate shales, sandstone, and conglomerates, and about 500 feet above base contains invertebrate fauna distinct from Domengine and Meganos formations as recognized on north side of Mount Diablo. In area of present report, Capay shale is exposed in banks of Ulatis Creek in Vaca Valley, Potrero Hills, and in Browns Valley on west side of Napa Valley. Probably middle shale member at Martinez now mapped as part of Martinez formation may be in part equivalent of the Capay. Thickness in some areas as much as 1,000 feet. Overlies Martinez formation; underlies Domengine sandstone.

Ralph Stewart, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 34. Capay formation was proposed for conglomerate and estuarine deposits. possibly 2,400 feet thick, in Capay Valley, Cache Creek. Lower 600 feet contains at least four conglomerates, and near top is a 10-foot gritty mudstone with many pebbles and small gastropods. The mudstone rests upon sandstone that contains a few poorly preserved Eocene fossils and is overlain by coarse conglomerate with micaceous quartz sand matrix. *Turritella merriami* has been found only in the conglomerate with other forms, many of which are worn and generally larger than those in the mudstone. Occurrence of *T. merriami* above the mudstone is similar to that in sequence at Marysville Buttes. It is reasonably certain that the mudstone was deposited contemporaneously with at least some part of Marysville claystone member of the Meganos, and that at least lower part of Capay formation is equivalent to at least the upper part of Meganos formation (unit "E" of Clark and Woodford, 1927). Lower Eocene.

Named for occurrence in Capay Valley, west of Rumsey Hills, west of town of Winters, Yolo County.

Cape Limestone (in Maquoketa Group)

Upper Ordovician: Southeastern Missouri and southwestern Illinois.

A. M. Gutstadt, 1954, Dissert. Abs., v. 14, no. 10, p. 1683. Maquoketa group is divided into (ascending) Orchard Creek shale, Cape limestone, and Eden shale.

A. M. Gutstadt, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 3, pt. 1, p. 523–524. Shideler (1937) applied the name Ada limestone to the Missouri "Fernvale." Templeton and Willman (1953, unpub.) reported that name Ada was preempted and proposed name Cape limestone, from Cape Girardeau, Mo. At this locality, where it is in contact with underlying Orchard Creek shale, the Cape is gray and medium crystalline and contains shale partings and abundant fossil fragments (mostly crinoid segments). Thickness 8 feet.

Well exposed at North Main and Broadway Streets, Cape Girardeau, Mo.

Cape Ann Granite[1]

Late(?) Paleozoic: Northeastern Massachusetts.

Original references: C. H. Clapp, 1910, Igneous rocks of Essex County, Mass; B. K. Emerson, 1917, U.S. Geol. Survey Bull. 597, p. 188–189, map.

U.S. Geological Survey currently designates the age of the Cape Ann Granite as late(?) Paleozoic on the basis of a study now in progress.

Named for occurrence at Cape Ann, Essex County.

†Cape Beauford coal measures[1]

Cretaceous: Alaska.

Original references: W. H. Dall and G. D. Harris, 1892, U.S. Geol. Survey Bull. 84, p. 249; W. H. Dall, 1896, U.S. Geol. Survey 17th Ann. Rept., pt. 1, p. 819–820.

†Cape Blanco Beds[1]

Miocene: Southwestern Oregon.

Original reference: J. S. Diller, 1902, U.S. Geol. Survey Bull. 196, p. 30–31.

At Cape Blanco, Port Orford quadrangle.

Cape Cod series[1]

Tertiary and Quaternary: Massachusetts.

Original reference: N. S. Shaler, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 2, p. 535.

Cape Elizabeth Formation (in Casco Bay Group)[1]

Pennsylvanian (?): Southwestern Maine.

Original reference: F. J. Katz, 1917, Washington Acad. Sci. Jour., v. 7, p. 198.

Named for development at Cape Elizabeth, Cumberland County.

Cape Fear Coquina

Pleistocene: Eastern North Carolina.

W. B. Wells, 1944, Elisha Mitchell Sci. Soc. Jour., v. 60, no. 2, p. 130, 132, pls. 63, 64. Rather heavily sanded shell rock known to underlie Kure sandstone (new) or the deeper consolidated phase of this stratum; contact unconformable. Throughout most of its area, its surface is only a few feet above mean sea level, but where Inland Canal cuts across it, top attains an altitude of 22 feet above mean sea level.

Crops out on sea front between Fort Fisher and Kure's Beach fishing pier, on lower Cape Fear Peninsula.

†Cape Fear Formation[1]

Lower Cretaceous: Coastal Plain of North Carolina.

Original reference: L. W. Stephenson, 1907, Johns Hopkins Univ. Circ. 71, p. 93–99.

S. D. Heron, Jr., 1958, South Carolina Div. Geology Bull., v. 2, no. 11–12, chart 1. Age shown on correlation chart as Lower Cretaceous.

S. D. Heron, Jr., 1959, Geol. Soc. America, Southeastern Sec., Guidebook for Coastal Plain Field Trip, p. 1–2, 5–6, 16–18. Outcrop relationships of Cape Fear, Middendorf, and Bladen units are open to several interpretations. View that Middendorf represents an updip portion of Bladen member of Black Creek seems preferable. Bladen rests on Cape Fear formation in downdip exposures, and Middendorf rests on Cape Fear in updip exposures in Fort Bragg. Lower (?) Cretaceous.

Named for exposures on Cape Fear River.

†Cape Girardeau Marble[1]

Middle Ordovician: Southeastern Missouri.

Original reference: B. F. Shumard, 1855, Missouri Geol. Survey 2d Ann. Rept., pt. 2, p. 155.

Named for Cape Girardeau, Cape Girardeau County.

†Cape Girardeau Sandstone[1]

Upper Ordovician (Richmond): Southeastern Missouri.

Original reference: B. F. Shumard, 1868, St. Louis Acad. Sci. Trans., v. 2, p. 156.

Named for Cape Girardeau, Cape Girardeau County.

Cape Horn Slate[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 Relief quartzite and below Delhi formation. Chesterian.

Named for occurrence at Cape Horn, overlooking North Fork of American River, Placer County.

Cape May Formation (in Columbia group)[1]

Pleistocene (Sangamon and Wisconsin): New Jersey and southeastern Pennsylvania.

Original reference: R. D. Salisbury, 1898, New Jersey Geol. Survey Ann. Rept. State Geologist 1897, p. 19–20.

Paul MacClintock, 1943, Jour. Geology, v. 51, no. 7, p. 458–472. From evidence in New Jersey, the Cape May seems best referred to Sangamon interglacial stage.

H. G. Richards, 1944, Acad. Nat. Sci., Philadelphia Notulae Naturae, no. 134, p. 5. Formation apparently represents entire duration of the Pleistocene between last major interglacial and the Recent. At present, formation is divided into following zones or phases: (1) interglacial marine, sand and clay with warm water fauna, last major interglacial; (2) glacial marine, sand with cold-water fauna, early Wisconsin; (3) transitional, fine sand; and (4) fluvial, sand and gravel, Wisconsin and post-Wisconsin. Future work will probably show that term Cape May formation should not be used for all these phases. Studies made in excavations of Cape May Canal.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Formation mapped in eastern Pennsylvania. Sands and gravels with clay and silt at base locally; includes areas of Recent alluvium and swamp deposits. Younger than Pensauken formation (Illinoian). Wisconsin stage. [Term Columbia group not used].

Named for fact it covers the whole of Cape May County, N.J.

Cape Neddick Gabbro[1]

Devonian (?): Southwestern Maine.

Original reference: A. Wandke, 1922, Am. Jour. Sci., 5th, v. 4, p. 151.

Occurs at Cape Neddick, York County.

Cape San Juan Limestone

Upper Cretaceous: Puerto Rico.

C. J. Maury, 1929, Science, new ser., v. 70, no. 1825, p. 609. Sequence of Upper Cretaceous sedimentaries includes San Germán deposits, Ensenada shale, Fajardo, and Cape San Juan limestones.

C. L. McGuinness, 1948, Ground-water resources of Puerto Rico: [San Juan?] Puerto Rico Aqueduct and Sewer Service, p. 174 (table). Synonym of San Diego formation.

Capetí Limestones

Oligocene, middle: Panamá.

A. A. Olsson, 1942, 8th Am. Sci. Cong. Proc., v. 4, p. 234 (correlation chart). Name appears on correlation chart. Occurs below Arusa formation [or member of Tapaliza formation]. Middle Oligocene.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 329. Undefined name applied to limestones in Darien area. Oligocene.

Darién area.

Capistrano Formation[1]

Miocene, upper, and Pliocene, lower: Southern California.

Original reference: A. O. Woodford, 1935, California Univ. Pubs., Dept. Geol. Sci. Bull., v. 15, no. 7, p. 169, 184, 216–217.

J. G. Vedder, R. F. Yerkes, and J. E. Schoellhamer, 1957, U.S. Geol. Survey Oil and Gas Inv. Map OM–193. Subdivided to include Osa member (new). Unconformably underlies Niguel formation (new).

Named for development around Capistrano, Orange County.

Capita Shale Member (of Domengine Formation)

Eocene: Central California.

M. B. Payne, 1951, California Div. Mines. Spec. Rept. 9, p. 3, 13, 21, 22, pls. 1, 4. At type locality, comprises 50 feet of homogeneous gray shale which is firm, massive, micaceous, and in places carbonaceous. In Gres Canyon, Capita member is represented by a sand facies. Overlies Nonada sandstone member (new); underlies Chaney Ranch sandstone (new); lower and upper contacts gradational.

Type locality: In Chaney Ranch Canyon, Panoche quadrangle, Fresno County. Name taken from Capita Canyon just south of Chaney Ranch Canyon.

Capitan Limestone[1]

Permian (Guadalupe Series): Western Texas and southeastern New Mexico.

Original reference: G. B. Richardson, 1904, Texas Univ. Min. Survey Bull., v. 9, p. 41.

R. K. DeFord and E. R. Lloyd, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 11. Capitan and Carlsbad are names of different facies of equivalent beds. Capitan is massive reef limestone, which grades basinward into upper Delaware Mountain sandstone (Bell Canyon, new) and lagoonward into Carlsbad limestone.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 4, p. 589–592, 654–656, 661–662, pl. 2. Classification of higher Guadalupe beds used in this paper differs from that used in previous reports. All beds of upper Guadalupe age were placed in Capitan limestone, a chronologic unit that included Altuda, Vidrio, and Gilliam members. Name Capitan is herein restricted to that part of former Vidrio member, or reef facies, that is upper Guadalupe (post-Word) in age, and both it and the Altuda and Gilliam are given rank of formation. This change brings usage in Glass Mountains into harmony with that of type area of Capitan in

Guadalupe Mountains, where name is restricted to a lithologic unit, the reef facies. This classification is also adopted by Lewis (1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1). Where traced westward from Delaware Mountains into Guadalupe Mountains, or from Delaware basin toward its margins, sandstones and limestones of Bell Canyon formation (new) of Delaware Mountain group are replaced by light-gray thick-bedded or massive limestone of Capitan; in higher beds of Bell Canyon, the change takes place along edge of Reef escarpment.

P. B. King, 1948, U.S. Geol. Survey Prof. Paper 215, p. 59–64, 75–79, pl. 3, strat. sections. Detailed discussion of geology of southern Guadalupe Mountains, Tex. Thickness 1,000 to 2,000 feet. Consists in part of compact light-gray, cream-colored, or white calcitic limestone associated with dolomitic limestones.

Named for El Capitan Peak, El Paso County, Tex.

Capitol 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), 1707–1709, 1717 (fig. 16). Quaternary section of Texas Coastal Plain between Brazos River and Rio Grande is divided into 11 terraces and terrace deposits. Name Capitol is applied to a terrace deposit younger than the Asylum (new) and older than Beaumont (Sixth Street). Thickness about 40 feet east of Austin. Traced coastward surface of terrace appears to coincide with surface of Lissie formation in Wharton County. Since term Capitol was used as a terrace by Hill and Vaughan (1898, U.S. Geol. Survey 18th Ann. Rept.), it has priority over Lissie (Deussen, 1914).

Named for occurrence near State Capitol at Austin, Travis County. Also well exposed east of Capitol, and from there eastward to Chicon Street.

Capitol Creek Shale[1]

Middle Cambrian: Montana.

Original references: A. Rothpletz, 1915, Die fauna der Belt formation bei Helena in Montana: Munich; C. D. Walcott, 1916, Smithsonian Misc. Coll. v. 64, p. 291.

Cap Mountain Limestone Member (of Riley Formation)

Cap Mountain Formation[1] (in Timbered Hills Group)

Upper Cambrian: Central Texas.

Original reference: S. Paige, 1911, U.S. Geol. Survey Bull. 450, p. 23.

C. E. Decker, 1939, Oklahoma Geol. Survey Circ. 22, p. 16 (table 1), 18–19. Formation included in Timbered Hills group in Oklahoma. Occurs below the Honey Creek and above the Reagan. Ulrich (1932, Geol. Soc. America Bull., v. 43, p. 742) considered this an extension of the formation by same name in Llano-Burnet area, Texas. Present only in secs. 23 and 26, T. 2 S., R. 4 E., in eastern part of Arbuckle Mountains southwest of village of Mill Creek.

P. E. Cloud, Jr., V. E. Barnes, and Josiah Bridge, 1946, Texas Univ. Bur. Econ Geology Pub. 4301, p. 154 [1945]; P. E. Cloud, Jr., and V. E. Barnes, 1948, Texas Univ. Bur. Econ. Geology Pub. 4621, p. 27, 29, 253, 309–310 [1946]. Redefined and reduced to member status in Riley formation (new). As redefined, includes some quite sandy beds formerly included in Hickory sandstone. Consists of lower part made up of alternating impure dark-brown limestone and calcareous sandstone becoming more calcareous upward, and an upper part of mostly brownish-gray thick-bedded to massive limestone. Thickness 400 feet or more in Blanco County. Overlies Hickory sandstone member; underlies Lion Mountain sandstone member. Lower boundary, based on lithology, rises westward, crossing faunal zones until only about one-quarter as much of limestone is present in northwestern Gillespie County as in Blanco County; top boundary gradational but much more nearly at same time-horizon.

E. A. Frederickson, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 7, p. 1349, 1350–1351. Term Cap Mountain discarded in Oklahoma. Beds are considered to be dolomitic Honey Creek equivalents.

Named for Cap Mountain, Llano County.

Capote Mountain Tuff (in Vieja Group)

Tertiary: Southwestern Texas.

R. K. DeFord, 1958, Texas Jour. Sci., v. 10, no. 1, p. 13, 15 (fig. 3), 26–28. Name proposed for the section of tuff overlying Bracks rhyolite (new) and underlying Brite ignimbrite (new). Outcrop characteristically threefold; upper white- to pinkish-gray member nearly 1,300 feet thick; middle red siltstone layer 10 to 40 feet thick; and lower variegated tuff member, predominantly dusky brown to grayish red purple, more than 300 feet thick. Difficult to differentiate from underlying Chambers tuff (new) on the north and south where the Bracks rhyolite is absent.

R. K. DeFord and L. W. Bridges, 1959, Texas Jour. Sci., v. 11, no. 3, p. 289–291. Underlies Tarantula gravel (new).

Type section: On west face of Capote Mountain, Rim Rock country, Presidio County.

Capps Limestone Member (of Mineral Wells Formation)[1]

Capps Limestone (in Lone Camp Group)

Middle Pennsylvanian: Central Texas.

Original references: F. B. Plummer and R. C. Moore, 1921, Texas Univ. Bull. 2132, p. 96, 97; 1922, Jour. Geology, v. 30, p. 24, 35.

C. O. Nickell, 1938, Texas Univ. Bur. Econ. Geology Pub. 3801, p. 91, 92, 94, 95.

Member of Mineral Wells formation in report on Brazos River valley area. Member is lenticular deposit of small area and considerable variation in thickness. Overlies Ricker sandstone member.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 90–91. Rochelle conglomerate and Capps and Adams Branch limestones have been miscorrelated in their type localities in Colorado River district and Brazos River district; this fact should be borne in mind in using early literature. Rochelle conglomerate may be traced northward below Capps limestone.

M. G. Cheney and D. H. Eargle, 1951, Geologic map of Brown County, Texas (1:62,500): Texas Univ. Bur. Econ. Geology. Mapped as Capps limestone at top of Lone Camp group.

J. W. Shelton, 1958, Geol. Soc. America Bull., v. 69, no. 12, pt. 1, p. 1524. Strawn-Canyon boundary is drawn at top of Capps limestone in Colorado River valley.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 62, pl. 27. Capps limestone lentil, as used by Plummer and Moore (1921), extends across Brown County north of Colorado River, except where removed locally by channel erosion. Community of Early encompasses type locality. Unit has been classified as member of Mineral Wells formation, but for purposes of this report [Brown and Coleman Counties] term Mineral Wells formation is not used. In present report, Capps limestone lentil is at top of Strawn group, undifferentiated.

Named for Capps Farm, 3 miles east of Brownwood, Brown County.

Captain Creek Limestone Member[1] (of Stanton Limestone)

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

Original reference: N. D. Newell, 1935, Kansas Geol. Survey Bull. 21, pt. 1, p. 76–79.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 32–33. Thickness about 2 feet in Nebraska; 4½ feet in northwestern Missouri.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 80. Dark to bluish-gray granular or dense brittle limestone; massive or even bedded; locally upper few inches is a brecciated silicified mottled pink and gray bed. Thickness along Kansas River 4½ to 5½ feet; locally in Miami County, a little more than 10 feet; near Independence, Montgomery County, a limestone 55 feet thick has been assigned to this member. Underlies Eudora shale member; overlies Vilas shale.

Type locality: On Captain Creek 2 miles east of Eudora, in roadcut near SE cor. sec. 3, T. 13 S., R. 21 E., Douglas County, Kans.

Capulin Basalts

Recent: 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. 1021 (table 2), 1023, 1031, pl. 1; H. R. Stobbe, 1949, Geol. Soc. America Bull., v. 60, no. 6, p. 1057. Dark-gray to black vesicular to scoriaceous olivine basalts containing plagioclase, olivine, and magnetite, often with small plagioclase phenocrysts. Outcrops relatively fresh and unweathered, rarely etched into relief, and usually preserve the disorganized surface of flowing lava. Derivation of name and geographic distribution given.

Named after the cone and flows of Mount Capulin. Found in five localities within 25 miles of Mount Capulin, which are either at or near to Horseshoe Crater, Mount Marcy, Twin Craters (south cone), and Van Cleve, Union, and Colfax Counties.

Capulin Mountain Basalt

Late Cenozoic: Northeastern New Mexico.

Brewster Baldwin and W. R. Muehlberger, 1959, New Mexico Bur. Mines Mineral Resources Bull. 63, p. 118 (fig. 18), 129, 136 (table 4). Medium dark gray to dark gray, porphyritic, and vesicular, with phenocrysts totaling about 10 percent of rock. Mentioned in discussion of Capulin basalts in Des Moines quadrangle [most of discussion refers to basalts from Capulin Mountain].

Capulin Mountain is in southwestern corner of Des Moines quadrangle, Union County.

Caraba facies (of Caimito Formation)

Oligocene, upper, to Miocene, lower: Panamá Canal Zone.

S. M. Jones, 1950, Geol. Soc. America Bull., v. 61, no. 9, p. 901. Facies presumably of parts of the middle and upper members of the Caimito. Where exposed at Río Caraba consists of a thick massive very sparsely jointed sandstone-conglomerate-breccia overlain by a thick section of thin-bedded limestone and limy fine-grained sandstone. The limestone overlying the facies has fossil assemblage characteristic of the Caimito formation. If facies is later demonstrated to be a mappable unit, it should be given formational status, although it is included in Caimito formation on plate 2 (geol. map).

Typically exposed along the Río Caraba southwest of Gamboa and in gullies along south bank of Chagres Crossing Reach due south of Canal Beacons 29 and 30.

†Carbon Group[1]

Tertiary: Wyoming.

Original reference: L. Lesquereux, 1876, U.S. Geol. Survey Terr. Bull. 5, 2d ser., p. 244–248.

Carbonado 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, 67. Lowest formation of group in Carbon River area. Underlies Wilkeson formation. Thickness in Carbonado River Canyon 1,328 feet. Formations in Carbon Canyon have been folded into anticlines and synclines with a general northwesterly trend.

Name derived from town of Carbonado, Pierce County.

Carbonate Hill Limestone (in Bisbee Group)

Lower Cretaceous: Southwestern New Mexico.

Elliot Gillerman, 1958, New Mexico Bur. Mines Mineral Resources Bull. 57, p. 47–50, table 1, pl. 1. Consists largely of thin-bedded coarse- to medium-grained dark-gray sandy calcarenite which weathers brown or gray. Thin conglomeratic beds of small subangular mostly limestone pebbles occur in lower part of formation. In most areas, base of formation marked by prominent bed of brown-weathering limestone containing abundance of large oyster shells. Similar beds, 8 feet to 10 feet thick, are found throughout formation. Thickness 113 feet on northeast side of McGhee Peak; elsewhere a close approximation to average thickness is 200 feet. Conformable with both the underlying McGhee Peak formation (new) and the overlying Still Ridge formation (new).

Named from exposures in vicinity of the Carbonate Hill (McGhee) mine, on east side of Peloncillo Range in sec. 34, T. 24 S., R. 21 W. No complete section could be measured around mine. Section studies and measured in detail west of mine on upper slopes of McGhee Peak. Four other exposures in the range. Peloncillo Mountains, Hidalgo County.

Carbon Butte shales (in Kwaguntan series)

Precambrian: Northern Arizona.

Charles Keyes, 1938, Pan.-Am. Geologist, v. 70, no. 2, p. 107 (chart), 113. Comprises black shales 1,000 feet thick. Underlie Echo limestone (new); overlie Solitude limestone (new).

Forms most of the height of Carbon Butte, a prominent remnantal butte, on east side of Chuar Valley; Grand Canyon region.

Carbondale Formation[1] (in Kewanee Group)

Carbondale Group

Middle Pennsylvanian: Illinois and western Kentucky.

Original reference: E. F. Lines, 1912, Illinois Geol. Survey Bull. 17, p. 74.

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. 5–6. Formation, in Pike County, Ind., includes Arthur limestone (new).

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 22, 26. In Illinois, includes Browning sandstone and Hanover limestone (both new).

J. M. Weller, 1940, Illinois Geol. Survey Rept. Inv. 71, p. 36 (footnote). Principal divisions of Pennsylvanian system in Illinois (Caseyville, Tradewater, Carbondale, and McLeansboro) considered formations in previous publications are, according to present usage of Illinois Geological Survey, groups.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 8 (fig. 1), 34–36, 46–48 (table 1), 65–66, pl. 1. Redefined as formation to include strata between base of Colchester (No. 2) coal and top of Danville (No. 7) coal. As originally defined Carbondale included strata from bottom of Murphysboro coal to top of Herrin (No. 6) coal. Murphysboro coal was then considered equivalent to No. 2 coal of western Illinois. Intent was to use No. 2 coal as base of Carbondale, and except at Murphysboro, it was so used. Dominantly gray shale with sandstone prominent locally. Commonly 225 to 300 feet thick; in parts of northern, western, and southwestern Illinois, thins to about 125 feet, locally even less; about 400 feet thick in part of southeastern Illinois. Overlies Spoon formation (new); underlies Modesto formation (new). Members in southern Illinois (ascending): Colchester (No. 2) coal, Shawneetown coal (new), Roodhouse coal, Summum (No. 4) coal, Hanover limestone, Harrisburg (No. 5) coal, St. David limestone, Briar Hill (No. 5A) coal, Vermilionville sandstone, Herrin (No. 6) coal, Brereton limestone, Jamestown coal, Conant limestone (new), Anvil Rock sandstone, Bankston Fork limestone, Allenby coal (new), Galum limestone, and Danville (No. 7) coal. In northern and western Illinois (ascending); Colchester (No. 2) coal, Francis Creek shale, Jake Creek sandstone, Lowell coal, Oak Grove limestone, Purington shale, Pleasantview sandstone, Kerton Creek coal, Summum (No. 4) coal, Hanover limestone, Covel conglomerate, Springfield (No. 5) coal, St. David limestone, Canton shale, Vermilionville sandstone, Big Creek shale, Herrin (No. 6) coal, Brereton limestone, Lawson shale (new), Pokeberry limestone, Copperas Creek sandstone, and Danville (No. 7) coal members. In eastern Illinois (ascending): Colchester (No. 2) coal, Shawneetown coal, Summum (No. 4) coal, Harrisburg (No. 5) coal, Herrin (No. 6) coal, and Danville (No. 7) coal members. Presentation of new rock-stratigraphic classification of Pennsylvanian in Illinois. Cyclical classification is retained but is entirely independent of rock-stratigraphic classification. Type section designated.

Type locality: Compiled from exposures in SE¼NE¼ sec. 1, T. 7 N., R. 4 E., Glasford quadrangle, and secs. 20 and 21, T. 8 N., R. 3 E., Canton quadrangle, Fulton County, Ill. Named for Carbondale, Jackson County.

Carbon Ridge Formation

Carbon Ridge Group

Permian: Central Nevada.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 2, 64–66. Proposed for rocks of Permian(?) age that occur south and east of Eureka. Probably included in "Upper Coal Measures" of Hague (1883, U.S. Geol. Survey 3d Ann. Rept.; 1892, U.S. Geol. Survey Mon. 20). Two facies distinguished: eastern, in Diamond Mountains; and western, which includes type area, south of Eureka. Both facies are unconformably overlain by Newark Canyon formation (new). In western facies, overlies Diamond Peak formation; in eastern facies, overlies Ely limestone. Composed largely of sandy or silty limestones that weather to shades of brown; dominantly thin bedded. Maximum thickness of 1,750 feet.

Grant Steele, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 91, 93 (chart 1), 102. Rank raised to group. In Carbon Ridge area, comprises (ascending) unnamed limy shales, argillaceous limestones, silts and mudstones, Riepe Spring limestone (new), Riepetown sandstone (new), and Pequop formation. Group retains same limits as recognized by Nolan and others (1956). Pennsylvanian-Permian (Missourian, Virgilian, Wolfcampian, Leonardian).

Grant Steele, 1960, Dissert. Abs., v. 20, no. 12, p. 4635. Discussion of stratigraphic interpretation of Pennsylvanian-Permian systems of eastern Great Basin. During Virgilian to earliest Wolfcampian time, following units were deposited: Strathearn, Jakes Creek (new), Carbon Ridge, Oquirrh, Ferguson Springs (new), and Pakoon.

W. B. Douglass, Jr., 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 181–183. Discussion of southern Butte Mountains area, White Pine County. Basal Permian rocks overlying disconformity at top of Ely limestone include some rocks which are Wolfcampian. These rocks, together with Leonardian and lower Wordian rocks constitute unit mapped as Carbon Ridge formation. Rocks of unit consist of monotonous alternating sequence of buff fine- to medium-grained limestones and a lesser amount of white to buff calcareous fine- to medium-grained sandstones. Thickness 997 feet. Conformably overlies Arcturus formation. On basis of fusulinid fauna, Knight (1956, Jour Paleontology, v. 30, no. 4) suggested that unit was equivalent to Arcturus formation as defined by Spencer (1917). Field evidence indicates that this is incorrect and that these rocks are more likely equivalent to "Rib Hill" formation of Ely district and also correlatable to west with Carbon Ridge formation at Eureka and Havallah formation at Battle Mountain.

Type area: On Carbon Ridge lying just north of mouth of Secret Canyon, vicinity of Eureka, Eureka County.

Carbon River [coal] Series[1]

Eocene: Western central Washington.

Original reference: B. Willis, 1886, U.S. 10th Census, v. 15, pls. 81, 84.

Puget Sound region.

Carcass Creek Glaciation or Drift

Pleistocene, upper: South-central Utah.

R. F. Flint and C. S. Denny, 1958, U.S. Geol. Survey Bull. 1061–D, p. 117 (fig. 25), 122–125, pl. 6. Distal half of Fish Creek-Grover drift lobe. Composed chiefly of till with morainal topography. Commonly has subparallel series of looped boulder-covered end moraines consisting of long laterals curving into incomplete nested terminals. Laterals approximate 50 feet in height in upstream segments and gradually become lower in downstream direction, curving into terminal ridges no more than 10 or 15 feet high. Successive moraine ridges separated by narrow swales floored with sandy alluvium and colluvium. Drift contains little outwash. Drift of Carcass Creek glaciation constitutes parent material of soils and caliche. This fact is compatible with but does not support hypothesis that this glaciation is probable correlative of Bull Lake stage in Rocky Mountains.

Mapped on flanks of Boulder Mountain, including the upper course of Carcass Creek on northeast flank of Boulder Mountain, near Grover, Wayne, and Garfield Counties.

Cardenas lava series

Precambrian: Northern Arizona.

Charles Keyes, 1938, Pan-Am. Geologist, v. 70, no. 2, p. 107 (chart), 109, 110–111. Sequence of eight lava-flows, being 100 to 250 feet thick, and separated from one another by a few feet of sandstone, 1 to 15 feet, in most instances. Total thickness 1,000 feet. Between sandstone sections of Grand Canyon series below and Chuaran series above. Marked erosional unconformities at top and bottom. Limited areal extent; lavas laterally dwindle away in all directions allowing the two unconformity planes to merge into one.

Name taken from Cardenas Butte at the base of which the full sequence is well exposed, in westward bend of Colorado River below mouth of Little Colorado River, Grand Canyon region.

Cardens Bluff Shale Member (of Hampton Formation)

Lower Cambrian: Northeastern Tennessee.

P. B. King and H. W. Ferguson, 1960, U.S. Geol. Survey Prof. Paper 311, p. 28 (table), 41, pls. 1, 18. Dominantly clay shale, darker than usual shale of formation; on divides, weathers to bright orange-rusty chips. In gorges of Doe and Watauga Rivers through Iron Mountains, bedding in shale is crossed by well-marked slaty cleavage. Thickness 100 to 200 feet. Basal shale of formation. Member loses characteristic features northeastward, either by pinching out between sandstone layers or by passing into interbedded sandstone and shale.

Named for Cardens Bluff on Watauga River below Watauga Dam, Carter County. Along crest of Iron Mountains, member forms well-defined strike valley that continues northeastward as far as U.S. Highway 21, between Shady Valley and Mountain City.

Cardiff Conglomerate[1]

Ordovician(?): Maryland, Pennsylvania, and Virginia.

Original reference: E. B. Mathers, Am. Jour. Sci., 4th ser., v. 17, p. 143.

G. W. Stose and A. I. Jonas, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. C–67, p. 95–96, 106; A. J. Stose and G. W. Stose, 1944, U.S. Geol.

Survey Prof. Paper 204, p. 50. Described in York County, Pa., where it underlies Peach Bottom slate and forms a narrow band between the slate and the Peters Creek schist on the flanks of a hill area of slate locally called Slate Ridge that extends from Susquehanna River southwestward 4 miles to Maryland line. Unit is closely folded. Ordovician(?). Removed from Glenarm series.

Norman Herz, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 980. In discussion of Baltimore gabbro complex, Cardiff conglomerate is included in Glenarm series, age of which is considered as probably early Paleozoic.

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

Present in strongly marked synclinal basin with its greatest development near Cardiff, Harford County, Md.

Cardiff Shale[1]

Cardiff Shale Member (of Marcellus Shale)

Middle Devonian: Western to east-central New York and eastern Pennsylvania.

Original reference: J. M. Clarke and D. D. Luther, 1904, New York State Mus. Bull. 63, p. 16.

Bradford Willard, 1937, Am. Jour. Sci., 5th, v. 33, no. 196, p. 276 (table 2). Table of Hamilton correlations in Maryland, Pennsylvania, and New York shows Cardiff shale member of Marcellus formation present in eastern Pennsylvania and central New York. At top of formation; overlies Chittenango member.

G. H. Chadwick, 1944, New York State Mus. Bull. 336, p. 104 [1946]. Discussion of Catskill and Kaaterskill quadrangles. Mount Marion beds are the Hamilton beds of former writers, but they are now known to represent but a part of Hamilton group and to belong to its lowest or Marcellus division. They seem to correspond roughly with Cardiff or upper Marcellus of central New York.

Well exposed in vicinity of village of Cardiff, Onondaga County.

Cardigan Gneiss

Precambrian(?): Southwestern Arizona.

James Gilluly, 1937, Arizona Bur. Mines Bull. 141, Geol. Ser. 9, p. 14–20; 1946, U.S. Geol. Survey Prof. Paper 209, p. 9, 10–15 [1947]. Includes rocks of many varieties, ranging in color from dark brownish gray through greenish gray to very light silvery gray and in texture from almost massive or crudely gneissic to thoroughly schistose. Commonest variety is banded, irregularly foliated rock, dark- to medium-gray on fresh fracture, with commonly a slight greenish cast caused by chlorite. On weathering, rocks become brown or dark brownish gray. Oldest formation in Ajo quadrangle, and serves as basement upon which the lavas and sedimentary rocks were deposited and as country rock for the intrusive masses. Intruded by Chico Shunie quartz monzonite and Cornelia quartz monzonite (both new); separated by faults from Concentrator volcanics (new).

Principal area of outcrop extends from Gibson Arroyo and the Cardigan prospect, from which formation is named, westward along lower southern slopes of Cardigan Peak and occupies most of the range of hills between Copper Canyon and Chico Shunie Arroyo. Exposed over about 8 square miles of quadrangle.

Careaga Sand or Sandstone

Careaga Formation

Pliocene, upper: Southern California.

C. R. Canfield, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 1, p. 54, Careaga formation, an unpublished name proposed by some field geologists for a mappable yellow sand unit which occurs in Santa Maria district, section exposed at Schumann Cut in Casmalia Hills. Correlates with an upper sand unit in the Foxen called the fine sand member.

S. G. Wissler and F. E. Dreyer, 1943, California Div. Mines Bull. 118, pt. 2, p. 235 [preprint 1941]. Careaga formation (Canfield's Foxen gravel and Foxen fine sand member) consists of upper member of from 20 to 70 feet of unfossiliferous bluish-gray gravels and lower member of from 110 to 500 feet of fine-grained fossiliferous sand. In type area, separated from underlying Foxen by slight angular unconformity.

W. P. Woodring, M. N. Bramlette, and K. E. Lohman, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 10, p. 1340 (table 10), 1355–1358. Described as Careaga sandstone. Subdivided into lower fine-grained sandstone unit, designated Cebada fine-grained member, and upper coarse-grained sand and conglomerate unit, the Graciosa coarse-grained member. Thickness 50 to 1,425 feet; greatest range is in Cebada member, which is absent in places and has a maximum thickness of 1,000 feet. Conformably underlies Paso Robles formation; gradationally overlies Foxen mudstone; in some areas, discordantly overlies lower part of Sisquoc or upper member of Monterey. Type region designated.

G. F. Worts, 1951, U.S. Geol. Survey Water-Supply Paper 1000, p. 27. Discussed as Careaga sand. In most water wells, the Careaga is logged as sand—rarely as sandstone; induration is apparently a surface feature and does not extend to any appreciable depth; therefore, Careaga sand is used here rather than sandstone.

Type region: North flank of Purisima Hills south of Careaga Station on the now abandoned Pacific Coast Railroad, Santa Barbara County.

Caribbean Limestone[1]

Pliocene: Panamá.

Original reference: D. F. MacDonald, 1913, Geol. Soc. America Bull., v. 24, p. 710.

[T. F. Thompson], 1943, Panama Canal Spec. Eng. Div., 3d Locks Proj., pt. 2, chap. 3, p. 21. Names Toro limestone and Caribbean limestone have been used to describe deposits of shell breccia or cemented coquina that overlies Gatun sandstone in region between Limon Bay and Chagres River. Formation [Toro] has been assigned to upper Miocene.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 329. Informal name for limestone in Canal Zone later named Toro limestone.

Between Limon Bay and Chagres River, C.Z.

Cariblanco 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. 147–149. Predominantly thick coarse conglomerates separated by sandstones and siltstones. Limestone present at three horizons: lenticular limestone containing volcanic rock fragments is interbedded with coarse sandstone near top of the lower massive conglomerate; petroliferous limestone concretions lie in volcanic sandstone in upper part of formation; and thick lenses of silty limestone are interbedded with volcanic sandstone and siltstone near top of formation. Layer of tuff composed largely of pink plagioclase crystals lies near middle of formation. Thickness in type area about 3,000 feet. In northeastern Puerto Rico, strata here correlated with the Cariblanco may be as thick as 8,000 feet. Increase in thickness toward northeast appears to be largely result of lateral interfingering of the Cariblanco with strata believed to be equivalent to Coamo formation (new). Unconformably(?) overlies Robles formation (new); conformably underlies Coamo formation. Name credited to Lynn Glover (in press).

H. L. Berryhill, Jr., and Lynn Glover 3d, U.S. Geol. Survey Misc. Geol. Inv. Map I–319. Basal 495 feet of formation extends eastward from Coamo quadrangle into westernmost part of Cayey quadrangle and crops out as massive, stratified conglomerate along upper part of steep ridge west of Vertedero where it is in a downfaulted block. Northwest of Vertedero, the conglomerate is truncated by a fault and lies in juxtaposition with Las Tetas lava member of Robles formation. Along east side of ridge west of Vertedero, conglomerate is in deposition contact with underlying siltstone of Colloa member (new) of Robles formation.

Named for outcrops along northeast-trending ridge which contains prominent peak known as Cariblanco, Coamo quadrangle.

†Caribou Formation[1]

Mississippian: Northern California.

Original reference: J. S. Diller, 1892, U.S. Geol. Survey Geol. Atlas, Folio 15 (prelim. proof sheet ed.).

Northwest of Caribou Bridge, Plumas County, in southeast part of Lassen Peak quadrangle.

Caribou Hills Glaciation

Pleistocene: Central southern Alaska.

D. B. Krinsley *in* T. L. Péwé and others, 1953, U.S. Geol. Survey Circ. 289, p. 5, 13 (table 1). Southwest part of Kenai Peninsula was glaciated three or more times during Quaternary period. Caribou Hills, the oldest recognized glaciation, preceded Swan Lake glaciation. Till exposed near heads of gullies in high ridges of the Caribou Hills. Series of successively lower marginal channels with linear lakes, lateral moraines, kame terraces on the Hills above altitude of 2,000 feet is record of several retreatal phases of this glaciation.

Found in highest parts and on slopes of Caribou Hills, southwest of Kenai Peninsula, Cook Inlet area.

Carimona Member (of Decorah Formation)

Carimona Member (of Platteville Formation)

Middle Ordovician: Southeastern Minnesota.

M. P. Weiss, 1955, Jour. Paleontology, v. 29, no. 5, p. 759–763. Proposed for the few feet of limestone and interbedded limestone and shale at top of the Platteville and underlying green shales of Decorah formation. Limestone beds are pale yellowish brown, very fine and fine grained, and medium bedded and have smooth to broadly rippled surfaces. Limestones are separated by beds of shale that increase in thickness from bottom to top of unit. Shales are yellowish brown to olive, calcareous, fissile, and poorly fossiliferous. Near base of member, a thin unfossiliferous chocolate-colored shale is overlain by a bed of bentonite 2 to 4 inches thick. Across Fillmore County, Minn., member thickens regularly northwestward from 3 to 6 feet and extends without much increase to the Twin Cities; thins to a few inches in southwestern Wisconsin where it underlies Spechts Ferry member of the Decorah. Where typically developed, overlies McGregor member; contact is placed below a thin yellowish-brown or chocolate-colored calcareous unfossiliferous fucoidal shale. Toward the southeast, this thin shale is separated from the bentonite by less than an inch of limestone, but, in type area and toward the northwest, two medium beds of limestone, separated by thin shale, intervene between the fucoidal shale, and the bentonite member extends upward to include highest bed of Carimona-type limestone and includes a few thin beds of greenish Decorah-type shale. The Carimona occupies same stratigraphic interval as Quimbys Mill member, but the two are lithologically distinct and not known to overlap.

A. F. Agnew, 1956. Geol. Soc. America Guidebook for Field Trips Minneapolis Mtg., Field Trip 2, p. 49–50. Reallocated to member status in Decorah formation for following reasons: Carimona lithology is similar to that of limestone bands in Spechts Ferry member of Decorah; Carimona and Spechts Ferry wedge out eastward, and Guttenberg member thins eastward, whereas Quimbys Mill member of Platteville wedges out to west and McGregor member of Platteville thins westward; and there is a disconformity at top of Quimbys Mill member.

M. P. Weiss, 1957, Geol. Soc. America Bull., v. 68, no. 8, p. 1032–1033. Carimona member of Platteville thins southeastward into Iowa, and at McGregor is only a few inches thick, including bentonitic limy shale that represents the Carimona bentonite; in this area, where the Spechts Ferry is a recognizable rock unit, the Carimona directly underlies it. A bentonite seam lies wholly within or underneath the Carimona member and about 4½ feet (in Fillmore County) below a bentonite in shale at base of Decorah. These bentonite beds converge southeastward and diverge northwestward; the bed in the Carimona is that one in Minnesota that has been mistakenly correlated with the Spechts Ferry bentonite in Iowa.

Typically developed in central Fillmore County, Minn. Name derived from hamlet of Carimona, 4½ miles west of Preston and in the S½ sec. 4, T. 102 N., R. 11 W.

Carl Sandstone Member (of Shenango Formation)

Mississippian (middle Meramec or younger): Northwestern Pennsylvania.

P. A. Dickey, R. E. Sherrill, and L. S. Matteson, 1943, Pennsylvania Geol. Survey, 4th ser., Bull. M–25, p. 15–16. Shenango formation in Oil City quadrangle contains three sandstones (descending): "C", or Carl; medial, or "B"; and lower, or "A". Thickness 51 feet near Carl; basal 6 feet is yellowish gray, coarse grained, and very massive, with lenticular clay nodules, and apparently disconformable with underlying shale; upper 45 feet is gray to greenish-gray and golden-brown medium- to coarse-grained sandstone with local crossbedding. Along Allegheny River in northern part of quadrangle, sandstone becomes progressively less massive, more shaly, and more poorly bedded eastward across quadrangle. Red and green shale and sandstone invade horizon of upper part of Carl at Oil City and eastward along river; at Smoky Hill, 2½ miles east of quadrangle, these continental red and green beds are prominently developed throughout sandstone. Thickness in Franklin quadrangle 30 to 50 feet; top lies about 300 feet above Corry sandstone. A disconformity may separate the Carl from underlying shale; if this is definitely established, the Carl should probably be included with overlying Patton formation.

Named for exposures at Carl, Venango County.

Carlile Shale (in Colorado Group)[1]

Carlile Shale Member (of Cody Shale, Colorado Shale, or Mancos Shale)

Carlile Formation (in Benton Group)

Upper Cretaceous: Eastern Colorado, northwestern Iowa, western Kansas, southeastern Montana, western Nebraska, northeastern New Mexico, South Dakota, and eastern Wyoming.

Original reference: G. K. Gilbert, 1896, U.S. Geol. Survey 17th Ann. Rept., pt. 2, p. 565.

W. W. Rubey and N. W. Bass, 1925, Kansas Geol. Survey Bull. 10, p. 16, 40. Carlile shale, in north-central Kansas, comprises Fairport chalky member (new) in basal part and Blue Hill shale member above. Overlies Greenhorn limestone.

W. W. Rubey, 1930, U.S. Geol. Survey Prof. Paper 165–A, p. 4 (table). Carlile shale, in Black Hills region, comprises unnamed lower member, 75 to 125 feet thick, and Turner sandy member (new), 150 to 200 feet thick. Overlies Greenhorn formation; underlies Sage Breaks shale member (new) of Niobrara formation.

H. D. Thomas, 1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 9, p. 1189–1197. Upper Cretaceous shale which has been called Carlile in Laramie basin, Wyoming, overlies Frontier formation and is, in turn, overlain by beds of the Niobrara. Fauna of upper part of Frontier is of same age as that of upper type Carlile of Colorado, whereas fauna of the "Carlile" of Laramie basin is of Niobrara age. Believed that use of name Carlile should be discontinued in Laramie basin and that name Niobrara should be extended downward to embrace beds erroneously called Carlile. This basal Niobrara shale is correlated with Sage Breaks shale member of the Niobrara of the Black Hills, and name Sage Breaks is here substituted for abandoned name Carlile.

C. H. Dane, W. G. Pierce, and J. B. Reeside, Jr., 1937, U.S. Geol. Survey Prof. Paper 186–K, p. 214–220. Carlile shale in eastern Colorado comprises (ascending) Fairport chalky shale, Blue Hill shale, and Codell sandstone members. Overlies Greenhorn limestone; underlies Niobrara formation.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 15 (fig. 7), 17. Formation comprises (ascending) Fairport shale, Blue Hill shale, and Codell sandstone members. Combined thickness of Carlile in Nebraska is about 150 feet in the east, 250 feet in the southwest, and 400 to 500 feet in the northwest. Overlies Greenhorn limestone; underlies Niobrara chalk. Colorado group.

C. H. Rankin, 1944, New Mexico Bur. Mines Mineral Resources Bull. 20, p. 7, 12, measured sections. Contains Juana Lopez sandstone member (new) near top in northern New Mexico.

P. C. Petsch, 1946, South Dakota Geol. Survey Rept. Inv. 53, p. 17 (fig. 5), 43–47. Discussion of geology of Missouri Valley in South Dakota. Text refers to Benton group as comprising Graneros shale, Greenhorn limestone, and Carlile shale. Outcrop of Carlile present between Westfield and

Sioux City along east bluffs of Big Sioux River in Plymouth and Woodbury Counties, Iowa.

C. H. Dane, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 78. Classed as member of Mancos shale in Rio Arriba County, N. Mex. Contains two subdivisions in this area. Lower, about 200 feet thick, consists largely of dark to black shale containing in basal 50 to 60 feet a group of six bentonitic clay beds. Upper, chiefly dark to black shale, weathering light brownish gray with numerous beds of hard dark-colored platy sandy limestone or calcareous sandstone. Estimated thickness about 600 feet in vicinity of El Vado. Overlies Greenhorn limestone member; underlies Niobrara calcareous shale member. Upper Cretaceous.

P. W. Richards and C. P. Rogers, Jr., 1951, U.S. Geol. Survey Oil and Gas Inv. Map OM–111. Report discusses Hardin area, Big Horn and Yellowstone Counties, Mont. Carlile classified as member of Cody shale. Underlies Niobrara shale member; overlies Greenhorn calcareous member. Thickness 280 feet.

Keith Young, 1951, Jour. Paleontology, v. 25, no. 1, p. 35–68. Suggested that term Carlile shale be discontinued in southern Montana and term Frontier formation be redefined to include all rocks between top of Mowry shale and base of Niobrara formation.

W. A. Cobban, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 10, p. 2187–2192, 2197 (fig. 2). Discussion of Colorado shale of central and northwestern Montana and equivalent rocks on north flank of Black Hills. Carlile shale in Black Hills region is 550 to 650 feet thick. Divisible into a basal unnamed dark-gray shale member 75 to 155 feet thick; Turner sandy member, 185 to 260 feet thick; and Sage Breaks member, 195 to 305 feet thick. Overlies Greenhorn formation; underlies Niobrara formation.

G. O. Bachman, 1953, U.S. Geol. Survey Oil and Gas Inv. Map OM–137. Benton formation in northwestern Mora County, N. Mex., is represented by equivalents of Graneros shale, Greenhorn limestone, and Carlile shale.

R. B. Johnson and J. G. Stephens, 1954, U.S. Geol. Survey Oil and Gas Inv. Map OM–146. Report covers La Veta area, Huerfano County, Colo. Carlile shale of Colorado group, consists of a shale unit, about 225 feet thick, and overlying Codell sandstone member, 5 to 10 feet thick. Overlies Greenhorn limestone; underlies Fort Hays limestone member of Niobrara formation.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. Carlile shale of Colorado group, comprises (ascending) Fairport chalk, Blue Hill shale, and Codell sandstone members. Overlies Greenhorn limestone; underlies Fort Hays limestone member of Niobrara chalk. Upper Cretaceous.

W. J. Mapel, 1959, U.S. Geol. Survey Bull. 1078, p. 48, 55, pls. Described in Buffalo-Lake De Smet area, Wyoming, where it is classified as member of Cody shale. Thickness about 156 feet. Overlies Greenhorn calcareous member; underlies Niobrara shale member.

U.S. Geological Survey currently classifies the Carlile as a member of the Colorado Shale in Winnett-Mosby area, Montana.

Named for Carlile Spring and Carlile Station, 21 miles west of Pueblo, Colo.

Carlim Limestone[1]

Middle Ordovician: Central Pennsylvania.

Original reference: C. Butts, 1918, Am. Jour. Sci., 4th, v. 46, p. 526, 533, 537.

R. M. Field, 1919, Am. Jour. Sci., 4th, v. 48, p. 414–417. Underlies Valentine formation (new).

Charles Butts, F. M. Swartz, and Bradford Willard, 1939, Pennsylvania Geol. Survey, 4th ser., Topog. and Geol. Atlas 96, p. 18–20, pl. 1. Underlies Bellefonte dolomite; overlies Lowville limestone. Chazy group.

G. M. Kay, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1969. "Carlim group" includes Hatter limestone (new) above and Loysburg formation, with Clover member, below. Chazyan (?) series.

G. M. Kay, 1943, Econ. Geology, v. 38, no. 3, p. 195. Terms Carlim, Lemont, and "Lowville" have been applied to different units at various localities. Carlim limestone included Clover limestone and Hatter formation in Tyrone district, the overlying Benner and much of the Nealmont being referred to the "Lowville"; in Bellefonte district, the "Carlim" included beds from the Clover to the lower Valley View, the upper part of that member and the Valentine being classed as "Lowville" and the latter included much of the Nealmont in other sections. The Lemont member of the "Carlim" in the Tyrone district is Hostler member of Hatter formation; it is the part of Valley View limestone between metabentonites E and D at Bellefonte and a part of the Nealmont at type locality at Lemont. Confusion developed principally from misidentification of, and misunderstanding of, ranges of species of *Maclurites*, *Tetradium*, and *Cryptophragmus*.

G. M. Kay, 1944, Jour. Geology, v. 52, no. 1, p. 20. Carlim limestone is the upper Loysburg plus the Hatter in its type locality is older than the Brenner formation that underlies Valley View member of Curtin limestone. Type Lemont limestone is equivalent to most of Nealmont limestone that overlies Valentine member of Curtin limestone. Type section of Lowville is in New York; it is preferable that a local name be applied in Pennsylvania, inasmuch as precise correlation is uncertain.

Charles Butts, 1945, U.S. Geol. Survey Geol. Atlas, Folio 227. Described in Huntingdon and Hollidaysburg quadrangles where it is 100 to 200 feet thick. Comprises lower unnamed member and Lemont limestone member. Overlies Bellefonte dolomite; hiatus. Underlies Lowville limestone; hiatus. Lower Ordovician.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 51. Published lists of fossils from Carlim limestone and Butts' collection in National Museum indicate that the Carlim is not Chazyan. In view of confusion, it seems best to drop Carlim in favor of Kay's terms Loysburg and Hatter.

Named for Carlim, 18 miles northeast of Williamstown, Blair County.

Carlin Formation

Pliocene, lower: Northeastern Nevada.

Jerome Regnier, 1960, Geol. Soc. America Bull., v. 71, no. 8, p. 1191, 1198, 1201, pl. 1. At least 600 feet of tuffaceous conglomerate and sandstone, rhyolitic and basaltic tuffs, diatomite shale, and limestone. Vertebrate fossils (late Clarendonian). Overlies Palisade Canyon rhyolite (new); sedimentary contact and angular unconformity. Also overlies Raine Ranch formation (new); underlies Hay Ranch formation (new).

Beds of formation fill Carlin basin. Good exposures are present 5 miles southwest of Carlin and in area along Susie Creek. Beds in most places show small faults and gentle folds.

Carlin Canyon Formation

Permian (Leonardian and Guadalupian?) : Northeastern Nevada.

T. G. Fails, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 10, p. 1693, 1695 (fig. 1), 1699–1702. Proposed for 1,225-foot sequence of tan quartzose calcisiltites and massive brown cherts of Leonardian and possibly Guadalupian age. Conformably overlies Beacon Flat formation (new) ; unconformably underlies Miocene-Pliocene Humboldt formation.

Type section: North side of Humboldt River at Carlin Canyon; top of section in NE¼NW¼NW¼ sec. 13, from which place section runs west along side of canyon for about 2,000 feet; jumps south along chert outcrop for about 3,400 feet to another westerly trending canyon, where section runs again west for about 1,200 feet at its base in prominent north-south valley in SE¼NW¼SE¼ sec. 14, T. 33 N., R. 53 E., Elko County.

Carlinville cyclothem[1] (in McLeansboro Group)

Carlinville cyclothem (in Modesto Formation)

Pennsylvanian: Southwestern Illinois.

Original reference: H. R. Wanless, 1931, Geol. Soc. America Bull., v. 42, p. 801–812.

J. R. Bell, 1952, Illinois Geol. Survey Bull. 77, p. 34–37. Maximum exposed thickness in Carlinville quadrangle 37 feet. Includes Carlinville limestone. In sequence, Carlinville cyclothem overlies Trivoli cyclothem and underlies Burroughs beds. Name Shoal Creek has been used for the cyclothem in belief that Carlinville limestone was correlative of Shoal Creek limestone. However, recent studies have shown that Carlinville limestone is not correlative of Shoal Creek.

H. R. Wanless, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 9, p. 1764 (table 2). Table shows Carlinville cyclothem between the Macoupin above and the Trivoli below.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 11. Type locality designated.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 54 (table 3), pl. 1. In Modesto formation (new). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type locality: SW¼SW¼ sec. 35, T. 10 N., R. 7 W., Macoupin County.

Carlinville Limestone (in McLeansboro Group)

Carlinville Limestone Member (of McLeansboro Formation)[1]

Carlinville Limestone Member (of Modesto Formation)

Middle and Upper Pennsylvanian: Southwestern and central western Illinois.

Original reference: A. H. Worthen, 1873, Illinois Geol. Survey, v. 5, p. 287, 290–301, 309.

J. R. Ball, 1952, Illinois Geol. Survey Bull. 77, p. 35–37. Carlinville limestone in McLeansboro group. In Carlinville quadrangle, generally consists of an upper massive limestone bed separated from a thinner lower one by dark shale. Locally there are three or four beds of limestone with intervening shale and then two or three of the limestone beds with intervening shale. Average total thickness 4½ feet. Included in Carlinville cyclothem.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 11. Type locality given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 37, 49 (table 1), 69, pl. 1. Reallocated to member status in Modesto formation (new). Stratigraphically below Burroughs limestone member and above Chapel (No. 8) coal member (new). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: SW¼SW¼ sec. 35, T. 10 N., R. 7 W., Macoupin County. Named for outcrops in vicinity of Carlinville.

Carlisle Center Formation

Carlisle Center facies (of Schoharie Formation)

Lower or Middle Devonian: East-central New York.

Winifred Goldring and R. H. Flower, 1944, Am. Jour. Sci., v. 242, no. 6, p. 340. Name proposed to replace preoccupied Sharon Springs formation of Goldring and Flower (1942).

R. E. Stevenson, 1949, New York State Sci. Service Rept. Inv. 3, p. 6. Buff to brown sandy shale, with top 6 inches being a greenish glauconitic sandy shale. Locally base is marked by glauconite bed. Thickness 5 to 45 feet. Overlies Esopus formation; underlies Springfield Center member (new) of Onondaga formation.

J. M. Berdan, 1950, New York State Water Power and Control Comm. Bull. GW–22, p. 10 (table 2). Overlies Esopus siltstone; underlies Schoharie grit. Thickness about 20 feet. Lower or Middle Devonian.

J. H. Johnsen, 1957, Dissert, Abs., v. 17, no. 10, p. 2247. Facies of Schoharie formation (redefined). Underlies Rickard facies (new). Exposed in road southwest of Little York and in cut on U.S. Route 20 about 2 miles west of Sharon Springs, just a little east of Schoharie County.

Carlos Sandstone Member[1] (of Wellborn Formation)

Eocene, upper: Southeastern Texas.

Original reference: B. C. Renick, 1936, Texas Univ. Bull. 3619, p. 31–32, table opposite p. 17.

W. L. Russell, 1955, Gulf Coast Assoc. Geol. Soc. Trans., v. 5, p. 168. Renick mapped Carlos sandstone extending west from Carlos about 3 miles. Fieldwork in this area shows that the sandstone extending west from Carlos is in the Manning at a stratigraphic position about 100 to 150 feet above top of Carlos. This sandstone is here named Goodbread. Type locality discussed.

D. H. Eargle, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 11, p. 2626 (table 1), 2628. Mentioned in discussion of Wellborn sandstone, but in this report the Wellborn is considered a formation, undivided.

Type locality: About one-half mile north of road intersection at Carlos, Grimes County.

Carlotta Formation (in Wildcat Group)

Pliocene to Pleistocene: Northwestern California.

B. A. Ogle, 1953, California Div. Mines Bull. 164, p. 13 (fig. 3), 35–39, 113–115, pls. 1, 2. Predominantly massive nonmarine conglomerate, sandstone, and carbonaceous claystone; some marine lenses; locally contains white volcanic ash beds. Thickness 500 to 3,000 feet. Uppermost formation of group; unconformably underlies Hookton formation (new); overlies Scotia Bluffs sandstone (new) with contact gradational.

Type section: Near town of Carlotta, Humboldt County. No complete well-exposed section exists. Principal distribution is in trough of major Eel River syncline and in western part of Fortuna quadrangle. Westward plunge of Cenozoic structures and the Little Salmon Creek fault limit eastward extent.

†Carlsbad Limestone[1] or Group

Permian (Guadalupe Series): Southeastern New Mexico and western Texas.

Original references: O. E. Meinzer, B. C. Renick, and Kirk Bryan, 1926, U.S. Geol. Survey Water-Supply Paper 580–A, p. 12–13, map; N. H. Darton, 1926, Geol. Soc. America Bull., v. 37, p. 419.

P. B. King, 1948, U.S. Geol. Survey Prof. Paper 215, p. 64–69, pls. 2, 3. Limestone described and mapped in southern Guadalupe Mountains, Tex.

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. 46. Group includes Seven Rivers, Yates, and Tansill formations.

P. T. Hayes, 1957, U.S. Geol. Survey Geol. Quad. Map GQ–98. Group described in Carlsbad Caverns East quadrangle where it comprises (ascending) Seven Rivers, Yates, and Tansill formations. Overlies Queen sandstone in northwest and toward southeast Goat Seep limestone. Underlies Salado formation; toward southeast interfingers with Capitan limestone.

Term Carlsbad Group abandoned; replaced by Artesia group (D. B. Tait and others, 1962, Am. Assoc. Petroleum Geologists Bull., v. 46, no. 4).

Named for exposures in vicinity of Carlsbad, N. Mex.

Carlton Granophyre[1] or Porphyry

Precambrian: Southwestern Oklahoma.

Original reference: M. G. Hoffman, 1930, Oklahoma Geol. Survey Bull. 52, p. 39–48. [Hoffman also used term Carlton porphyry.]

Composes nearly all of Carlton Mountains, Wichita Mountains area.

Carlton Limestone (in Sumner Group)[1]

Carlton Limestone Member (of Wellington Formation)

Permian: Southeastern Kansas.

Original reference: R. C. Moore, 1936, Kansas Geol. Soc. 10th Ann. Field Conf. Guidebook, p. 12.

W. A. Ver Wiebe, 1937, Wichita Municipal Univ. Bull., v. 12, no. 5, p. 6–8. Wellington formation is subdivided into 10 members. The Carlton is the fifth in the sequence (descending). Younger than Highland shale member (new); older than Chisholm Creek shale member (new).

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 41. Occurs a short distance below Hutchinson salt member. Contains fossil insects. Leonard series.

Identified southward from Walton, Harvey County, to Wichita, Sedgwick County.

Carlton Porphyry[1] or Rhyolite

Carlton Mountain Porphyry

Precambrian: Southwestern Oklahoma.

Original reference (Carlton porphyry): C. N. Gould, 1904, Oklahoma Geol. Survey Dept. Geology and Nat. History 3d Bienn. Rept., p. 18, 20.

J. A. Taff, 1904, U.S. Geol. Survey Prof. Paper 31, p. 64. Carlton Mountain porphyry mentioned in discussion of igneous rocks of Wichita Mountains. Plate 2 shows granite-porphyry mapped in vicinity of Carlton Mountains, Comanche County. [May be same as Carrollton Mountain porphyry, the geographic feature now being Carlton Mountains.]

R. E. Denison, 1959, (abs.) Oklahoma Acad. Sci. Proc. 1958, p. 124–125. The Carlton is a typically porphyritic and locally perlitic rhyolite with major phenocrysts of microperthite and minor phenocrysts of quartz, orthoclase, sodic plagioclase, and magnetite. Groundmass is micro- to cryptocrystalline and occasionally a micrographic intergrowth of quartz and feldspar. Believed to be surface equivalent of one of Wichita granites.

Occurs in area of Carlton Mountain[s], Comanche County.

Carlton Slate

Precambrian: Northeastern Minnesota.

A. E. Sandberg, 1938, Geol. Soc. America Bull., v. 49, no. 5, p. 797 (fig. 2), 798, 810. The Keweenawan at Duluth rests unconformably on Carlton slate.

G. M. Schwartz, 1942, Geol. Soc. America Bull., v. 53, no. 7, p. 1002–1003. Thomson formation has been referred to as Thomson slate, St. Louis slates, Cloquet slates, and Carlton slate, but Thomson slate has priority. It is here suggested that term Thomson formation replace Thomson slate.

Occurs in vicinity of Duluth.

Carltonian Formation[1]

Precambrian (Keweenawan): Northeastern Minnesota.

Original reference: A. C. Lawson, 1893, Minnesota Geol. Nat. History Survey Bull. 8, p. xxi, 22, 23.

Named for extensive exposures in Carlton Peak, northeast Minnesota.

†Carlyle Limestone[1]

Pennsylvanian: Eastern Kansas.

Original reference: E. Haworth and M. Z. Kirk, 1894, Kansas Univ. Quart., v. 2, p. 119.

Named for Carlyle, Allen County.

Carmack Limestone[1]

Lower Mississippian: Northeastern Mississippi.

Original reference: W. C. Morse, 1928, Jour. Geology, v. 36, p. 37.

W. C. Morse, 1930, Mississippi Geol. Survey Bull. 23, passim. Term Camack Creek used interchangeably with Carmack limestone.

W. C. Morse, 1936, Mississippi Geol. Survey Bull. 32, p. 16 (pl. 1). Generalized section of Paleozoic rocks shows Carmack limestone underlying Iuka formation and overlying Devonian Whetstone Branch formation.

Named for Carmack Creek, a tributary of Tennessee River north of Whetstone Branch, Tishomingo County.

Carmack Creek Limestone

See Carmack Limestone.

Carman Quartzite (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. Fine-sand quartzite and argillaceous fine sandstone with some limestones toward top. Thickness 60 to 135 feet. Underlies Youngman formation (new); overlies Beldens formation.

Marshall Kay and W. M. Cady, 1947, Science, v. 105, no. 2736, p. 601. Basal formation of Maquam group (new).

Marshall Kay, 1958, Am. Jour. Sci., v. 256, no. 2, p. 81. Has type section at head of Shipyard Bay in Highgate Springs area; it contains about 120 feet of thin- to medium-bedded quartz sandstone having a few argillaceous partings and includes some calcarenite beds in upper part. Section exposes contact with underlying Beldens calcitite but top is cut off by fault.

Type locality: Shipyard Bay, Highgate Springs, Franklin County, Vt.

Carmel Formation (in San Rafael Group)[1]

Middle and Upper Jurassic: Southern, central, southeastern and northeastern Utah, northeastern Arizona, western Colorado, and northwestern New Mexico.

Original references: J. Gilluly and J. B. Reeside, Jr., 1926, U.S. Geol. Survey Press Bull. 6064, March 30; 1928, U.S. Geol. Survey Prof. Paper 150–D, p. 73–76.

E. T. McKnight, 1940, U.S. Geol. Survey Bull. 908, p. 86–89, pls. In area between Green and Colorado Rivers, the Carmel is exposed in irregular belt from Green River near mouth of the San Rafael roughly eastward to Moab fault at the Dugway northeastward across Moab anticline and Courthouse syncline. Thickness 125 feet at north end of Tenmile Butte and 152 feet near Courthouse Spring. In contrast to its lithology in San Rafael Swell and other parts of southern Utah, the Carmel contains no limestone in area of this report. It is composed chiefly of pink to red to reddish-brown muddy sandstone with, locally, considerable gray to reddish sandy mudstone. The mudstone occurs in upper part of formation near the Green River, but eastward grades into reddish-brown muddy sandstone that forms top of Carmel at Courthouse Rock. In eastern part of area, light-colored beds are subordinate to red facies and appear chiefly in basal part of formation, which toward the Green River is entirely red. These light-colored beds toward the east are largely sandstone, in part limy, and are white, yellowish white, and dirty grayish. They are interbedded with red muddy sandstones, are discontinuous along outcrop, and commonly show lenslike thickening and thinning. Overlies Navajo sandstone; underlies Entrada sandstone, apparent conformity. Upper Jurassic.

H. E. Gregory, 1950, U.S. Geol. Survey Prof. Paper 220, p. 51 (table), 89, 92–94, strat. sections. Described in Zion Park region where it is 200 to 300 feet thick; underlies Entrada sandstone and unconformably overlies Navajo sandstone (Temple Cap member) of Glen Canyon group. Consists of bluish-gray limestone in resistant massive beds and soft shaly beds; some argillaceous and gypsiferous shale; marine fossils. A series of fluvial and eolian beds formerly included in the Carmel are here treated as Temple Cap member of Navajo.

H. J. Bissell, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 4, p. 597. In Strawberry Valley quadrangle, Utah, grades into Twin Creek limestone.

R. W. Imlay, 1952, Geol. Soc. America Bull., v. 63, no. 9, p. 963–964, chart 8C (columns 2–9). Formation not been accurately dated but probably corresponds to most of Middle and the earliest Upper Jurassic.

C. B. Hunt, Paul Averitt, and R. L. Miller, 1953, U.S. Geol. Survey Prof. Paper 228, p. 38 (table), 68–70, strat sections. Described in Henry Mountains region where it is 100 to 626 feet thick. Consists of thin-bedded red sandstone, shaly sandstone and shale, thin limestone, and, in northwestern part of area, thick beds of gypsum. Unconformably overlies Navajo sandstone; underlies Entrada sandstone.

J. H. Mackin, 1954, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–14. Extended into Iron Springs district, Utah, where it includes all the strata previously called Homestake limestone. Overlies Navajo sandstone; underlies Entrada sandstone.

J. W. Harshbarger, C. A. Repenning, and J. H. Irwin, 1957, U.S. Geol. Survey Prof. Paper 291, p. 3 (fig. 2), 33–35. Over most of Navajo country, Carmel consists of typically silty strata, but, in southwestern part of area, has different lithologic characteristics owing to introduction of locally derived sand. This variation of deposition continued during deposition of Entrada sandstone; hence, the two units are difficult to differentiate in this area. Thickness between 100 and 200 feet.

F. W. Cater, Jr., 1955, U.S. Geol. Survey Geol. Quad. Map GQ–64. Mapped in Horse Range Mesa quadrangle, Colorado, where it consists largely of red to buff nonresistant horizontally bedded siltstone, mudstone, and sandstone. Thickness 20 to 50 feet. Grades upward into Entrada sandstone; overlies Navajo sandstone.

Named for occurrence at Mount Carmel, Kane County, Utah.

Carmelo Series[1]

Upper Cretaceous: Western California.

Original reference: A. C. Lawson, 1893, California Univ. Pubs., Dept. Geol. Bull., v. 1, p. 1–59.

O. P. Jenkins, 1938, Geologic map of California (1:500,000): California Div. Mines, sheet 4. Mapped with Upper Cretaceous marine sediments.

Carmelo Bay region, southwest coast of San Mateo County.

†Carmen Formation

Miocene, lower: Eastern central Idaho.

A. L. Anderson, 1956, Idaho Bur. Mines and Geology Pamph. 106, p. 1, 16, 28–31, pl. 1. Consists for most part of moderately well-indurated thin-bedded fine-grained clastic rocks, mostly shales with considerable amount of intercalated sandstone and locally some conglomerate and lignite. Except for lignitic beds, rocks are light colored, mostly white or light gray. One conglomerate bed near base is some tens of feet thick. Distinguished from underlying Challis volcanics by absence of lava flows, ignimbrites, and other products of direct volcanic origin.

A. L. Anderson, 1959, Idaho Bur. Mines and Geology Pamph. 118, p. 21, 27. Preoccupied name Carmen replaced by Kirtley formation.

Named after settlement of Carmen. Excellent exposures above and below settlement and along Carmen Creek to east. Contained wholly within and forms floor and flanks of broad intermontane Salmon Basin, Lemhi County.

Carmichaels Formation[1]

Pleistocene (Illinoian) : Western Pennsylvania.

Original reference: M. R. Campbell, 1902, U.S. Geol. Survey Geol. Atlas, Folio 82.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C-26, p. 153-154, pl. 1. In Fayette County, deposits occur in abandoned meanders of Monongahela and Youghiogheny Rivers. Thickness 60 to 80 feet locally but more commonly thinner.

Named for exposures at Carmichaels, Green County.

Carnahan Bayou Member (of Fleming Formation)

Miocene: Central Louisiana.

H. N. Fisk, 1940, Louisiana Dept. Conserv. Geol. Bull. 18, p. 118 (fig. 26), 154-158, geol. map. Group of siltstones with intercalated sand lenses, local brackish-water clays, and thin tuffaceous beds. Thickness more than 125 feet. Underlies Dough Hills member (new) ; overlies Lena member (new).

Basal beds are typically exposed in roadcuts along U.S. Highway 71W, south of Lena, Rapides Parish. Name derived from Carnahan Bayou.

Carnahan Run Shale (in Conemaugh Formation)

Pennsylvanian: Western Pennsylvania.

J. J. Burke, 1958, Science, v. 128, no. 3319, p. 302. Calcareous marine shale, 1½ to 7 feet thick (5 feet at type locality) ; occurs 126 feet below Ames limestone, 13½ to 23½ feet above Woods Run limestone, and approximately 216 to 226 feet above Upper Freeport coal.

Type locality: About 0.7 mile north of North Vandergrift, Parks Township, Armstrong County.

Carnerada Conglomerate Member (of Marlife Shale)

Upper Cretaceous: Central California.

M. B. Payne, 1960, Soc. Econ. Paleontologists and Mineralogists, Pacific Sec. Guidebook Spring Field Trip, p. 5 (fig. 3), 6 (fig. 4), 7 (fig. 5), 13 (fig. 6). Red cobble conglomerate 0 to 2,200 feet thick. At base of Marlife shale (new). Overlies Ciervo shale (new). Name credited to D. W. Sutton (unpub. thesis).

Type locality: South Branch of Moreno Gulch, Fresno County. Name derived from Carnerada Canyon.

Carneros Sandstone Member[1] (of Temblor Formation)

Miocene, or Miocene, lower: Southern California.

Original reference: G. M. Cunningham and W. F. Barbat, 1932, Am. Assoc. Petroleum Geologists Bull., v. 16, no. 4, p. 419-421.

H. H. Heikkila and G. M. MacLeod, 1951, California Div. Mines Spec. Rept. 6, p. 4 (table 1), 5 (table 2), 9, pl. 1. Described in Bitterwater Creek area as commonly a hard medium- to fine-grained calcarenite tan to gray sandstone. Along axial trace of McDonald anticline, minimum exposed thickness is 1,250 feet; thickness at mouth of Cedar Canyon 123 feet; change in thickness probably due to rapid change in facies; sandstone pinches out as it crosses Bitterwater Creek northwestward. Conformably overlies Santos shale member; conformably underlies Media shale member.

Named for Carneros Creek, Kern County.

Carney Lake Complex

Precambrian: Northern Michigan.

S. B. Treves, 1960, Dissert. Abs., v. 20, no. 10, p. 4080. Chiefly lower Precambrian gneisses that contain inclusions of older rocks, and minor syenite, granodiorite dikes, and pegmatites, numerous middle Precambrian metadiabase dikes and some quartz-rich pegmatite veins; a few upper Precambrian diabase dikes.

Present in Dickinson County.

†Carolina Gneiss[1] or Series

Precambrian: Northwestern North Carolina, South Carolina, northern Georgia, eastern Tennessee, and western Virginia.

Original reference: A. Keith, 1901, U.S. Geol. Survey Geol. Atlas, Folio 70, p. 2.

G. W. Crickmay, 1936, Geol. Soc. America Bull., v. 47, no. 9, p. 1379. Carolina gneiss, or Carolina series, is made up largely of biotite gneiss and mica schist, with beds of kyanite schist, quartzite, and rarely marble. Ashland, Wedowee, and Canton formations of Alabama and Georgia are here regarded as part of Carolina series.

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 the 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. Names Carolina and Roan have lithologic but not stratigraphic value.

F. D. Eckelmann and J. L. Kulp, 1956, Am. Jour. Sci., v. 254, no. 5, p. 291, 314. Carolina gneiss includes all the various mica gneisses and mica schists in Spruce Pine district. Rocks are interlayered with those of the Roan gneiss, and the two types grade into each other along and across the strike. Roan-Carolina sequence (or complex) appears to be a single sedimentary unit with varying lithology, complicated by intense isoclinal folding and plastic deformation. Crosscutting relationship between the Cranberry gneiss or Henderson gneiss and the Roan-Carolina complex are entirely absent; the Cranberry and Henderson formations are in a consistent and conformable stratigraphic position below the Carolina-Roan complex as seen in Cranberry, Roan Mountain, and Mount Mitchell quadrangles.

Named for its occurrence on Piedmont Plateau in North and South Carolina.

Carolinas Limestone

Pliocene or Pleistocene: 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. 21–26, 31 [English translation in library of U.S. Geol. Survey, p. 20–25, 31–32]; 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, table 3. *Halimeda* and coralline limestone. Beds dip seaward at angle of about 20°. Underlies Mariana limestone. May be Plio-Pleistocene.

Occurs on southeast coast of Tinian Island.

Caroline Limestone

Pleistocene or early Holocene: Caroline Islands (Fais).

Risaburo Tayama, 1939, Correlation of the strata of the South Sea Islands: Geol. Soc. Japan Jour., v. 46, no. 549, p. 347 (correlation chart) [English translation in library of U.S. Geol. Survey]; 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 68, table 5 [English translation in library of U.S. Geol. Survey, p. 82]. Named on correlation chart. Coral reef limestone. Older than Fais limestone. Consists chiefly of Halimeda limestone, with lesser amounts of coral limestone. Plio-Pleistocene.

S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 26. About 3 meters thick. Twenty meters above sea level. Early Holocene.

Fais (Feys) Island, west Caroline Islands.

†Carolinian Bed[1]

Eocene: Eastern South Carolina and North Carolina.

Original reference: E. Ruffin, 1843, South Carolina Agric. Survey 1st Rept., p. 6–24.

Exposed on Ashley and Cooper Rivers and their branches, also on Santee River and its branches, and on the Savannah and its branches. Named for extensive development in Coastal Plain of South Carolina.

Carpenter Bed[1]

Upper Cretaceous (Gulf Series): Western Texas.

Original reference: J. A. Taff, 1891, Texas Geol. Survey 2d Ann. Rept., p. 733, 735.

Probably named for Carpenter Spring, east side of Eagle Mountain, El Paso County.

Carpenter Limestone Member (of Grayson Formation)

Upper Cretaceous: Southwestern Texas.

Elliot Gillerman, 1953, U.S. Geol. Survey Bull. 987, p. 11 (table 1), 27, 28, pls. 1, 8, 16. Consists of about 90 feet of nodular thin-bedded black limestone weathering blue gray and interbedded gray shales; fossiliferous. Underlies a 60-foot middle member informally referred to as the reef-limestone; conformably overlies Georgetown limestone, to which it is very similar in appearance.

Type locality: Carpenter Canyon at a point about 1 mile above Carpenter Wells, Hudspeth County.

Carpenter Creek Porphyry[1]

Post-Cretaceous(?) : Central Montana.

Original reference: L. V. Pirsson, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 3, p. 501.

U.S. Geological Survey currently designates the age of Carpenter Creek Porphyry as post-Cretaceous(?) on basis of study now in progress.

Named for occurrence above Carpenter Creek, Little Belt Mountains.

Carpinteria Formation[1]

Pleistocene, upper: Southern California.

Original reference: R. W. Chaney and H. L. Mason, 1934, Carnegie Inst. Washington Pub. 415, p. 48–52 [preprint 1932].

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 38, pl. 1. Late Pleistocene.

Probably named for Carpinteria, Santa Barbara County.

†Carquinez Series[1]

Eocene: Western California.

Original reference: A. C. Lawson, 1902, Science, new ser., v. 15, p. 416.

Carrasco limestone[1]

Upper Cambrian(?) : Southwestern New Mexico.

Original references: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 257–259; 1915, Conspectus of geologic formations of New Mexico: Des Moines, Robert Henderson, State Printer, p. 4, 5.

Well displayed back of Carrasco smelter property, near Silver City, Silver City region.

Carrigan black lands[1]

Pleistocene: Southwestern Arkansas.

Original reference: R. T. Hill, 1888, Arkansas Geol. Survey, v. 2, Ann. Rept. 1888.

Carrizo 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.

Present in eastern Union County.

†Carrizo Formation[1]

Miocene: Southern California.

Original reference: J. P. Smith, 1910, Jour. Geology, v. 18, no. 3, chart opposite p. 226.

Named for exposures in broad valley of Carrizo Creek, immediately north of Coyote Mountain, Imperial County.

Carrizo Sand (in Claiborne Group)[1]

Carrizo Formation (in Wilcox Group)

Eocene, middle: Southern and eastern Texas and western Louisiana.

Original reference: J. Owen, 1889, Texas Geol. and Min. Survey 1st Rept. Prog., p. 70, 73–74.

H. B. Stenzel, 1939, Texas Univ. Bur. Econ. Geology Pub. 3818, p. 20 (table), 60–65 [1938]. Sand (formation) described in Leon County, Tex., where it is about 60 feet thick. Underlies Newby glauconitic sand member (new) of Reklaw formation; overlies Sabinetown formation of Wilcox group.

G. E. Murray, Jr., and E. P. Thomas, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 1, p. 47 (fig. 1), 65–68, geol. map. In this report, Carrizo formation is considered uppermost formation in Wilcox group. Overlies Sabinetown formation; underlies Reklaw formation.

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 the 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 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 Reklaw, it would appear that the Bigford is not exact equivalent of the Reklaw, but is older and intervenes between the Carrizo and the Reklaw.

H. B. Stenzel, 1953, Texas Univ. Bur. Econ. Geology Pub. 5305, p. 10 (fig. 3), 14 (fig. 5), 19–34. Formation (sand) described in Henrys Chapel quadrangle where it is 27 to 104 feet thick and consists of lower cross-bedded part and upper shaly level-bedded part. Overlies Wilcox group, locally, Henrys Chapel ball clay lentil (new); underlies Newby glauconitic sand member of Reklaw formation.

Type exposure: In quarries about one-half mile west of Carrizo Springs, Dimmit County, Tex.

†Carrizo Creek Beds[1]

Miocene: Southern California.

Original reference: C. R. Orcutt, 1890, California State Mining Bur. 10th Ann. Rept., p. 915.

Crops out on Carrizo Creek, but can also be seen along west side of valley around Coyote Mountains at Yuba Buttes and at Superstition Mountain as well as at San Felipe Valley, west of Salton Sea, Imperial County, and at places north of San Gorgonio Pass, in Riverside County.

Carrizo Mountain Formation

Carrizo Mountain Group

Carrizo Mountain Schist[1]

Precambrian: Western Texas.

Original reference: W. H. von Streeruwitz, 1891, Texas Geol. Survey 2d Ann. Rept. 1890, p. 681–683.

P. B. King, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 144 (fig. 1), 145–147. Carrizo Mountain schist described in Van Horn region where it consists of a number of contrasting types of metamorphic rocks which can be mapped separately over wide areas. These rocks fall into two main groups, one of which appears to lie stratigraphically below the other; lower group is largely of igneous origin and upper group largely sedimentary origin. Schist is overthrust northward on succeeding Allamoore limestone (new).

P. B. King and P. T. Flawn, 1953, Texas Univ. Bur. Econ. Geology Pub. 5301, p. 20–24, pl. 2. Carrizo Mountain group used in this report. Described as a body of metamorphic rocks of great thickness which in individual areas can be subdivided into a variety of rock types, most of which are mappable as separate entities. Many of these entities are well defined sedimentary units a thousand or more feet thick, which would be formations in their own right in sequence less disturbed and more widely exposed. Unit does not correspond with other formations as these are commonly differentiated in Texas. Although it is impracticable to subdivide unit into named divisions, it deserves informal designation as a group in much same manner as metamorphic units in Alaska and Canada. U.S. Geological Survey prefers term formation. Term group is used in this report without prejudice as to whatever usage may be adopted in subsequent reports of U.S. Geological Survey.

Hugh Hay-Roe, 1957, Texas Univ. Bur. Econ. Geology Geol. Quad. Map 21. All Precambrian rocks in Wylie Mountains and vicinity are referred to Carrizo Mountain group. Unconformably underlies Powwow conglomerate.

Named for Carrizo Mountains, El Paso County.

Carrizozo Lava Flow

Recent: South-central New Mexico.

J. E. Allen, 1951, *in* Roswell Geol. Soc. Guidebook 5th Field Trip, p. [7, 9–11]. Lava flow or malpais in all probability was extruded within last 1,000 years from base of single crater near northern end of flow. Exhibits all features commonly associated with recent flows of basaltic composition, such as flow units, pressure ridges, collapsed lava tunnels, and kipukas or steptoes of older rocks surrounded as islands by lava. Other minor surface features are ropy lava (pahoehoe), spatter cones, grooved lava, squeezeups, vesicular lava, and banded lava. Flow is approximately 44 miles long, in places up to 5 miles wide, and has average thickness of about 70 feet. Very close to 1 cubic mile in volume.

Eastern edge of flow is encountered along U.S. Highway 380, 4.2 miles west of Carrizozo.

†Carrollton Limestone[1]

Mississippian: Northwestern Arkansas.

Original reference: H. S. Williams, 1900, Arkansas Geol. Survey Ann. Rept. 1892, v. 5, p. 334–337.

Exposed in cliff in ravine in Carrollton, Carroll County.

Carrollton Mountain Porphyry[1]

Precambrian: Southwestern Oklahoma.

Original reference: H. F. Bain, 1900, Geol. Soc. America Bull., v. 11, p. 135 (table), 136–137.

Bain's map shows Carrollton Mountains in eastern part of Wichita Mountains, Comanche County.

Carson Conglomerate

Tertiary, lower or middle: Central northern New Mexico.

Evan Just, 1937, New Mexico School Mines Bull. 13, p. 13 (table 1), 31, 48–49, pls. 1, 3. Characteristically coarse, containing many boulders over a foot in diameter. Usually well cemented and quite resistant to processes of denudation. Matrix is light gray and resembles concrete; cement is silica. Boulders, cobbles, and pebbles consist of rhyolite, trachyte, andesite, black chert, and quartzite. Overlaps Precambrian rocks of area.

R. H. Jahns, 1946, New Mexico Bur. Mines Mineral Resources Bull. 25, p. 25. Early or middle Tertiary. Best exposures cited.

Overlaps rocks of Precambrian age along western, northern, and northeastern borders of Petaca area, Rio Arriba County. Best exposed in vicinity of Las Tablas where beds form bold cliffs and benches along lower slopes of Tusas River valley.

Carson Lava[1]

Pleistocene: Southwestern Washington.

Original reference: I. A. Williams, 1916, Oregon Bur. Mines and Geol., Min. Res. Oregon, v. 2, no. 3, p. 95–96.

W. D. Lowry and E. M. Baldwin, 1952, Geol. Soc. America Bull., v. 63, no. 1, pl. 2. Age shown on chart as Pleistocene.

Extends from Carson Station to Wind River Canyon, Skamania County.

Carson Creek Formation[1]

Paleozoic or Mesozoic: Northern California.

Original reference: F. A. Moss, 1927, Eng. and Mining Jour., v. 124, p. 1010–1011.

O. P. Jenkins, 1943, California Div. Mines Bull. 118, pt. 4, p. 675. Local name for bedrock series. Paleozoic or Mesozoic.

Exposed west of Carson Hill, Calaveras County.

Carsonian series[1]

Quaternary: Nevada.

Original reference: C. R. Keyes, 1923, Pan.-Am. Geologist, v. 40, p. 52, 78.

Well exposed in the valleys of the Carson and Truckee Rivers in western Nevada.

Carsonville Granite

Precambrian: Southwestern Virginia.

A. J. Stose, 1942, (abs.) Am. Geophys. Union Trans., 23d Ann. Mtg., pt. 2, p. 342. 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. 34–37, pl. 1. Narrow belt of fine-grained pink felsitic granite that intrudes the Striped Rock granite along its northern and western borders; it is interbanded with a porphyritic biotite granite which has pink microcline phenocrysts and contains xenoliths of Saddle gneiss.

Named from village of Carsonville, 2 miles north of Baxter Ferry on New River. Well exposed on road near Carsonville, near Mountain View School to west, on Rock Creek, on Roaring Branch, on a tributary to Saddle Creek, and near head of Little Peach Bottom Creek. Occurs within areas of Comers granite gneiss and Grayson granodiorite gneiss.

Carters Limestone (in Stones River Group)

Carters Limestone Member (of Lowville Limestone)[1]

Middle Ordovician: Central Tennessee.

Original reference: J. M. Safford, 1869, Geology of Tennessee, p. 258–268.

Ray Bentall and J. B. Collins, 1945, Tennessee Div. Geology Oil and Gas Inv. Prelim. Chart 4, sheet 1. Rank raised to formation in Stones River group.

C. W. Wilson, 1949, Tennessee Div. Geology Bull. 56, p. 44–45. Names Tyrone and Lowville should not be used in central Tennessee; name Carters has priority over New York name, Lowville, and Kentucky name, Tyrone; name Carters limestone should be restored to formational rank and used as originally defined by Safford, that is, to include strata between overlying Hermitage formation and underlying Lebanon limestone. In central Tennessee, Carters limestone consists of upper thin-bedded unit and lower massive-bedded unit, which are referred to as Upper member and Lower member. The two members are separated by a bentonite bed, and Lower member contains two bentonite beds. Thickness of Lower member averages 50 feet; maximum thickness of Upper member 28 feet. Safford's "type locality" discussed in detail.

Named for exposures on Carters Creek, Maury County. Carters Creek arises from many several tributaries about 8 miles north of Columbia, Maury County, flows essentially southward, joining Rutherford Creek about 3½ miles north of Columbia.

†Carters Creek Limestone[1]

Middle Ordovician: Central Tennessee.

Original reference: J. M. Safford, 1869, Geology of Tennessee, p. 258–268.

Named for exposures on Carters Creek, Maury County.

†Cartersville Formation[1]

Lower Cambrian: Northwestern Georgia.

Original reference: H. K. Shearer, 1918, Georgia Geol. Survey Bull. 34, p. 48–49, 128–163.

T. L. Kesler, 1950, U.S. Geol. Survey Prof. Paper 224, p. 19. Abandoned. Shearer grouped together some parts of Conasauga and Rome formations in which metasiltstone is common and designated them Cartersville formation. It has been impossible to adhere to this grouping, because Shearer's contacts transgress the strike of the rocks and his formation includes carbonate rocks, calcareous metashale, and noncalcareous metashale which, as shown herein, are stratigraphically distinct.

Named for exposures in vicinity of Cartersville, Bartow County.

Cartersville Granite[1]

Precambrian: Central Virginia.

Original reference: A. I. Jonas, 1928, Virginia Geol. Survey, prelim. ed. of geol. map of Virginia.

Mapped at and around Cartersville, Cumberland County.

Carterville Formation[1]

Upper Mississippian: Southwestern Missouri.

Original reference: C. E. Siebenthal, 1907, U.S. Geol. Survey Geol. Atlas, Folio 148.

E. B. Branson, 1944, Missouri Univ. Studies, v. 19, no. 3, p. 268–270. Consists of shaly lumpy somewhat conglomeratic and in most places oolitic limestone, calcareous shale, light to dark argillaceous arenaceous shale. and shaly sandstone, massive unindurated sandstone, massive hard sandstone, and quartzite. Thickness ranges from a few inches up to 50 feet. Occupies depressions (apparently old sink holes) in Boone formation; in all occurrences surrounded by a rim of Boone limestone.

C. H. Behre, Jr., and A. V. Heyl, Jr., 1959, Deutsche Geol. Gesell. Zeitschr., v. 110, pt. 3, p. 517 (fig. 2). Chart shows formation, about 16 feet thick, overlying Short Creek member of Boone formation and underlying Cherokee shale.

Named for exposures west of Carterville, Jasper County.

Carthage Limestone[1]

Mississippian (Warsaw): Southwestern Missouri.

Original reference: J. A. Gallaher, 1898, Missouri Geol. Survey Bien. Rept., p. 30, 37, 38.

Named for exposures at Carthage, Jasper County.

Carthage Limestone (in Lisman Formation)

Carthage Limestone (in McLeansboro Formation)[1]

Pennsylvanian: Western Kentucky and southern Illinois.

Original references: D. D. Owen, 1856, Kentucky Geol. Survey, v. 1, p. 60, 61; 1857, Kentucky Geol. Survey, v. 3, p. 18.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 26). Shown on correlation chart as limestone in Lisman formation.

Named for Carthage Settlement (no longer in existence) on Ohio River, just above mouth of Wabash River, Union County, Ky.

Carthew Member (of Altyn Formation)

Precambrian (Belt Series): Southern Alberta, Canada, and western Montana.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc. America Bull., v. 48, no. 12, p. 1883–1884, fig. 2. Magnesian limestones, dolomites, quartzites, and intermediate rocks which grade upward into basal Appekunny formation. Colors range from blue gray through buff to brown and dark brownish red; bedding thin to thick. Red beds, especially, show thin laminae. Thickness estimated at 700 to 900 feet. Overlies Hell Roaring member (new).

Type locality: Eastern cliffs of Cameronian Mountain above Cameron Creek, Waterton Lakes Park, Alberta. Well exposed on eastern face of Bertha Mountain, on slopes between Vimy Peak and the Narrows of Waterton Lake, and on northern cliffs of Gable Mountain, Glacier National Park.

Cartwright Gravel

Pleistocene (pre-Wisconsin): Northwestern North Dakota and northeastern Montana.

A. D. Howard, 1958, Geol. Soc. America Bull., v. 69, no. 5, p. 578, pl. 1. Gravel which marks paths of streams across Missouri Plateau peneplain. Caps Cartwright bench along parts of major valleys characterized by distinctive brown, water-worn pebbles.

A. D. Howard, 1960, U.S. Geol. Survey Prof. Paper 326, p. 19–21, pl. 1. Gravel and interbedded sand on Missouri Plateau peneplain. Thickness 35 to 40 feet at Cartwright locality; regional average thickness about 30 feet. Older than Crane Creek gravel; younger than Flaxville gravel. Pre-Wisconsin, Aftonian(?).

Well exposed along road that descends into Yellowstone Valley, 5 to 6 miles north of town of Cartwright in northwestern McKenzie County, N. Dak., not far from Yellowstone-Missouri confluence.

Carwood Formation[1] (in Borden Group)

Lower Mississippian: Southeastern Indiana.

Original reference: P. B. Stockdale, 1929, Ohio Jour. Sci., v. 29, no. 4, p. 170.

P. B. Stockdale, 1931, Indiana Div. Geology Pub. 98, p. 76–77, 147–192. Includes following facies (herein named): Bennettsville, Knob Creek, Evans Landing, Delaneys Creek, Sparksville, Gent, Fleener, and Kelly Hill.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (column 76). Shown on correlation chart in Borden group, Osage series. Underlies Floyds Knob formation; overlies Locust Point formation.

Named from village of Carwood (Bridgeport), 4¾ miles southeast of Borden, NW¼NW¼ sec. 9, and SW¼SW¼ sec. 4, T. 1 S., R. 6 E., Clark County. Any one of numerous exposures in Clark County might serve as a "type" section; best is along Borden-Martinsburg Road, one-half mile southwest of Borden.

Cary Stade

Cary (Caryan) Substage[1] or 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. 132. Bradyan subage (new) occurs between Tazewellian Caryan sub-ages. It divides Wisconsinian into two unequal parts. Report also mentions Cary till and Cary loess.

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. Minimum date of Tazewell-Cary interstadial is 14,000 years. Cary maximum in southern extremity of Des Moines lobe in Iowa was 14,000 years ago. A young group of ages ranges from 11,900 to 14,000 years and record Cary glaciation in southern extremity of Des Moines lobe.

V. C. Shepps, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 167–187; V. C. Shepps and others, 1959, Pennsylvania Geol. Survey, 4th ser., Bull G–32, p. 2–59. Deposits of Cary substage in northwestern Pennsylvania include Kent, Lavery, Hiram, and Ashtabula tills.

Meyer Rubin, 1960, Am. Geophys. Union Trans., v. 41, no. 2, p. 288–289. Discussion of changes in Wisconsin glacial stage chronology by C^{14} dating. Type Mankato till dates at about 12,000 years, making it older than Valders till of Thwaites at Two Creeks, and actually placing it into Cary substage range of ages. Because of difficulty in finding any type of break between Cary-age and Tazewell-age deposits in many places, some workers have abandoned division of the two entirely, grouping them together.

J. C. Frye and H. B. Willman, 1960, Illinois Geol. Survey Circ. 285, p. 1, 3–4, 7. Presentation of new classification of Wisconsinan stage of Lake Michigan glacial lobe. Consists of following substages (descending): Valderan, Twocreekan, Woodfordian, Farmdalian, and Altonian. The Woodfordian includes Iowan substage of Illinois usage (but not of the type), the type Tazewell and Cary substages. Includes that part of the Cary that has recently been assigned to the Mankato (Leighton, 1957; Wright, 1957, Science, v. 125, no. 3256).

M. M. Leighton, 1960, Jour. Geology, v. 68, no. 5, p. 529–552. Presentation of new classification of Wisconsin glacial stage of north-central United States. Cary glacial substage by St. Charles intraglacial substage and from younger Mankato glacial substage by Bowmanville intraglacial substage. Author [Leighton] does not agree with classification proposed by Frye and Willman (1960) in which they placed all three substages, Tazewell, Cary, and Mankato in the Woodfordian.

Name amended to Cary Stade to comply with Stratigraphic Code adopted 1961.

Name derived from town of Cary, McHenry County, Ill.

Caryville 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. Thickness 60 feet near Caryville; 10 feet in Cross Mountain section; 20 feet in Walnut Mountain section. Overlies a shale unit 80 to 190 feet thick at base of group; separated from overlying Fodderstack sandstone (new) by a shale interval 50 to 150 feet thick.

Named from exposures in section above Caryville, Jacksboro quadrangle, Campbell County. A northwest-southeast belt of massive Caryville crosses Windrock, Duncan Flats, Fork Mountain, Block, and Jacksboro quadrangle.

Casadepaga Schist[1]

Pre-Paleozoic or Lower Paleozoic: Northwestern Alaska.

Original reference: P. S. Smith, 1910, U.S. Geol. Survey Bull. 433, p. 70–75, map.

Covers 100 square miles in Solomon and Casadepaga quadrangles, one belt along east part of quadrangles and another along west part of quadrangles, Seward Peninsula.

Casa Larga Marls

Eocene, upper: Panamá Canal Zone.

[T. F. Thompson] 1943, Panama Canal, Spec. Eng. Div., 3d Locks Proj., pt. 2, chap. 3, p. 8. Oldest known sedimentary formations known to rest upon the Basement Complex occur within the vicinity of the Tranquilla shales, which formerly cropped out at a point in the Chagres River Valley now inundated by the waters of Madden Lake, and in so-called Casa Larga marls to the southeast of Tranquilla shale locality. On basis of their fossil content, the marls are considered to be upper Eocene.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 329. Expression used by Thompson was "so-called Casa Larga marls." An undefined name for calcareous strata in Gatuncillo formations.

Madden basin.

†Cascade Formation[1]

Precambrian : Northwestern Michigan.

Original reference: M. E. Wadsworth, 1890, Lake Superior along the south shore, by Julian Ralph, p. 77–99 ; 1st ed., 1890 ; 2d ed. 1891.

Well exposed at Cascade Range, Marquette district.

†Cascade Formation[1]

Lower Cretaceous : Central Montana.

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

Kiril Spiroff, 1938, Econ. Geology, v. 33, no. 5, p. 558 (fig. 2). Mapped as Cretaceous in Barker mining district, Hughesville, Montana.

Named for development in Cascade County ; Little Belt Mountains and Fort Benton region.

†Cascade Sandstone (in Chemung Formation)[1]

Cascade sandstone member (of Cayuta monothem)

Upper Devonian : Northeastern Pennsylvania.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. G–5, p. 74–79, 82, 98.

K. E. Caster, 1938, Jour. Paleontology, v. 12, no. 1, p. 45 (fig. 7), 47. Reallocated to base of Cayuta monothem. Described near Lanesboro as usually massive coarse gray to olive-green sandstone; highly micaceous and usually stained with iron oxide. Made up of several lenses not individually traceable for great distance, yet unit as whole is very persistent. Layers of coarse flat pebbles and conglomeratic layers locally developed. Underlies Owego shale member (new). [Shown as equivalent to lower part of Owego in fig. 7.] Also termed Cascade Creek sandstone member.

Forms cliffs which wall in Cascade Creek at Erie Railroad crossing, Susquehanna County.

Cascade Creek Sandstone (in Chemung Formation)[1]

Upper Devonian : Northeastern Pennsylvania.

Original references: J. J. Stevenson, 1892, Am. Geologist, v. 9, p. 22 ; 1892, Am. Assoc. Adv. Sci. Proc., v. 40, p. 235.

Susquehanna and Wayne Counties.

Cascades Formation[1] or Andesite

Pleistocene : Central northern Oregon and southwestern Washington.

Original reference: I. A. Williams, 1916, Oregon Bur. Mines and Geology, Mineral Resources Oregon, v. 2, no. 3.

1959, Dept. Geology and Mineral Resources Bull. 50, p. 9, 11. Cascade andesite (Cascan) listed in Cenozoic formations of Oregon.

Occurs in Cascade Mountains.

Cascadia Formation[1]

Oligocene and Miocene (?) : Central northern Oregon.

Original reference: E. T. Hodge, 1928, Pan-Am. Geologist, v. 49, p. 341–356.

Exposed near Cascadia, Linn County.

Cascadian 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. 834–835, 841 (table 1). Oldest of five glacial epochs; followed by Bull Run glacial epoch.

Cascadilla Shale Member (of Ithaca Formation)

Cascadilla Shale Member[1] (of Ithaca facies subgroup)

Upper Devonian: South-central New York.

Original reference: K. E. Caster, 1933, Geol. Soc. America Bull., v. 44, pt. 1, p. 202.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1768, chart 4. Member of Ithaca formation. Underlies Williams Brook member; overlies Six Mile shale member. Thickness 150 feet.

Occurs in Ithaca region. Probably named for Cascadilla Gorge at Ithaca, Tompkins County.

Cascajo Conglomerate Member (of San Joaquin Formation)

Pliocene, upper: Southern California.

W. P. Woodring, Ralph Stewart, and R. W. Richards, 1940, U.S. Geol. Survey Prof. Paper 195, p. 49–54, pl. 3 [1941]. Unit of conglomerate and sandstone, generally blue, lying at base of San Joaquin formation. Average thickness 50 feet, but at places considerably greater. Overlies Etchegoin formation.

Type locality: Cascajo Hill, on west flank of South Dome, Kettleman Hills. South Dome is the northern part of the anticline that is overlapped by the alluvium of San Joaquin Valley.

Cascan Formation

Pliocene or Pleistocene: Central northern Oregon.

E. T. Hodge, 1938, Geol. Soc. America Bull., v. 49, no. 6, p. 841 (table 1), 842 (fig. 4), 879–886. Mnemonic name proposed for formation composed chiefly of andesitic lava flows that lie on top of Dalles and Troutdale formations and are older than Mount Hood formation.

E. T. Hodge, 1940, Oregon State Coll. Studies in Geology Mon. 1 [map with text]. Described in Madras quadrangle where it lies conformably upon Madras formation and unconformably upon all older formations. Older than a Recent unit termed the Intracanyon formation.

W. D. Lowry and E. M. Baldwin, 1952, Geol. Soc. America Bull., v. 63, no. 1, p. 7, pl. 2. Pliocene.

Type locality: Cascade Mountains of northern Oregon.

Casco Bay Group[1]

Pennsylvanian (?): Southwestern Maine.

Original reference: F. J. Katz, 1917, Washington Acad. Sci. Jour., v. 7, p. 198.

Includes (ascending) Cape Elizabeth Formation, Spring Point Greenstone, Diamond Island Slate, Scarboro Phyllite, Spurwink Limestone, Jewell Phyllite, and Mackworth Slate.

Named for development in and around Casco Bay, Cumberland County.

Casey Limestone[1]

Middle Devonian: Southern central Kentucky.

Original reference: T. E. Savage, 1930, Kentucky Geol. Survey, ser. 6, v. 33, p. 12, 143–144.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, chart 4. Shown on correlation chart below Duffin limestone and above Boyle limestone.

J. M. Weller, 1944, Illinois Geol. Survey Bull. 68, p. 211. Southward in Kentucky it [Sellersburg limestone] loses its typical lithologic and faunal characters and may be overlapped by the Casey limestone.

Well exposed in southwestern part of Casey County.

Caseyville Formation (in McCormick Group)

Caseyville Sandstone (in Pottsville Group)[1]

Caseyville Group

Lower Pennsylvanian: Southeastern Illinois and western Kentucky.

Original reference: D. D. Owen, 1856, Kentucky Geol. Survey, v. 1, p. 48, 49, 62, pl.

J. M. Weller, 1940, Illinois Geol. Survey Rept. Inv. 71, p. 36–39. Group includes (ascending) Lusk, Battery Rock, and Pounds formations. Maximum thickness more than 400 feet in parts of Pope and Hardin Counties; thins irregularly westward to not more than 200 feet in northern Union County. Underlies Tradewater group.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 8 (fig. 1), 28–30, 44 (table 1), 61–62, pl. 1. Defined as formation in McCormick group (new). Includes strata from base of Pennsylvanian to top of Pounds sandstone member. Corresponds to Caseyville formation as defined by Lee (1916, Geology of the Shawneetown quadrangle in Kentucky; Kentucky Geol. Survey) and probably to strata referred to as Caseyville conglomerate by Owen (1856). Caseyville as previously used in Illinois (Weller, 1940) is thus redefined to exclude 40 to 60 feet of strata (including Reynoldsburg coal) above Pounds sandstone and below Grindstaff sandstone that are here included in overlying Abbott formation (new). Characterized by dominance of sandstone and prominent development of sandy shale and siltstone. Thickness commonly 350 feet. In southeastern area, includes (ascending) Lusk shale, Battery Rock sandstone. Sellers limestone, Gentry coal (new), and Pounds sandstone members; in southwestern area includes (ascending) Wayside sandstone, Battery Rock sandstone, Drury shale, and Pounds sandstone members. Type area defined by Lee (1916). Supplementary section given.

U.S. Geological Survey has abandoned use of the term Pottsville in Kentucky and Illinois.

Type area (Lee, 1916): Measured from outcrops on Illinois shore of Ohio River between mouth of Saline River and Gentry's Landing below Battery Rock, T. 11 S., R. 10 E., Shawneetown quadrangle, Hardin County. Reference section: Along railroad cut of Illinois Central Railroad from tunnel, NW¼SW¼SE¼ sec. 31, T. 11 S., R. 5 E., southward to

NE¼SE¼NE¼ sec. 18, T. 12 S., R. 5 E., Brownfield and Harrisburg quadrangles, Pope County, Ill.

Cashaqua Shale Member (of Sonyea Formation)

Cashaqua Formation (in Naples Group)

Cashaqua Shale[1]

Upper Devonian : Western and central New York.

Original reference: J. Hall, 1840, New York Geol. Survey 4th Rept., p. 390–391, 409, 423, 452–455.

W. H. Bradley and J. F. Pepper, 1938, U.S. Geol. Survey Bull. 899–A, p. 12. Cashaqua shale includes (ascending) unnamed shale member, Rock Stream flagstone member (new), and Parrish limestone lentil.

G. W. Colton and Wallace de Witt, Jr., 1958, U.S. Geol. Survey Oil and Gas Inv. Chart OC–54. Rank reduced to member status in Sonyea formation. Hall (1840) gave formational name Cashaqua to soft gray mudrock and shale that crops out along lower part of Cashaqua Creek (spelled Keshequa on recent topographic maps) near Sonyea in west-central Livingston County. As originally defined by Hall and as subsequently used by other geologists in western two-thirds of area covered by present report, Cashaqua shale included, in terms of nomenclature of this report, all rocks between Middlesex shale member of Sonyea formation and base of Rhinestreet shale member of West Falls formation. In Livingston and Ontario Counties and west half of Yates County, Hall's Cashaqua shale included in ascending order units herein assigned to Pulteney shale (new), Rock Stream siltstone, and Cashaqua shale members of Sonyea formation. In eastern half of Yates County, Hall's Cashaqua included parts of West River shale and underlying Geneseo shale. Hall's Cashaqua is redesignated Cashaqua shale member of Sonyea. Name is herein restricted to the medium-gray to medium-greenish-gray mudrock and shale facies that crop out at type exposure of Hall's Cashaqua near Sonyea. In Erie County, directly overlies Middlesex shale member; between southwestern Genesee County and eastern Livingston County, overlies Pulteney shale member; from eastern Livingston County to Keuka Lake, overlies Rock Stream siltstone member. Thickness 35 to 159 feet. Reference section designated.

R. G. Sutton, 1960, New York State Mus. Bull. 380, p. 13–18. Formation included in Naples group. Overlies Middlesex shale; underlies Rhinestreet black shale. Subdivided to include Sawmill Creek (new), Rock Stream, and Rye Point (new) members. Thickness 28 to 480 feet; thickens from shore of Lake Erie to Seneca Lake.

Named for exposures on Cashaqua Creek, Livingston County, above junction of Genesee Valley Canal. Reference section: Buck Creek in Morris Township, 3 miles southwest of Sonyea, Livingston County.

Casitas Formation

Pleistocene : Southern California.

J. E. Upson, 1951, U.S. Geol. Survey Water-Supply Paper 1108, p. 21–23, table facing p. 12, pl. 1. Body of considerably deformed red continental deposits consisting of clay, silt, sand and gravel. Thickness in measured sections 188 to 401 feet; about 1,000 feet thick beneath Shepard Mesa and may be more than 3,000 feet thick beneath alluvial plain farther south. Underlies older alluvium, terrace deposits, and younger alluvium; overlies Santa Barbara formation; east of Rincon Creek, overlaps and cuts out Santa Barbara and rests on Rincon shale and older formations at least at margins of Santa Barbara basin.

Extensively exposed in valley of Rincon, Carpinteria, and Gobernador Creeks, Santa Barbara County.

Casmalia Gypsiferous Shale or Redbeds[1]

Miocene: Southern California.

Original reference: H. W. Hoots and S. C. Herold, 1935, Geology of natural gas: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 156.

Occurs in Casmalia Hills, Santa Maria district.

†Cason Limestone[1]

Silurian: Northern Arkansas.

Original reference: H. S. Williams, 1894, Am. Jour. Sci., 3d, v. 48, p. 325–331.

Named for Cason tract, near Batesville, Independence County.

Cason Shale[1]

Upper Ordovician: Northern Arkansas.

Original reference: H. S. Williams, 1894, Am. Jour. Sci., 3d, v. 48, p. 325–331.

E. B. Brewster and N. F. Williams, 1951, Guidebook to the Paleozoic rocks of northwest Arkansas [Shreveport Geol. Soc. 19th Ann. Field Trip]: Arkansas Resources Devel. Comm., Div. Geology, p. 13. Black and blue-gray shale and thin argillaceous platy limestone. Thickness as much as 23 feet. Unconformable on the Fernvale limestone, and in most places in this area unconformably overlain by St. Joe limestone.

Named for Cason tract, near Batesville, Independence County.

Casper Formation[1]

Pennsylvanian and Permian: Southeastern Wyoming.

Original reference: N. H. Darton, 1908, Geol. Soc. America Bull., v. 19, p. 407, 413, 414, 416, 418–430.

G. E. Condra, E. C. Reed, and O. J. Scherer, 1940, Nebraska Geol. Survey Bull. 13, p. 10–11; 1950, Bull. 13–A, p. 11. Section measured in Laramie Range, Wyo., south of Union Pacific Railroad, 18 miles west of Cheyenne. According to Colorado terminology, upper formations of section would be classed under Ingleside formation, but in Wyoming this part of section plus equivalent of the Fountain is called Casper as revised by Knight (1929, Wyoming Univ. Pub. Sci. Geology, v. 1, no. 1). Hence, name Casper is used for Pennsylvanian in Laramie Range to include Ingleside and Fountain formations.

H. D. Thomas, 1948, Wyoming Geol. Assoc. Guidebook 3d Ann. Field Conf., p. 88–89. in Casper Mountain-Alcova area, the Casper is 400 to 500 feet thick; this is comparable to combined thickness of Amsden and Tensleep to the west. Many geologists have divided section in this area into Amsden and Tensleep. Basal bed, commonly sandstone, rests on eroded surface of Madison. Lower part of Casper comprises thin interbedded limestones and sandstones resembling Amsden; upper part is thick tan cross-bedded sandstone which seems lithologically identical to Tensleep of areas to west. Entire Casper of this area seems to be completely younger than any part of Tensleep. Fusulinids (*Triticites*) have been collected from Casper.

M. L. Thompson, H. D. Thomas, and J. W. Harrison, 1953, Wyoming Geol. Survey Bull. 46, p. 5–55. Formation comprises alternating succession of beds made up principally of crossbedded sandstones and fossiliferous limestones. Thickness 500 to over 1,000 feet. Rests unconformably on Mississippian limestone (Madison) along northern part of Laramie Range. Mississippian rocks thin southward, and south of Little Medicine section the Casper everywhere rests on Precambrian rocks. In northern part of range, overlain unconformably by Opeche shale, but evidence of such break becomes less clear in southern part of range. Fusulinid faunas indicate formation ranges from Middle Pennsylvanian (Desmoinesian) to Lower Permian (Wolfcampian).

R. S. Agatston, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 4, p. 535–549. Formation includes all beds from top of Madison limestone to base of Permian (Opeche) red shales. Fusulinid data, correlated with midcontinent fauna, suggest that formation spans Middle and Upper Pennsylvanian and part of Lower Permian. Subdivided into lower, middle, and upper divisions. Lower division present throughout most of southeastern Wyoming and exposed along flanks of Laramie Range throughout Laramie and Shirley basin regions. Composed of four major rock types (in order of importance); arkose, sandstone, shale, and limestone, Middle division represented throughout Laramie Mountain and Basin region, Shirley basin, and southeastern part of Wind River basin. Where definable, thickness 100 to 300 feet, and strata consist mainly of carbonates separated by thin sandstone interbeds which underlie upper Casper interbedded cherty dolomite and sandstone with local disconformity. Age thought to be Upper Pennsylvanian. Upper division exposed throughout Laramie Mountains and adjacent basins. The section, 230 to 500 feet thick, is sandstone, limestone, and dolomite. Red sandstone, shaly sandstone, and shale (200 to 400 feet thick) overlie presently recognized upper limit of the Casper along east flank of Laramie Mountains, but underlie Opeche shale and Minnekahta limestone. They have been included in Broom Creek and Cassa groups by Condra and others (1940).

C. A. Burk and H. D. Thomas, 1956, Wyoming Geol. Survey Rept. Inv. 6, p. 3–11. Underlies Goose Egg formation (new).

D. O. Peterson, 1960, Dissert. Abs., v. 20, no. 7, p. 2757. Discussion of 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 extended to include strata formerly referred to by these names.

E. K. Maughan and R. F. Wilson, 1960, *in* Guide to the geology of Colorado: Rocky Mountain Assoc. Geologists, p. 36 (fig. 2), 38–39 (fig. 3). 40 (table 1), 41. Mississippian, Pennsylvanian, and Permian.

Named for occurrence in Casper Range.

Cass Limestone[1] (in Douglas Group)

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. 29–30. When named in 1927, exact age relation of the Cass was not known, but since that time it has been found that this subdivision is cyclothemal formation composed of three members (ascending): Shoemaker limestone (redefined), Little Pawnee shale (new), and Haskell limestone. Thickness 17 feet or more. Underlies Robbins shale; overlies Plattford formation.

Type locality: Platte River bluffs and Burlington quarries located 1½ to 2 miles northwest of South Bend, Cass County.

Cassa Group

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

G. E. Condra, E. C. Reed, and O. J. Scherer, 1940, Nebraska Geol. Survey Bull. 13, p. 2 (fig. 2), 5, 19, 45. Comprises upper 180 feet of Division I of Hartville "formation" (Condra and Reed, 1935). Thickness ranges from 175 to 328 feet. Underlies Phosphoria group; overlies Broom Creek group (new). Consists of Owl Canyon formation (new) below, Lyons sandstone above.

Type locality: Buckshot Canyon (also called Ragan Canyon), T. 29 N., R. 67 W., 3 miles northeast of Cassa, Platte County, Wyo.

Cassadaga Group

Cassadaga Stage

Upper Devonian (Chautauquan): North America.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1734, chart 4. Devonian subdivided into 10 stages of which the Cassadaga is ninth in sequence (ascending). [For complete sequence see Helderberg stage, this reference.] Follows Chemung stage and is succeeded by Conewango. Embraces sequence from Dunkirk shale to Wolf Creek-Panama conglomerate. Includes Canadaway and Conneaut groups.

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 Cassadaga group. Includes Canadaway and Conneaut formations. Overlies Chemung group; underlies Conewango group.

Type section (stage): Headwaters and valley of Cassadaga Creek in Dunkirk, Chautauqua, and Jamestown quadrangles, New York.

Cassel Hill Member (of Catahoula Formation)

Miocene: East-central Louisiana.

W. D. Chawner, 1936, Louisiana Dept. Conserv. Geol. Bull. 9, p. 121–122. Loose, noncalcareous sands and sandy clays which commonly contain considerable silicified wood; occurs at base of the Catahoula. Thickness as much as 45 feet; near Cassel Hill 15 to 25 feet thick. Unconformably overlies Vicksburg formation. Separated from overlying Chalk Hills member (new) by an interval of massive sandstone and gray tuff.

Well developed in vicinity of Cassel Hill, NE¼ sec. 9, T. 10 N., R. 5 E., Catahoula Parish.

Cassin Formation[1]

Lower Ordovician: West-central Vermont and northeastern New York.

Original reference: H. P. Cushing, 1905, New York State Mus. Bull. 95, p. 362.

R. R. Wheeler, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1938–1939. Geographically extended to northeastern New York.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, p. 266. Usage of name summarized.

Typically exposed at old Fort Cassin, Addison County, Vt.

Cassinian Series or Stage

Ordovician (Canadian) : North America.

R. H. Flower, 1957, New Mexico Bur. Mines Mineral Resources Mem. 2, p. 18. Divisions within Canadian system favor natural division into four major units: Gasconadian, Demingian, Jeffersonian, and Cassinian. The Cassinian include the Fort Cassin and Providence Island beds of Champlain Valley and Smithville and Black Rock of northern Arkansas. Classification based principally on cephalopod distribution.

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

Cassville Shale Member (of Washington Formation)[1]

Cassville Shale (in Washington Group)

Cassville shale member

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

Original reference: I. C. White, 1891, U.S. Geol. Survey Bull. 65, p. 41.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. 26–C, p. 135, 145. Basal unit of Washington group. Overlies Waynesburg coal; underlies Waynesburg sandstone from which it is separated locally by Elm Grove limestone. Thickness as much as 25 feet.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 10 (fig. 3), 89–90. Cassville shale member is basal unit of Washington series of the Permian in Ohio. Conformably overlies Waynesburg (No. 11) coal; underlies Elm Grove limestone member. Thickness in Morgan County 3 to 6 feet.

R. L. Nace and P. P. Bieber, 1958, West Virginia Geol. Survey Bull. 14, p. 18 (table 2), Cassville shale in Washington formation listed in stratigraphic summary of Dunkard group in Harrison County. At base of formation. Thickness 0 to 15 feet.

Thomas Arkle, Jr., 1959, Geol. Soc. America Guidebook Pittsburgh Mtg. p. 118 (table 2). Cassville shale listed in Washington series. Permian.

U.S. Geological Survey currently designates the age of the Cassville Shale Member of Washington Formation as Pennsylvanian on the basis of a study now in progress.

Named for exposures in vicinity of Cassville, Monongalia County, W. Va.

Castaic Formation

Miocene, upper: Southern California.

Peter Dehlinger, 1952, California Div. Mines Spec. Rept. 26, p. 5 (footnote). Incidental mention.

J. C. Crowell, 1954, California Div. Mines Bull. 170, map sheet 7. Consists of shale with interbedded sandstone and minor beds of pebble conglomerate. Thickness at least 7,000 feet. Conformably underlies Ridge Basin group (new) with an interfingering contact that is marked by an abrupt upward increase in the proportion of sandstone beds; unconformably overlies Mint Canyon formation. Previous investigators have included the Castaic in the Modelo, but it differs lithologically from Modelo of Ventura and thus can be differentiated.

Type locality: Along lower reaches of Castaic Canyon north of Castaic, Ridge basin area. Los Angeles and Ventura Counties. Crops out only northeast of San Gabriel fault.

Castalia Sand

Pleistocene, upper: Eastern North Carolina.

W. B. Wells, 1944, Elisha Mitchell Sci. Soc. Jour., v. 60, no. 2, p. 130–131, 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. Castalia sand is a stratum exhibiting marked variations in thickness, consolidation, and color. A large part of layer is poorly consolidated and consists of gray dark mottled medium sand. Underlies Pine sand (new); overlies Kure sandstone (new).

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

Castanea Sandstone[1]

Lower Silurian (Albion Series): Central Pennsylvania.

Original reference: F. M. Swartz, 1934, Geol. Soc. America Bull., v. 45, p. 83, 91, 102, 109.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Shown on correlation chart at top of Albion series; underlies Rose Hill shale at base of Clinton group; lies above Tuscarora (Clinch) sandstone.

Named for Castanea, a suburb of Lock Haven, Clinton County.

Castile Gypsum[1] or Formation

Castile Anhydrite[1]

Permian (Ochoa Series): Western Texas and southeastern New Mexico.

Original reference: G. B. Richardson, 1904, Texas Univ. Min. Survey Bull. 9, p. 43.

W. B. Lang, 1949, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 10, p. 1569-1572. Base of Salado formation redefined. Anhydrite included in top of Castile (Lang, 1937) is included in base of Salado. This redefinition of Salado confines Castile to Delaware basin.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 586, 609, 611, pl. 2; 1948, U.S. Geol. Survey Prof. Paper 215, p. 68–69, 89–91, pl. 3. Formation, as now defined, includes beds in lower part of Ochoa series that are confined in extent to Delaware basin and overlap sloping surface of Capitan limestone along its margins. Also overlies Bell Canyon formation (new) of Delaware group. Salado includes higher beds, which occur both in the basin and beyond its margins. As thus defined, Castile is dominantly anhydrite-bearing and Salado dominantly salt-bearing but these distinctions are not absolute. Drill records indicate that formation has maximum thickness of between 1,500 to 2,000 feet near center of basin.

Named for Castile Spring, El Paso County, Tex.

Castine Volcanics[1]

Castine Formation

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. 5.

P. S. Wingard, 1958, Kansas Acad. Sci. Trans., v. 61, no. 3, p. 330–333. Castine formation, previously designated as Cambrian, now tentatively designated as either Middle or Upper Silurian. Overlies Ellsworth formation.

Named for exposures on Castine Peninsula, Hancock County.

Castiyo Limestone

Aquitanian: Mariana Islands (Tinian).

Risaburo Tayama, 1939, Correlation of the strata of the South Sea Islands: Geol. Soc. Japan Jour., v. 46, no. 549, p. 346 (correlation chart) [English translation in library of U.S. Geol. Survey]; 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].

S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 25. Castiyo is coralliferous, foraminiferal, and algal limestone. *Miogypsina* limestone and Tinian formation of Tayama (1936) and Lasso limestone of Tayama (1952) should be included in this formation. Aquitanian. Type locality stated. Refer to K. Asano (1939, Jubil. Pub. Yabe's 60th Birthday).

Type locality: Puntan Casityo, Tinian Island.

Castle Granite[1]

Miocene or Pliocene: Central southern Montana.

Original reference: W. H. Weed, 1899, U.S. Geol. Survey Geol. Atlas, Folio 56.

F. C. Armstrong, 1957, Econ. Geology, v. 52, no. 3, p. 221. In Castle Mountains, Flathead quartzite occurs near Castle granite and locally has been thermally metamorphosed by it.

Forms central core of Castle Mountain, Little Belt Mountains.

†Castle Limestone Member (of Madison Limestone)[1]

Lower Mississippian: Central northern 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. 314–315. Strata called Mission Canyon are lithologically and faunally identical with Weed's Castle limestone; because latter term has been discarded, it is proposed that term Mission Canyon be applied throughout Montana and northern Wyoming.

Named for town of Castle, Little Belt Mountains quadrangle, where it is well developed.

Castle Rhyolite

Tertiary: Northwestern Wyoming.

R. E. Wilcox, 1944, Geol. Soc. America Bull., v. 55, no. 9, p. 1053, 1059, pl. 1. Compact rhyolite, the ground mass of which ranges in texture from glassy to micrographic or diffuse spherulitic. Underlies Meadow rhyolitic tuff (new). Elkhorn basalt (new) is probably intermediate in age between Castle rhyolite and Cataract basalt (new).

Exposed in cliffs below Third Cataract in Gardiner River, Yellowstone Park.

Castle 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. 79. Bedded cinders, bombs and spatter composing a partly eroded cinder cone from which lava flow of nepheline basalt, more than 100 feet thick, extends for half a mile. Unconformably overlies rocks of Kailua volcanic series. Distribution noted.

Named for occurrence on Castle Ranch. Covers area of about one-half square mile north of Ulumawao Peak, on northeast side of Koolau Range about 10 miles northwest of Makapuu Head.

Castle Creek Flows

Pleistocene to Recent: Southwestern Oregon.

Howel Williams, 1942. Carnegie Inst. Washington Pub. 540, p. 92–93. Castle Creek flows (pumice flows) were products of glowing avalanches that descended southwest flank of Mount Mazama into valley of Castle Creek. The flows traveled 18 miles before they joined flows of Rogue River valley. They were prevented from spreading northward by high ridge of lava, but southward they overflowed gorge of Castle Creek and spilled into valley of Union Creek, which they filled to maximum depth of 250 feet. Pumice flows spread all the way down Castle Creek, but later scoria flows did not extend beyond park boundary, a distance of about 7 miles. Glowing avalanches of pumice and scoria were part of final activity of Mount Mazama and followed what is termed the main pumice fall.

Castle Creek flows westward from Crater Lake.

†Castlegate coal group (in Blackhawk Formation)[1]

Upper Cretaceous: Central eastern Utah.

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

In Book Cliffs.

Castlegate Sandstone (in Mesaverde Group)

Castlegate Member (of Price River Formation)

Castlegate Sandstone Member (of Price River Formation)[1]

Upper Cretaceous: Eastern central Utah and western central Colorado.

Original reference: J. B. Forrester, 1918, Utah Acad. Sci. Trans., v. 1, p. 24.

E. M. Spieker, 1946, U.S. Geol. Survey Prof. Paper 205–D, p. 130–131. Age definitely fixed as Montana and probably late Montana.

R. G. Young, 1955, Geol. Soc. America Bull., v. 66, no. 2, p. 187, 188–189, figs. 2, 3, pl. 3. Referred to as member instead of sandstone member because it includes coal-bearing rocks throughout considerable part of its outcrop. Primarily a massive crossbedded white or pink sandstone which changes from coarse to fine grained as traced eastward. This part of member belonging to Farrer facies (new), represents inland flood-plain deposits and is replaced for a few miles east of Green River by lagoonal deposits which contain a few thin coals. These, in turn, are replaced eastward in vicinity of Thompsons by littoral marine bar sandstones. This part of Castlegate, as well as thin topmost lagoonal deposit present from Desert east to Cottonwood Canyon, is placed in Neslen facies (new). Member separated from remainder of formation in Beckwith Plateau by Buck tongue of Mancos shale, which thickens eastward. Member thins eastward and disappears in Mancos near West Salt Creek, Colo. From western end of Book Cliffs to Green River, composed mainly of nonmarine sandstone. Near Green River, it passed into lagoonal deposits. Three littoral marine bar sandstones interfinger eastward into Mancos, as far as Salt Creek, Colo. Thickness of member ranges from about 500 feet at Castlegate to featheredge near West Salt Creek.

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. Price River formation restricted by removal of Castlegate sandstone, which is raised to formational rank. Thickness at type locality about 400 feet. In area of this report [Book Cliffs], its thickness ranges up to 190 feet. Eastward from Westwater Wash, where it is about 70 feet thick, formation thins rapidly, and at Utah-Colorado State line it is 30 feet thick; at mouth of West Salt Creek, it is discontinuous. Ranges from massive conglomeratic sandstone at Castlegate to fine-grained siltstone at east boundary of Utah and passes into entirely shaly beds in Colorado. Underlies Buck tongue of Mancos shale in Beckwith Plateau to Colorado line.

Named from Castlegate, Carbon County, Utah, where it forms gatelike passage in Price River Canyon about 2 miles above the town.

Castle Hayne Limestone

Castle Hayne Marl[1]

Eocene, middle and upper: Coastal Plain of North Carolina and South Carolina.

Original reference: B. L. Miller, 1910, Geol. Soc. America Bull., v. 20, p. 674–675.

C. W. Cooke and F. S. MacNeil, 1952, U.S. Geol. Survey Prof. Paper 243–B, p. 20 (fig. 2), 25–26. Geographically extended into South Carolina, where it is recognized only in artificial exposures. At pit of Carolina Cement & Lime Company, Harleyville, Dorchester County, unconformably underlies Cooper marl, is 46 feet thick, and consists of buff-gray tough to hard crumbly fossiliferous limestone overlying a gray soft fine-grained granular limestone. Considered upper Claiborne.

H. E. LeGrand and P. M. Brown, 1955, Carolina Geol. Soc. Guidebook of Excursion in Coastal Plain of North Carolina, Oct. 8–9, p. 9, 28, 30, 36. Described in coastal plain of North Carolina where it underlies Yorktown formation near Pollicksville. Includes shell bed composed of valves and fragments of *Ostrea georgiana* Conrad in a reddish sandy matrix. This is section from which Miller (Clark and others, 1912, North Carolina Geol. and Econ. Survey, v. 3) designated Trent marl as middle Eocene. Kellum (1926, U.S. Geol. Survey Prof. Paper 143) concluded that the Trent was early Miocene, separated from underlying Castle Hayne of Jackson age by erosional unconformity. 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 unit designated by Kellum as lower Miocene is 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 in Castle Hayne although considered a distinctive facies of it.

J. L. Stuckey and S. G. Conrad, 1958, North Carolina Div. Mineral Resources Bull. 71, p. 44–45; J. L. Stuckey, 1958, Geologic map of North Carolina (1:500.000) : North Carolina Div. Mineral Resources. Mapped as middle and upper Eocene. As mapped, included Castle Hayne and Trent formations of older maps.

Named for exposures at Castle Hayne, New Hanover County, N.C.

Castle Hill Andesite[1]

Devonian (?) : Northeastern Maine.

Original reference: H. E. Gregory, 1900, U.S. Geol. Survey Bull. 165, p. 114, 169, 174.

Lies between Aroostook River and the State road from Ashland to Presque Isle, partly in Castle Hill Township and partly in Wade Plantation, Aroostook County.

Castle Hill Tuff[1]

Devonian (?) : Northeastern Maine.

Original reference: H. E. Gregory, 1900, U.S. Geol. Survey Bull. 165, p. 119, 120–121, 122–125.

Exposed in open fields and along roadside about 1 mile west of Castle Hill Hotel, on Castle Hill Ridge, Aroostook County.

Castle Rock Conglomerate[1]

Oligocene, lower : Eastern Colorado.

Original reference : W. T. Lee, 1902, Am. Geologist, v. 29, p. 96–109.

H. E. Woods 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 16, pl. 1. Oligocene, Chadronian.

Named for typical development on Castle Rock Butte, Douglas County.

Castleton Conglomerate Member (of Bull Formation)

Lower Cambrian : Western Vermont and eastern New York.

E-an Zen, 1959, New England Intercollegiate Geol. Conf. Guidebook 51st Ann. Mtg., p. 2. Limestone-pebble, slate-matrix, intraformational conglomerate. Pebbles carry early Cambrian *Elliptocephala* fauna. Thickness probably not more than 20 feet. Overlies Mudd Pond member (new) ; occurs near top of formation below West Castleton formation (new).

Probably named for Castleton River, Vt.

Castle 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, the Recent epoch includes (ascending) Castle Valley, Temple Lake, Spanish Valley, and Gannett Peak stages.

Twin Lakes area.

Castner Limestone

Precambrian : Southwestern Texas.

R. L. Harbour, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 11, p. 1786 (fig. 1), 1787–1788, 1789. Oldest rocks exposed in Franklin Mountains. Includes limestone, hornfels, and chert, as well as diabase sills; contains moundlike algal structures near base. Thickness about 1,112 feet. Underlies Mundy breccia (new). Rests on intrusive granite. Term limestone considered preferable to formation despite the fact that limestone comprises little more than half the thickness of unit at type locality.

Type locality: One and one-half miles southeast of North Franklin Mountain and one-half mile northwest of point at which Fusselman Canyon issues from mountains. Named from exposures in Castner Range on Fort Bliss Military Reservation. Outcrops limited to northern half of Franklin Mountain by faults and intrusive granite. South of Castner Range, fault in Fusselman Canyon drops Castner below level of Quaternary deposits.

Casto Volcanics[1]

Permian (?): Central Idaho.

Original reference: C. P. Ross, 1927, Idaho Bur. Mines and Geology Pamph. 25.

C. P. Ross, 1934, U.S. Geol. Survey Bull. 854, p. 28–35, pl. 1. Coarse conglomerate present in a few places in Casto quadrangle. One bed of limestone noted. Underlie Challis volcanics; unconformable above old sedimentary rocks; cut by Idaho batholith. Thickness 2,000 to 5,000 feet.

Covers large area in Casto quadrangle.

Castor Creek Member (of Fleming Formation)

Miocene: Central Louisiana.

H. N. Fisk, 1940, Louisiana Dept. Conserv. Geol. Bull. 18, p. 118 (fig. 26), 164–168, 174, geol. map. Brackish-water calcareous clays and noncalcareous silts. Thickness at least 200 feet. Underlies Blounts Creek member (new); overlies Williamson Creek member (new).

Well exposed in southern valley wall of Castor Creek in Tps. 3 and 4, R. 2 W., Rapides Parish.

Castro Shale Member (of Alhambra Formation)

Eocene, upper: Northwestern California.

C. E. Weaver, 1953, Washington [State] Univ. Pubs. in Geology, v. 7, p. 19 (chart), 53–54, pl. 4–A. Brownish-gray silty shale becoming somewhat arenaceous toward top. Thickness at type section 145 feet. Underlies Roop sandstone member (new) with contact gradational; overlies Escobar sandstone (new).

Type section: West limb of Pacheco syncline, short distance east of the east portal or Muir Tunnel, near Martinez, Contra Costa County.

Catahoula Group[1]

Oligocene and Miocene (?): Southeastern Mississippi.

Original reference: B. W. Blanpied and others, 1934, Shreveport Geol. Soc. 11th Ann. Field Trip. p. 4.

Catahoula Sandstone,[1] Tuff,[1] or **Formation**

Miocene, Miocene (?), and Oligocene (?): Louisiana, southern Alabama, Mississippi, and eastern Texas.

Original reference: A. C. Veatch, 1905, Louisiana Geol. Survey Bull. 1, Rept. 1905, p. 84, 85, 90.

F. B. Plummer, 1933, Texas Univ. Bull. 3232, p. 715–720. Formation, in eastern Texas, divided into two members Chita (new) and Onalaska. In south Texas, divided into three members (ascending): Gant, Soledad, and Chusa.

B. W. Blanpied, chm., 1934, Shreveport Geol. Soc. [Guidebook] 11th Ann. Field Trip p. 12–22. Catahoula group, Clarke and Wayne Counties, Miss., comprises (ascending) Bucatunna member, Lower Chickasawhay member, Upper Chickasawhay member, and "Catahoula." Overlies Vicksburg group; underlies Citronelle.

B. C. Renick, 1936, Texas Univ. Bull. 3619, p. 67, table facing p. 17. In southeastern Texas, includes Dunlap Quarry sandstone member.

W. D. Chawner, 1936, Louisiana Dept. Conserv., Geol. Bull. 9, p. 110–134. In Catahoula Parish, formation is composed largely of tuffaceous sandstones, sands, and clays, with some loose sands and hard silicified sandstones. Maximum thickness 350 feet. Includes Cassel Hill member (new) in lower part and Chalk Hills member (new) above. Unconformably underlies Citronelle(?) formation.

H. N. Fisk, 1938, Louisiana Dept. Conserv., Geol. Bull. 10, p. 142–149. In Grant and La Salle Parishes, Catahoula formation comprises two mappable units, lower tuffaceous siltstone member and an upper thicker member composed of lenticular sands, clays, and silts. Grades downward into sands and clays of Vicksburg group. Underlies Montgomery member (new) of Pleistocene.

H. N. Fisk, 1940, Louisiana Dept. Conserv., Geol. Bull. 18, p. 143–147. Lower formation in Grand Gulf group in report on Avoyelles and Rapides Parishes. Underlies Fleming formation. Name Catahoula became widely used and has appeared in literature of adjacent coastwise States. Its usage can be justly criticized because lower limit of formation has never been accurately defined and upper limit was not and cannot be established from type locality where beds pass beneath Mississippi River flood plain. No section published permits a lithologic correlation to be established, yet usage of name has been extended into subsurface on lithology. Only part of Catahoula formation found at surface in Rapides Parish is upper 100 feet of siltstones and intercalated sand lentils exposed in northwestern top of parish. Catahoula-Vicksburg contact not exposed in Rapides Parish and lower limit of Catahoula in subsurface is arbitrarily placed on first appearance of Vicksburg fossils.

F. W. Bates and J. B. Wharton, Jr., 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 8, p. 1136–1138. Term Catahoula group should be dropped, leaving Gulf Coast Miocene composed of three formations: Fleming, Catahoula, and Chickasawhay. Believed that there is not sufficient evidence of sufficient lithologic or paleontologic change to warrant placing division between Miocene and Oligocene strata at base of Fleming; hence, entire Catahoula should be considered Miocene in age. Subsurface data.

F. S. MacNeil, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 9, p. 1315 (fig. 1). 1344–1354, "Upper Chickasawhay" of Shreveport Geological Soc. Guidebook 11th Ann. Field Trip is herein named Paynes Hammock sand. This sand intertongues at west with nonfossiliferous beds referred to Catahoula sandstone and with the Paynes Hammock tongue below Catahoula tongue. Paynes Hammock sand and equivalent beds on west referred to Catahoula sandstone are correlated with Tampa limestone. Upper part of Catahoula may be Alum Bluff in age. Miocene.

W. L. Russell, 1957, Gulf Coast Assoc., Geol. Soc. Trans., v. 7, p. 65–72. Formation described in Grimes, Brazos, and Burleson Counties, Tex. Thickness about 350 feet in Grimes County. Basil member is Chita, 10 to 50 feet thick. About 70 to 100 feet above Chita in south-central Brazos County is Dunlap sandstone, 0 to 40 feet thick. About 175 feet above base of Catahoula is Corough sandstone (new), 0 to 40 feet thick. Overlies Whitsett formation; underlies Oakville formation.

D. H. Eargle and J. L. Snider, 1957, Texas Univ. Bur. Econ. Geology Rept. Inv. 30, p. 14. Catahoula tuff described in Karnes County. Thickness about 480 feet. Unconformably overlies and progressively overlaps underlying Frio clay and upper part of Jackson formation. Underlies Oakville sandstone. Because of stratigraphic relations, believed to be early Miocene.

G. R. Pinkley, 1958, South Texas Geol. Soc. [Guidebook] Fall Field Trip, p. 35, 37. Formation, in Fashing field, Atascosa County, includes Gueydan ash member at base.

U.S. Geological Survey currently designates the age of the Catahoula as Miocene(?) and Oligocene(?) in some areas on the basis of a study now in progress.

Named for typical development in Catahoula Parish, La.

Cataldo Quartzite[1]

Precambrian (Belt Series): Northern Idaho and central eastern Washington.

Original references: O. H. Hershey, 1912, Geol. Soc. America Bull., v. 23, p. 526; 1912, Am. Jour. Sci., 4th, v. 34, p. 264–267.

Exposed over a great area, beginning a little above mouth of Pine Creek, and thence nearly to station of Rose Lake; also occurs near town of Tekoa, Wash. Probably named for town of Cataldo, Kootenai County, Idaho.

Catalina Gneiss

Precambrian: Southeastern Arizona.

R. L. DuBois, 1959, Arizona Geol. Soc. Guidebook 2, p. 110–113. Term Catalina gneiss describes the gneissic rocks that make up the core of Santa Catalina Mountains and extend southeastward from Mount Lemmon into Tanque Verde and Rincon Mountains. Divided into three general types: banded augen gneiss, augen gneiss, and granitic gneiss-gneissic granite.

Area: Santa Catalina Mountains.

Catalina Granite

Post-Cretaceous: Southeastern Arizona.

F. L. Peirce, 1958, Dissert. Abs., v. 19, no. 2, p. 300. Orogeny which apparently took place during Laramide time was accompanied by emplacement of Leatherwood quartz diorite (new) which was followed by emplacement of Catalina granite. Some border phases of the granite apparently represent replacement of sediments, and some of the granite was igneous as shown by the chilled borders of dikes of the granite that cut the Leatherwood quartz diorite (new).

R. L. DuBois, 1959, Arizona Geol. Soc. Guidebook 2, p. 114. Characterized by two different facies: northern exposures, according to Peirce, are hypidiomorphic granular granodiorite, containing mainly quartz, orthoclase, and oligoclase; outcrops on the south are of crystalloblastic granite, composed of abundant quartz and orthoclase.

In Santa Catalina Mountains [Pima County].

Catalina Schist

Catalina metamorphic facies (of Franciscan Series)[1]

Mesozoic or older: Southern California.

Original reference: A. O. Woodford, 1924, California Univ. Pub., Dept. Geol. Sci. Bull., v. 15, no. 3.

W. P. Woodring, M. N. Bramlette, and W. S. W. Kew, 1946, U.S. Geol. Survey Prof. Paper 207, p. 13, Woodford (1924) designated the metamorphic rocks of Palos Verdes Hills and the more extensive rocks of Santa Catalina Island the Catalina metamorphic facies of the Franciscan. Absence of unaltered sedimentary rocks indicates that metamorphics are older than Franciscan. Name Catalina schist considered more appropriate term.

J. E. Schoellhamer and A. O. Woodford, 1951, U.S. Geol. Survey Oil and Gas Inv. Map OM–117. Mesozoic or older.

Occurs on Catalina Island, off coast of southern California, and in San Pedro Hill and Palos Verdes Hills on adjacent mainland.

Catalina Schist Breccia[1]

Miocene, lower (?): Southern California.

Original reference: A. O. Woodford, 1925, California Univ. Pub., Dept. Geol. Sci. Bull., v. 15, no. 7, p. 211–212.

Southeast end of Catalina Island.

Catamount Schist[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 Swede Pond quartzite and below Bear Pond schist.

Type locality: Catamount Mountain, west of Pettersville, Warren County.

Cataract Basalt (in Gardiner River Rhyolite-Basalt Complex)

Tertiary: Northwestern Wyoming.

R. E. Wilcox, 1944, Geol. Soc. America Bull., v. 55, no. 9, p. 1050, 1055–1056, pls. 1, 2. Name applied to basalt of Gardiner River rhyolite-basalt complex (new). Normal facies is massive medium-grained basalt, carrying abundant phenocrysts of plagioclase and ferromagnesian minerals. Younger than Meadow rhyolitic tuff (new) and older than Sheepeaters basalt (new). Contemporaneous with Lodgepole rhyolite (new); overlies Elkhorn basalt (new).

Present on Gardiner River, Yellowstone Park. Uncontaminated phase occurs at Second Cataract, about 700 feet downstream from complex at First Cataract. Crops out at frequent intervals several miles southward upgrade of wide tributary valley.

Cataract Formation[1]

Cataract Group

Lower Silurian: Ontario, Canada, and northern Michigan and western New York.

Original reference: C. Schuchert, 1913, Geol. Soc. America Bull., v. 24, p. 107.

G. V. Cohee, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 33, sheet 2. In Michigan, formation crops out in extreme eastward extension of Northern Peninsula on east side of Drummond Island, Chippewa County, and in a few places to west in Delta and Luce Counties. Rocks are light-brown to brownish-gray dense to finely crystalline dolomite that is cherty in part.

G. M. Ehlers, 1948, Michigan Geol Soc. [Guidebook] Ann. Field Trip, June 18, 19, 20, 21. Cataract group listed on Silurian chart of Northern Peninsula, Mich. Includes Mayville dolomite. Mayville comprises (ascending) Manitoulin dolomite, Cabot Head shale, and Dyer Bay dolomite; thicknesses of these units are given from subsurface data. Underlies Burnt Bluff group. Alexandrian series.

D. W. Fisher, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 9, p. 1984. Discussion of stratigraphy of Medinan group in New York and Ontario. Recommended that names Albion, Alexandrian, Anticostian, Cataract, and Power Glen be suppressed.

G. M. Ehlers and R. V. Kesling, 1957, Michigan Geol. Soc. [Guidebook] Ann. Geol. Excursion, p. 2 (table), 4 (fig. 1), 5–7. Group in northern Michigan comprises (ascending) Manitoulin dolomite, Cabot Head shale, and Moss Lake formation (new). Thickness 110 to 200 feet. Underlies Burnt Bluff group with Lime Island dolomite (new) at base. Term Mayville not used in this classification. Alexandrian series.

Well exposed at Cataract, Ontario.

†Cataract Falls Sandstone (in Ste. Genevieve Formation)

Mississippian: Southwestern Indiana.

C. A. Malott, 1945, (abs.) Indiana Acad. Sci. Trans., v. 55, p. 77 [1946]. Proposed for a persistent sandstone, ranging from 1 foot to more than 30 feet in thickness, that occupies nearly the middle one-third of the formation.

C. A. Malott, 1946, Jour. Geology, v. 54, no. 5, p. 323. Unit referred to as "Cataract Falls sandstone" is directly correlated with Rosiclare sandstone of southern Illinois.

Occurs at double falls of Mill Creek near Cataract, Owen County.

Catawissa Reds[1] or Red Beds

Upper Devonian: Northeastern Pennsylvania and eastern New York.

Original reference: G. H. Chadwick, 1932, Eastern States Oil and Gas Weekly, v. 1, no. 17, p. 7.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Shown on correlation chart as Catawissa red beds; occur below Montrose red beds and above Katsberg red beds; equivalent to Cayuta shale and sandstone.

Crops out at Catawissa, Columbia County, Pa., south of Susquehanna River. Also present in western Catskills along Delaware River.

Cathedral Granite[1]

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

Original reference: R. A. Daly, 1906, Geol. Soc. America Bull., v. 7, p. 329–376.

Cathedral Bluffs Tongue (of Wasatch Formation)[1]

Cathedral Bluffs Tongue (of Knight Formation)

Eocene, lower and middle: Southwestern Wyoming and northwestern Colorado.

Original reference: A. R. Schultz, 1920, U.S. Geol. Survey Bull. 702.

W. J. Morris, 1955, Dissert. Abs., v. 15, no. 3, p. 394. Name Knight formation extended from Bridger basin to include dominantly fluviatile Wasatchian deposits of Washakie basin. Hence Cathedral Bluffs is considered tongue of Knight formation.

G. N. Pipiringos, 1955, Wyoming Geol. Assoc. Guidebook 10th Ann. Field Conf., p. 101, 102. Overlies Tipton tongue of Green River formation; underlies and interfingers with Laney shale member and Morrow Creek member of Green River; intertongues laterally with Battle Spring formation (new). Thickness as much as 900 feet. Has yielded some fossils thought by some to be early Eocene and by others to be middle Eocene.

Forms highly colored escarpment of Laney Rim and Cathedral Bluffs, Sweetwater County, Wyo.

Cathedral Peak Granite[1] (in Tuolumne Intrusive Series)

Cretaceous: East-central California.

Original reference: F. C. Calkins, 1930, U.S. Geol. Survey Prof. Paper 160, p. 126–127, 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 83.7 millions of years. Younger than Half Dome quartz monzonite and older than Johnson granite porphyry and Hoffman quartz monzonite (new).

Named for fact it composes Cathedral Peak and adjoining parts of Cathedral Range in Yosemite National Park.

Cathedral Valley Agglomerate

Tertiary, upper: Southwestern Alaska.

G. C. Kennedy and H. H. Waldron, 1947, U.S. Geol. Survey Alaskan Volcano Inv. Rept. 2, pt. 2, p. 12, pl. 2. Thick sequence of agglomerate beds with subordinate tuff beds and lava flows; rocks are predominantly basalt and basaltic andesite. Beds dip north toward Bering Sea at angles of a few degrees. Probably comparable in age to Belkofski tuff (new) but direct evidence is lacking.

Type region: Cathedral Valley in vicinity of Pavlof Volcano, Alaska Peninsula.

Catheys Limestone[1]

Catheys Limestone (in Nashville Group)

Middle Ordovician : West-central Tennessee.

Original reference: C. W. Hayes and E. O. Ulrich, 1903, U.S. Geol. Survey Geol. Atlas, Folio 95.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 136–157. Six major facies recognized: shaly, laminated siltstone, granular, clayey, dove-colored, nodular, and pale-colored. Facies do not occur as stratigraphic units in chronological order but rather are interbedded with each other and may recur in both vertical and lateral distribution. In general, the Catheys thickens eastward from featheredge covered by younger sediments somewhere between Perry-Wayne-Hardin Counties and Maury-Giles Counties to as much as 250 feet in Sequatchie Valley. Overlies Bigby-Cannon limestone, being in contact with Bigby facies in western part and with Cannon facies in eastern part. Underlies Leipers formation. In Nashville group, Hayes and Ulrich did not specify type section. Bassler (1932, Tennessee Div. Geology Bull. 38) suggested section at Columbia. In present study, two sections are measured along Catheys Creek, each of which would serve as type section. Section along Dry Fork 65 feet; section along north slope of spur overlooking Catheys Creek 69 feet.

Suggested type sections (Wilson) : Along road up Dry Fork Creek and up hill to east, beginning about 500 feet south of intersection of Dry Fork and Catheys Creek 1 mile west of Isom, Maury County. On slope of spur overlooking Catheys Creek between Ivory Hollow and Shannon Branch about one-fourth mile southeast of Taylorsville, and about 2 miles east of Isom. Named for Catheys Creek, Lewis and Maury Counties.

Cat Hill Gneissoid Granite[1]

Precambrian : Southeastern New York.

Original reference: C. P. Berkey, 1911, New York State Mus. Bull. 146, p. 52, 57.

Occurs in Garrison district, Putnam County. Probably named for occurrence at Cat Hill.

Cativa Marl (in Gatún Formation)

Miocene, middle : Panamá.

H. N. Coryell and Suzanne Fields, 1937, Am. Mus. Novitates no. 956, p. 1. Fossiliferous marl in lower part of Gatún formation.

W. P. Woodring, 1960, *in* R. Hoffstetter and others, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 330–331. Undefined name for calcareous siltstone in Gatún formation.

Catlin Member (of 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. 20–21, 22, pl. 2. Composed of interbedded massive limestone, in part cherty, and thin-bedded shaly and sandy limestone. The massive limestone beds are for the most part fine grained although some are coarser grained; some of the coarser beds are crowded with trilobite fragments. The thinner bedded limestones are light to medium gray and have sandy interbeds that weather to brown or pinkish brown. Thickness 250 feet throughout the area around Eureka. Member is in sharp though normal contact with Dunderberg shale below and is conformable with Bullwhacker member (new) above.

Named from exposures near the Catlin shaft of the Croesus mine in New York Canyon, Eureka mining district, Eureka County.

Cat Mountain Rhyolite

Tertiary: Southeastern Arizona.

W. H. Brown, 1939, Geol. Soc. America Bull., v. 50, no. 5, p. 710 (fig. 2), 729–731, pl. 1. Cliff forming series of rhyolite flows and mud flows. When fresh, rhyolites are red, and the mud flows or breccias are red or buff. Weathers dark reddish brown on steep slopes and many shades of purple, brown, buff, red, blue, and even white on more subdued slopes. Breccia at the base and tuff at the top. Thickness in Cat Mountain-Golden Gate Mountain area at least 700 to 800 feet; farther south, thickness between 200 and 300 feet. Usually rests either on overthrust mass of Cretaceous sedimentary and volcanic rocks or, where thrust has been removed by erosion, directly on truncated edges of sedimentary rock. Underlies Safford tuff (new); unconformably overlies Amole arkose (new).

Well exposed on Cat Mountain and Golden Gate Mountain. Most conspicuous and one of the most widespread formations in Tucson Mountains, Pima County.

Catoctin Greenstone, Formation, or **Metabasalt**

Catoctin Schist[1]

Catoctin Series

Precambrian: Western Maryland, northern Virginia, and northeastern West Virginia.

Original reference: A. Keith and H. R. Geiger, 1891, Geol. Soc. America Bull., v. 2, p. 155–164.

A. S. Furcron, 1939, Virginia Geol. Survey Bull. 54, p. 19–28. Catoctin series, in Warrenton quadrangle, divided into Warrenton agglomerate member (new) at base and basalt flows now altered to metabasalt or "greenstone" schist. Underlies Loudoun formation; overlies Fauquier formation (new).

A. J. Stose and G. W. Stose, 1946, Maryland Dept. Geology, Mines and Water Resources [Rept. 12], Carroll and Frederick Counties, p. 20–22. Catoctin metabasalt described in Frederick County where it is exposed in area between South and Catoctin Mountains. Underlies Loudoun formation. Overlies Swift Run tuff. The volcanic series, comprising Catoctin basalt, aporhyolite, and Swift Run tuff, overlies granitic injection complex of early Precambrian age.

R. O. Bloomer and R. D. Bloomer, 1947, Jour. Geology, v. 55, no. 2, p. 94–106. Formation in central Virginia consists of undetermined thickness of hydrothermally altered andesite classed as propylite. Underlain by variable thickness of both metamorphosed and unmetamorphosed conglomerate, sandstone, tuff, and andesite to which name Oronoco formation is assigned. In northern Virginia, the Catoctin is overlain by Loudoun formation. In central Virginia, the Unicoi, which is at least partly equivalent to the Loudoun, crops out along western flanks of Blue Ridge but is not exposed in Catoctin outcrop belt. In western part of Piedmont province, the Catoctin overlies the Lynchburg. Catoctin may be Cambrian in age.

P. B. King, 1950, U.S. Geol. Survey Prof. Paper 230, p. 12–14, 15 (fig. 5), pl. 1. Described in Elkton area, Virginia, as Catoctin greenstone. Consists of altered lava, largely basaltic in composition, and associated pyroclastic sediments. Thickness 0 to 1,000 feet; maximum thickness on slopes of Blue Ridge in southeast part of area. Underlies Loudoun formation of Chilhowee group; overlies Swift Run formation.

R. O. Bloomer, 1950, Am. Jour. Sci., v. 248, no. 11, p. 753–783. The Catoctin is exposed in two parallel belts that extend into central Virginia. One belt caps main mass of the Blue Ridge, and the other occurs in an alignment of ridges about 20 miles to the southeast. In central Virginia, northwestern belt of Catoctin is thrust upon Chilhowee group, but farther northeast it underlies the Loudoun. In some places, the Catoctin in northwestern belt overlies the Swift Run or granitized complex. Elsewhere, the granitized complex has been thrust upon the Catoctin and base is unexposed. Catoctin in central Virginia is exposed on both limbs of major anticlinal fold that has been truncated by erosion, at least, to combined thickness of Catoctin and Lynchburg formations. Generally believed that there is significant hiatus between Catoctin formation and Chilhowee series. The Catoctin and concordantly underlying Lynchburg and Swift Run formations are defined as late Precambrian and the Chilhowee as Lower Cambrian. Although age classification may be correct, there is evidence of continuous sequence from base of Lynchburg into Chilhowee. This relationship may appear to be refuted where Chilhowee rests with conspicuous unconformity upon granitized complex definitely older than late Precambrian. However, this unconformity is an inclined surface that cuts across formation boundaries. Lynchburg and Catoctin overlap this surface from east to west. Hence, absence or restricted thickness of Catoctin beneath the Chilhowee in certain sections is not due to interval of erosion between the two formations, but to location of sections with respect to margin of overlap. In places, there appears to be complete section between Catoctin in the Blue Ridge and the Wissahickon in the Piedmont of central Virginia. No continuous faults, including Martic overthrust have been identified. The Catoctin is not everywhere separated from the Wissahickon or the Lynchburg from the Wissahickon by faults. In this report, term Oronoco is abandoned in favor of Swift Run formation. Not certain whether Catoctin is late Precambrian or Cambrian.

W. R. Brown, 1953, Kentucky Geol. Survey, ser. 9, Spec. Pub. 1, p. 91 (fig. 1). In James River synclinorium, Catoctin greenstone underlies Candler formation of Evington group (both new); overlies Lynchburg gneiss.

J. C. Reed, Jr., 1955, Geol. Soc. America Bull., v. 66, no. 7, p. 871–896, pl. 1. Formation described near Luray, Va., where it unconformably overlies granitic rocks and is not intruded by them, as has been suggested by some earlier workers. No important time break is indicated between deposition of Catoctin formation and overlying Cambrian sediments (Chilhowee group). Catoctin may be early Cambrian.

W. R. Brown, 1958, Virginia Div. Mineral Resources Bull. 74, p. 8 (fig. 2), 22–28, pl. 1. Catoctin greenstone described in Lynchburg quadrangle. Catoctin is at top of Lynchburg formation but intertongues, in part, with upper Lynchburg and overlying Candler formation. Lynchburg and Catoctin are referred to as "Late Precambrian" group which overlies Virginia Blue Ridge complex (new) and underlies Lower Paleozoic(?) Evington group.

W. B. Brent, 1960, Virginia Div. Mineral Resources Bull. 76, p. 12 (table 1), 14, 16. Catoctin greenstone described in Rockingham County. Overlies Swift Run formation; underlies Loudoun formation of Chilhowee group. Cambrian or Precambrian.

Named for Catoctin Mountain, Loudoun County, Va., and Frederick County, Md.

Catron Formation (in Breathitt Group)

Catron Formation (in Pottsville Group)[1]

Middle Pennsylvanian: Southeastern Kentucky.

Original reference: G. H. Ashley and L. C. Glenn, 1906, U.S. Geol. Survey Prof. Paper 49, p. 33, 41, 207, pl. XLA.

H. R. Wanless, 1946, Geol. Soc. America Mem. 13, p. 96–99, 138. Underlies Hignite formation; overlies Mingo formation. Report contains measured sections, correlation charts, and plates.

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

Named for exposures on Coon Branch of Catron Creek in Black Mountains, Harlan County.

Catskill Formation[1] **or Redbeds** (in Susquehanna Group)

Middle and Upper Devonian and Lower Mississippian: New York, Maryland, New Jersey, and Pennsylvania.

Original reference: W. W. Mather, 1840, New York Geol. Survey 4th Rept., p. 212, 213, 227–233.

Bradford Willard, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19. Catskill, as used in this report, is defined broadly as the continental magnafacies of the Devonian. In Pennsylvania, it is divisible into several clearly separable and distinct units. These are all well exposed and typically developed. Their relative ages are fixed through the fact that in practically all cases they are traceable into fossiliferous marine beds. Many of these divisions, known and named by I. C. White, are of long standing, have a well-established place in the literature, and take precedence over any other system of Catskill terminology previously misapplied to Pennsylvania. No doubt some of Chadwick's divisions are valid and may even be close correlates with terms used in this report. However, names drawn from the section in Catskill Mountains have no place in the nomenclature in Pennsylvania's continental Devonian sequence. Thickness varies through process of progressive off-lap. Featheredge is encountered in traversing west from Potter into McKean and Warren Counties; pinching out is observed in Conemaugh gorge west of Johnstown; similar conditions are also reported in Fayette County. Thickest section, about 6,200 feet, is along Lehigh River, Carbon County. Limits of Catskill vary radically. Top is drawn where red or green Catskill sandstones and shales yield to gray, usually conglomeratic Pocono. At base, continental beds intertongue with marine, neritic facies of the Devonian which changes progressively from early Middle Devonian in New Jersey to Portage in upper Delaware Valley, earliest Chemung in Susquehanna Valley above Harrisburg, very late Chemung on Allegheny Front and progressively later Chautauquan from north-central to northwestern Pennsylvania. Some units included in Catskill facies are the Mount Pleasant red shale, Honesdale sandstone, Cherry Ridge red beds, Damascus red shale, Shohola formation, Delaware River flags. Analomink red shale, and New Milford formation.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 333. Discussion of geology of Appalachian Valley in Virginia. Term Hampshire formation is used in preference to term Catskill. Chadwick (1933, Am. Jour. Sci., 5th, v. 36; 1936, New York State Mus. Bull. 307) demonstrated that Catskill formation of type locality corresponds mainly to Hamilton and Portage formations and that Chemung and Hampshire are younger than true Catskill. Thus, if they [Chemung and Hampshire] were ever present in eastern New York, they would have overlain the Catskill and extended above top of present Catskill Mountains. Hence, name Catskill cannot be properly applied to red rocks described in this report under restored name Hampshire formation.

P. H. Price and H. P. Woodward, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 11, p. 1993–1994; H. P. Woodward, 1943, West Virginia Geol. Survey, v. 15, p. 528. Darton's (1892) term Hampshire formation is herein revived for rocks previously called Catskill formation in West Virginia. It is appropriate to refer to post-Chemung red beds of West Virginia as the Catskill facies, but, because term facies refers to an equivalent of some other formations, there must be some definite post-Chemung horizon of which the local "Catskill" beds can be regarded as the nonmarine equivalent.

Charles Butts, 1945, U.S. Geol. Survey Geol. Atlas, Folio 227. In this report [Hollidaysburg and Huntingdon quadrangles, Pennsylvania], term Hampshire formation is used in preference to term Catskill. Use of Hampshire conforms with present usage of Virginia Geological Survey.

Ernst Cloos, 1951, Maryland Dept. Geology, Mines and Water Resources [Rept.] Washington County, p. 92. Thickness about 3,800 feet in Washington County. Lower Catskill rocks consist of brownish-red in part arkosic sandstones alternating with red argillaceous shale including occasional bands of greenish shale; upper part of formation contains more greenish-gray sandstone and shale alternating with red rocks. Catskill continental beds seem to be nonmarine equivalent of the upper Devonian contemporaneous and intertonguing with marine sediments ranging from Hamilton to Chemung and in part post-Chemung. Underlies Pocono group.

T. W. Amsden, 1954, Maryland Dept. Geology, Mines and Water Resources Bull. 13, p. 16. In Maryland, only the post-Chemung part of the Devonian remains in the red-bed facies. As there is no unanimity of opinion as to how name Catskill should be applied in New York area, it seems preferable to use name Hampshire in Garrett County, which is only a few miles from type area of Hampshire.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., Field Trip 1, p. 3. Included in Susquehanna group. Pennsylvania Geological Survey currently limits use of term Catskill to the thick brownish- and grayish-red units which characterize middle and upper parts of the Middle and Upper Devonian red-bed sequence. Light-colored sandstone, such as Honesdale and Elk Mountain members, known in the east are included in the Catskill only in those areas where they are underlain by a thick all-red unit. Correlation of members in eastern part of the State with those in central part is complicated and is reserved for future detailed mapping. Overlies transition beds in group; underlies Pocono formation.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Formation mapped in central and eastern Pennsylvania. Chiefly red to brownish shales and sandstones; includes gray and greenish sandstone tongues named Elk Mountain, Honesdale, Shohola, and Delaware River in east. Included in Susquehanna group; map bracket shows Catskill above unnamed marine beds and below Oswayo formation. As mapped, marine beds, which consist of gray to olive-brown shales, graywackes, and sandstones, contain "Chemung" beds and "Portage" beds including Burket, Brallier, Harrell, and Trimmers Rock with Tully limestone at base, Upper Devonian.

Named for development in Catskill Mountains, Greene County, N.Y.

†Catskill (Delthyris) Shaly Limestone[1]

Catskill Shaly Limestone Member (of New Scotland Formation)

Lower Devonian: Eastern New York.

Original reference: L. Vanuxem, 1842, Geology of New York, pt. 3, p. 120–122.

G. H. Chadwick, 1944, New York State Mus. Bull. 336, p. 71–75. Name Catskill shaly limestone member applied to upper member of New Scotland. Overlies Kalkberg limestone member. Thickness about 120 feet.

Type exposure: On the Catskill at mouth of main gorge of Austin's glen, Catskill. Named for occurrence on Catskill Creek, near Madison, Greene County.

Cattaraugus Formation[1]

Cattaraugus Shale or Formation (in Conewango Group)

Devonian: Southwestern New York and northern Pennsylvania.

Original reference: J. M. Clarke, 1902, New York State Mus. Bull. 52, p. 524–528.

J. G. Woodruff, 1942, New York State Mus. Bull. 326, p. 53–63, charts, geol. map. Formation in Conewangan series. Computed thickness about 370 feet in Wellsville area, though no outcrop shows more than 10 feet of rock. Comprises three principal rock types: (1) flat pebble conglomerates of Upper Devonian age, (2) crossbedded thinly laminated green sandstones, and (3) red shale. Includes Wolf Creek conglomerate member at base and Salamanca conglomerate member in upper part. Overlies Germania formation; underlies Oswayo formation.

I. H. Tesmer, 1954, Hobbies, v. 35, no. 2, p. 30 (table), 33. Basal formation in Conewango group, Chautauquan series. Comprises (ascending) Panama conglomerate, Amity, Salamanca conglomerate, and Saegerstown members. Thickness about 300 feet. Underlies Oswayo formation; overlies Chadakoin formation of Arkwright group (new). Upper Devonian. Area of report, Chautauqua County.

L. V. Rickard, 1957, New York Geol. Assoc. Guidebook 29th Ann. Mtg., p. 17 (table 2), 19. In Wellsville area, considered middle formation in Conewango group. Overlies Wolf Creek conglomerate; underlies Oswayo shale. Thickness about 375 feet in Genesee River valley. Westward in Salamanca and Olean quadrangles, the Cattaraugus has been subdivided into (ascending) Amity shale, Saegerstown shale, and Salamanca conglomerate.

I. H. Tesmer, 1958, (abs.) Geol. Soc. America Bull., v. 69, no. 12, pt. 2, p. 1651. Series of structure-contour maps drawn on base of each of several successive conglomerates in southwestern New York and northwestern Pennsylvania suggests following stratigraphic sequence (ascending) for Cattaraugus formation: Le Boeuf conglomerate, unnamed member (mostly shale and siltstone), Woodcock-Bimber Run-Dutchmans conglomerate, unnamed member (mostly shale and siltstone), Panama conglomerate, unnamed member (mostly shale and siltstone), Wrightsville-Wolf Creek conglomerate, unnamed member (mostly shale and siltstone), Riceville shale, Corry-Pope Hollow conglomerate, Orangeville shale, Sharpsville sandstone, unnamed member (mostly shale and siltstone), Salamanca conglomerate, unnamed member (mostly shale and siltstone) Killbuck conglomerate, and unnamed member (mostly shale and siltstone). Overlies Chadakoin formation; underlies Oswayo formation.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. In western Pennsylvania, consists of red, gray, and brown shale and sandstone with proportion of red decreasing westward. Includes Venango sands of drillers and Salamanca sandstone and conglomerate; some limestone in Crawford and Erie Counties. Upper Devonian.

Named for development in Cattaraugus County, N.Y.

Cattaraugus parafacies[1]

Devonian or Carboniferous: Southwestern New York and northern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, table opposite p. 61.

Named for development in Cattaraugus County, N.Y.

Cattasauqua Limestone[1]

Ordovician: Southeastern Pennsylvania.

Original reference: I. C. White, 1882, Pennsylvania 2d Geol. Survey G_6, p. 153.

The name of the town is spelled Catasauqua, Lehigh County.

Cattron Diorite

Precambrian: Southwestern Virginia.

A. J. Stose and G. W. Stose. 1946, Maryland Dept. Geology, Mines and Water Resources Carroll and Frederick Counties Rept., p. 17, 18. Altered to hornblende diorite in most of its extent. Intruded Saddle gneiss (new). Injected, intruded, and replaced by series of granitic intrusions. In places, pink pegmatite cuts across unit that contains intrusions of white aplite. By metasomatic replacement, diorite has become hypersthene granodiorite with microcline metacrysts which contain inclusions of andesine, hypersthene, and other primary minerals of the diorite.

A. J. Stose and G. W. Stose, 1957, Virginia Geol. Survey Bull. 72, p. 25–26, pl. 1. Fine-grained grayish-green gneissic rock in which milky-gray feldspar and green hornblende are only minerals discernible to unaided eye. Diorite contains injection of both white and pink aplite which is composed of microcline and quartz. This resulted in two varieties of injection gneiss that have been mapped separately.

Named from Cattrons Mill on Elk Creek, where one of larger outcrops occurs. Injection gneiss formed by intrusion of white aplite in diorite exposed in vicinity of Salem Church, Cattrons Mill, on northwest side of Brierpatch Mountain, and east of Fallville. Migmatite formed by pink aplite injection seen near Bennington Mill, south of Elk Creek village, and southwest of Fallville.

†Cavanal Group[1]

Cavaniol Group[1]

Pennsylvanian : Central eastern Oklahoma and western Arkansas.

Original reference: N. F. Drake, 1897, Am. Phil. Soc. Proc., v. 36, p. 371, 388.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 100. Abandoned by Oklahoma Geological Survey. Group concept is not useful and has not been employed.

Named for Cavanal Mountains, northern part of Le Flore County, Okla.

†Cave Limestone[1]

Pennsylvanian : Eastern Kansas.

Original reference: G. C. Swallow and F. Hawn, 1865, Kansas Geol. Survey Rept. on Miami County, p. 7.

Apparently named for occurrence in it of many caves and crevices from which bold springs usually flow.

Cave Creek Formation

Cenozoic (?) : Southeastern Arizona.

H. E. Enlows, 1955, Geol. Soc. America Bull., v. 66, no. 10, p. 1217. Rhyolitic tuffs and welded tuffs 4,500 feet thick. Probably correlative with Rhyolite Canyon formation in Chiricahua National Monument. Name credited to Raydon (unpub. thesis).

In Cave Creek area, Cochise County.

Cave Creek Formation (in Cimarron Group)[1]

Permian : Central southern Kansas and northwestern Oklahoma.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 3, 27.

G. H. Norton, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 12, p. 1751, 1793. Cragin's "Cave Creek formation" is identical with Blaine formation of Oklahoma. It is here divided into (ascending) Medicine Lodge, Nescatunga, Shimer, and Haskew gypsums. Cave Creek has priority, but the Blaine has wider accepted usage.

Named for Cave Creek, Comanche County, Kans.

Cavendish Schist[1]

Upper Cambrian : Southeastern Vermont.

Original reference: C. H. Richardson, 1929, Vermont State Geologist 16th Rept., p. 210, 223.

In roadcut a few rods north of Gassetts Station, Windsor County.

Cave Springs Sandstone[1]

Pennsylvanian : Southern Kansas.

Original reference: E. Haworth, 1898, Kansas Univ. Geol. Survey, v. 3, p. 66.

In vicinity of Cave Springs, Elk County.

†Caw Caw Formation[1] or Sands[1]

Eocene, middle : Central South Carolina.

Original reference: E. Sloan, 1908, South Carolina Geol. Survey, ser. 4, Bull. 2, p. 449.

Named for exposures at Caw Caw Swamp, Orangeburg County.

Cawker terrane[1]

Cretaceous: Kansas.

Original reference: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 255.

Derivation of name not stated, but probably Cawker City, Mitchell County.

Cawood Sandstone Member (of Hance 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, 37, 120, 158.

H. R. Wanless, 1946, Geol. Soc. America Mem. 13, p. 65, 66, 67, 69, 77, 138. Massive sandstone about 200 feet above base of formation.

Forms massive bluffs along Martins Fork of Cumberland River at Cawood, Harlan County, Ky.

Cayey Siltstone Member (of Robles Formation)

Upper Cretaceous: Puerto Rico.

H. L. Berryhill, Jr., and Lynn Glover 3d, 1960, U.S. Geol. Survey Misc. Geol. Inv. Map I-319. Thick sequence of rocks consisting principally of siltstone. About 300 to 350 meters thick in north-central part of quadrangle but thins toward southwest where it intertongues with Lapa lava member and consists of three tongues: one beneath the lava, another separates the two flows making up the lava, and a third overlies the lava. Lower and middle tongues pinch out southwestward within the quadrangle. Also includes layers of sandstone and volcanic breccia and locally a conglomerate at top. Overlies Río Matón formation.

Named for exposures along Highway 1, southwest of Cayey, beginning at Quebrada Santo Domingo and ending at the Río Matón, Cayey quadrangle.

Cayey Tuffs

Cretaceous: Puerto Rico.

J. D. Weaver *in* R. Hoffstetter and others, 1956, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2b, p. 319. Berkey (1915, New York Acad. Sci. Annals, v. 26, p. 29) suggested name for an extensive development of tuffs in vicinity of Cayey, but term has not been used since. [Term Sierra de Cayey tuffs is used on page 61.]

Cayuga Group[1] or **Dolomite**

Cayuga Series

Upper Silurian and Lower Devonian: New York, western Maryland, Pennsylvania, and Virginia.

Original reference: J. M. Clarke and C. Schuchert, 1899, Science, new ser., v. 10, p. 874-878.

H. P. Woodward, 1941, West Virginia Geol. Survey, v. 14, p. 145-257. Cayugan formations of West Virginia are Williamsport sandstone (redefined), Bloomsburg red-bed facies, and Wills Creek and Tonoloway limestones. Total thickness varies from 170 to more than 1,250 feet. Upper Silurian.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Cayugan series used for uppermost division of Silurian system. Includes interval above Niagaran series.

R. L. Miller and J. O. Fuller, 1954, Virginia Geol. Survey Bull. 71, p. 154–159, pls. In this report [Rose Hill district, Lee County], upper part of Cayuga is missing owing to faulting, and subdivision of beds of Cayuga age is not practical. Because of dominance of dolomite in sequence, unit is called Cayuga dolomite. Consists in general of basal sandstone several feet thick overlain by about 20 feet of blue-weathering limestone and then by thick-bedded dolomite that varies in thickness because it lies directly beneath overthrust fault plane. Not possible to determine true stratigraphic thickness in mapped area; where present, ranges from thin film to possible 90 feet. Thickness outside mapped area indicates that formation thins from northeast to southwest in Wise and Lee Counties. Unconformably overlies Clinton shale. Cayuga is youngest Silurian formation in region. In northeastern Lee County, underlies Lower Devonian Helderberg limestone; farther northeast in Virginia other Devonian formations are present in section. Despite length of hiatus contact of Brallier shale and Cayuga dolomite at Hagan is seemingly conformable.

L. V. Rickard, 1955, New York State Geol. Assoc. 27th Ann. Mtg., p. 7. In central New York, Upper Silurian Cayugan series (revised) contains Salina and Bertie formations. Underlies Helderbergian series (revised) of Lower Devonian.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. New York Silurian, standard reference section for United States, is divided into two series, an older, Niagaran, and a younger, Cayugan. This is departure from earlier usages involving three series. Cayugan series divided into two stages: Canastota(n) and Murder(ian) (both new). Rondout and Manlius formations, formerly included in Silurian are now placed in Early Devonian.

W. B. Brent, 1960, Virginia Div. Mineral Resources Bull. 76, p. 11 (table 1), 47. In Rockingham County, group comprises Bloomsburg formation and overlying Tonoloway limestone. Thickness 220 to 600 feet. Overlies Clinton formation.

U. S. Geological Survey currently designates the age of the Cayuga Series as Late Silurian and Early Devonian on the basis of a study now in progress.

Typically exposed at north end of Cayuga Lake, N.Y.

Cayuse Flow

Recent: Southwestern Oregon.

Howel Williams, 1944, California Univ. Pub., Dept. Geol. Sci. Bull. 27, p. 50 (fig. 4), 54. Discussion of volcanoes of Three Sisters region. Name applied to flow from Cayuse Cone.

Cayuse Cone is southeast of South Sister Mountain.

Cayuse Limestone

Precambrian (Belt Series): Northwestern Montana.

Charles Deiss, 1943, Geol. Soc. America Bull., v. 54, no. 2, p. 211, 213 (table 1), 215–216. Dull-gray crystalline buff-tan-weathering dolomite interbedded with pale-maroon and green-gray fissile argillite which grades upward into alternating zones of shaly bedded calcareous argillite and finally passes into sideritic and dolomitic hard marble; upper part blue- and dull-gray thick-bedded finely oolitic, coarsely crystalline algal limestone which shows typical bioherm structure. Thickness 1,000 to 2,100 feet; entire thickness exposed throughout distance of only 4 miles on upper part of hills west of South Fork and south of West Fork of Sun River. Unconformably overlies Miller Peak argillite north and south of Deer Creek; north of West Fork of Sun River, Cayuse is thrust upon Mississippian Hannan limestone and shale of Lower Cretaceous Kootenai along Lewis overthrust. Underlies Hoadley formation (new) with contact probably gradational. Miller Peak argillite, Cayuse limestone, Hoadley formation, and Ahorn quartzite (new) are equivalent in age to lower and middle part of Missoula group of Clapp and Deiss (1931) in Sapphire and Garnett Ranges. Report covers southwestern Saypo quadrangle.

Name derived from Cayuse Creek, tributary of South Fork of Flathead River in northern part of Ovando quadrangle, where formation is thickest.

Cayuta Shale Member (of Chemung Formation)[1]

Cayuta Formation (in Chemung Group)

Cayuta monothem

Upper Devonian: Western New York and northern Pennsylvania.

Original reference: H. S. Williams, 1906, Science, new ser., v. 24, p. 365–372.

Bradford Willard, 1937, Pennsylvania Acad. Sci. Proc., v. 11, p. 32, 33. Rank raised to formation in Chemung group. Geographically extended to Pennsylvania.

K. E. Caster, 1938, Jour. Paleontology, v. 12, no. 1, p. 45 (fig. 7), 47. Termed a monothem. Includes Starrucca shale member at top, Owego shale member below, and Cascade [also called Cascade Creek] sandstone member at base. Underlies Wellsburg monothem.

Exposed along Cayuta Creek from Cayuta Lake, Schuyler County, N.Y., to creek's discharge into Susquehanna River.

Cazenovia Group[1]

Cazenovia Stage

Middle Devonian (Erian): Eastern North America.

Original references: T. A. Conrad, 1841, New York Geol. Survey 5th Rept., p. 31; L. Vanuxem, 1842, Geology of New York, pt. 3, p. 150–160.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1733, chart 4. Cazenovia group of Conrad (1841) and Vanuxem (1842) revived and used as a stage term. As used here, includes strata from top of Onondaga to base of Centerfield, or the Marcellus and Skaneateles formations. In this report, the Devonian is subdivided into 10 stages of which the Cazenovia is fourth in sequence (ascending). Follows the Onesquethaw (new) and is succeeded by the Tioughnioga (new). [For complete sequence see Helderberg stage this reference.]

G. M. Ehlers *in* K. K. Landes, G. M. Ehlers, and G. M. Stanley, 1945, Michigan Dept. Conserv. Geol. Survey Div. 44, Geol. Ser. 37, p. 35 (table 1). In Mackinac Straits region, Michigan, Cazenovia group includes Dundee limestone. Overlies Detroit River group.

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 Cazenovia group including Marcellus and Skaneateles formations. Underlies the Tioughnioga group.

Type sction (stage) : In township of Cazenovia, N.Y., where entire sequence occurs. Group named for exposures at town of Cazenovia.

Cebada Fine-Grained Member (of Careaga Sandstone)

Pliocene, upper : Southern California.

W. P. Woodring, W. N. Bramlette, and K. E. Lohman, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 10, p. 1356–1358; W. P. Woodring and M. N. Bramlette, 1950, U.S. Geol. Survey Prof. Paper 222, p. 10, 32, 42–47, pl. 1. Consists of fine-grained generally massive soft sandstone; lower part typically very fine grained and light gray, but most of sandstone is light yellowish brown. Maximum thickness 1,000 feet. Lower member of Careaga. Gradationally overlies Foxen mudstone, and on north flank of eastern Purisima Hills overlaps part of Sisquoc formation; underlies Graciosa member of Careaga.

Type region : On north flank of Purisima Hills south of Careaga Station on the now abandoned Pacific Coast Railroad, Santa Maria district.

Cedar Formation[1]

Upper Triassic : Northern California.

Original references : J. S. Diller, 1892, Prelim. proof-sheet ed. of U.S. Geol. Survey Lassen Peak folio; 1895, pub. as U.S. Geol. Survey Geol. Atlas, Folio 15.

Named for exposures on Cedar Creek, along toll road between Redding and Round Mountain, Lassen Peak region.

†Cedar Limestone[1]

Middle and Upper Devonian : Eastern Iowa.

Original reference : D. D. Owen, 1852, Rept. Geol. Survey Wisconsin, Iowa, and Minnesota. p. xix.

Named for valley of Cedar River, eastern Iowa.

Cedar Bay Granite[1]

Mesozoic (?) : Southeastern Alaska.

Original reference : U. S. Grant and D. F. Higgins, 1910, U.S. Geol. Survey Bull. 443, p. 41–43, 46.

Surrounds two-thirds of Cedar Bay and forms core of neck of land between Wells Bay and passage northwest of Glacier Island, Prince William Sound region.

Cedar Butte Basalt[1]

Pleistocene : Southern Idaho.

Original references : H. T. Stearns, 1932, Correlation chart of Idaho compiled by M. G. Wilmarth, dated Sept. 1, 1932; 1936, Jour. Geology, v. 44, no. 4, p. 434–439.

H. T. Stearns, Lynn Crandall, and W. G. Steward, 1938, U.S. Geol. Survey Water-Supply Paper 774, p. 30 (table), 69, pl. 6. Aphanitic blue pahoehoe basalt with fresh green olivine phenocrysts. Thickness about 200 feet.

Type locality : Cedar Butte, T. 8 S., R. 29 E., Power County.

Cedar City Tongue (of Kayenta Formation)

Upper Triassic(?): Southwestern Utah.

Paul Averitt and others, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 12, p. 2521–2522. Largely nonresistant mudstone and siltstone. Mudstone and silty mudstone, which make up major part of total thickness, are reddish brown locally streaked and spotted light gray; siltstone, which forms beds 1 to 5 feet thick, is moderate reddish orange to light gray and is mottled with white in some places. In Chinle section along Coal Creek, measured by Thomas and Taylor (1946) and redescribed by Gregory (1950, Utah Geol. and Mineralog. Survey Bull. 37), rocks here assigned to Cedar City tongue are designated as units 28, 29, and 30; and units 23, 24, and 25, respectively. Thickness 425 feet along Coal Creek but 720 feet in Shurtz Creek, 5 miles south; this increase in thickness accompanies decrease in thickness of underlying Shurtz sandstone tongue (new) of Navajo sandstone.

U. S. Geological Survey currently considers the Cedar City tongue to be Upper Triassic(?). This age designation is made on basis of recent studies of the Kayenta.

Type locality: About 2 miles east of Cedar City, Iron County, directly east of the Red Hill. State Highway 14 crosses type locality a few hundred feet below power plant of Southern Utah Power Co.

Cedar Cliff Limestone Lens (in Wills Creek Shale)[1]

Cedar Cliff Limestone Member (of Williamsport Sandstone)

Upper Silurian: Western Maryland and northern West Virginia.

Original reference: C. K. Swartz, 1923, Maryland Geol. Survey, Silurian Volume, p. 41.

H. P. Woodward, 1941, West Virginia Geol. Survey, v. 14, p. 152, 162, 192. Reallocated to member status in Williamsport sandstone (redefined). Present in middle part of formation in area near Cumberland, Md.

Well exposed at Cedar Cliff, southwest of Cumberland, Allegany County, Md.

Cedar Creek Argillite[1] (in Stevens Series)

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), 609–611, pl. 1. Remapping of northeastern Stevens County and discovery of Cambrian and Ordovician fossils are thought to justify adoption there of formation names established by Parker and Cannon (1943) for Metaline quadrangle. Correlative with Maitlen phyllite are parts of Weaver's Northport limestone, Boundary argillite, Deep Lake argillite, and all of Cedar Creek argillite.

Exposed along road up Cedar Creek to Frisco-Standard mine and on north slopes of Red Top Mountain, Stevens County.

†Cedar Creek Beds[1]

Cedar Creek facies (of Brule Formation)

Cedar Creek Member (of White River Formation)

Oligocene, middle: Northeastern Colorado.

Original reference: W. D. Matthew, 1901, Am. Mus. Nat. History Mem., v. 1, pt. 7, p. 355–374, 444.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 16, pl. 1. Referred to as Cedar Creek facies of lower Brule formation. Apparently higher in volcanic ash than typical Orella member of Brule in Nebraska-South Dakota area. If considered valid and appropriate member name, it would have priority over Orella.

E. C. Galbreath, 1953, Kansas Univ. Paleont. Contr. 13, Vertebrata, art. 4, p. 14–16. Proposed here to use term Cedar Creek member of White River formation for the beds of Orellan age, composed of pink and tan sandstones and silts, that lie above disconformity separating Horsetail Creek member from this member or above the grayish-white silts where no disconformity is evident and that lie below a "white marker" which is lowest bed of Vista member (new). These deposits are, seemingly, Matthews's (1901) Cedar Creek beds, which Woods and others (1941) called Cedar Creek facies of Brule formation. Data on typical exposures. Location of Cedar Creek beds described by Matthew not definitely known.

Typically exposed in secs. 29 and 21, T. 11 N., R. 53 W., Logan County. Named for Cedar Creek, Logan County.

Cedar Creek 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, 12, 21, 36.

Best developed at type locality on Cedar Creek 1½ miles southwest of town of Cedar Creek, Cass County.

Cedar Fort Member (of Oquirrh Formation)

Pennsylvanian (Desmoinesian): Northwestern Utah.

H. J. Bissell, 1959, Utah Geol. Soc. Guidebook 14, p. 108–115, pls. 1, 2. Predominantly orthoquartzites, with subordinate amounts of cherty and argillaceous limestones, and some crystalline limestones and bioclastic limestones. Thickness 1,371 feet at type locality. Overlies Meadow Canyon member and underlies Lewiston Peak member (both new).

Type locality: On east limb of Pole Canyon syncline (west limb of West Canyon anticline) in sec. 36, T. 5 S., R. 3 W., Utah County. Section measured on spur south of small east-trending canyon bearing local name of Spring Creek. Named for exposures northwest of town of Cedar Fort.

Cedar Grove Sandstones (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. 169–178.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 91, 95, 104. Cedar Grove sandstones included in Kanawha group.

Named for its association with Cedar Grove coal, Cedar Grove, Kanawha County.

Cedar Hill Serpentinite

Lower Paleozoic: Northern Maryland and southeastern Pennsylvania.

D. M. Lapham, 1960, Pennsylvania Geologists Guidebook 25th Ann. Field Conf., p. 35–38. Cedar Hill serpentinite is within easternmost serpentinite belt of two such belts which trend northeast from Maryland into

Pennsylvania. Western belt trends approximately N. 30° E., is about 4 miles long and composed of small serpentine lenses separated by Peters Creek formation. Eastern serpentinite is essentially continuous, extending northeastward from Susquehanna River for about 15 miles and trending about N. 80° E. At Cedar Hill, contact with Peters Creek schist lies just north of Cedar Hill quarry. Further to the east, the serpentinite is in contact with Wissahickon schist. Both schist formations are believed to be lower Paleozoic in age.

Named for occurrence at Cedar Hill, Cecil County, Md.

Cedar Hills Anhydrite[1]

Permian: Central Kansas.

Original reference: R. G. Moss, 1932, Kansas Geol. Survey Bull. 19.

In Ness and Hodgeman Counties.

Cedar Hills Sandstone Member (of Hennessey Shale)

Cedar Hills Sandstone (in Cimarron Group)[1]

Cedar Hills Sandstone (in Nippewalla Group)

Permian: Southern Kansas and northern Oklahoma.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p 3, 24.

G. H. Norton, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 12, p. 1782, 1789–1791. Assigned to Nippewalla group (new).

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 39. Consists of feldspathic sandstone, siltstone, and silty shale, chiefly red, containing beds of white sandstone in upper and lower parts; upper part contains "snow balls" of white gypsum; shaly siltstone separates the more resistant and more massive coarse siltstone and very fine sandstone. Thickness about 180 feet. Underlies Flowerpot shale; overlies Salt Plain formation. Nippewalla group, Leonard series.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped as sandstone member of Hennessey shale.

Named for Cedar Hills, Barber County, Kans.

Cedar Keys Limestone

Cedar Keys Formation

Paleocene: Northern and central Florida (subsurface).

W. S. Cole, 1944, Florida Geol. Survey Bull. 26, p. 27–28. Term Cedar Keys formation is designed to cover rocks encountered in wells in peninsular and northern Florida from first appearance of *Borelis* fauna to top of Upper Cretaceous. Thickness 570 feet in Hilliard Turpentine Company No. (W–336) and 566 feet in Cedar Keys No. 2 (W–355).

P. L. Applin and E. R. Applin, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 12, p. 1699, 1704, 1708. Cedar Keys limestone overlies Lawson limestone (new) and underlies Oldsmar limestone (new).

R. O. Vernon, 1951, Florida Geol. Survey Bull. 33, p. 84–86. Cedar Keys formation, as used in this report, covers interval extending from top of *Borelis* fauna, or top of a characteristic lithology, to top of the Cretaceous, which, in Levy County, is upper Lawson limestone. Cole's Cedar Keys is thus expanded by inclusion of an indefinite thickness of beds at top and contracted by exclusion of upper Lawson. Applin (1944) applied name Cedar Keys to a similar interval and with this usage formation is much more uniform in its occurrence and thickness. Florida Geological Survey has accepted new definition but retains original name. Paleocene.

Type well and derivation of name not given.

Cedar Mesa Sandstone Member (of Cutler Formation)[1]

Cedar Mesa Formation (in Cutler Group)

Permian: Southeastern Utah.

Original reference: A. A. Baker and J. B. Reeside, Jr., 1929, Am. Assoc. Petroleum Geologists Bull., v. 13, no. 11, p. 1420, 1421, 1423, 1441, 1445, 1446.

S. A. Wengerd and M. L. Matheny, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 9, p. 2054, 2055. In revised terminology in Four Corners region, Cedar Mesa is raised to formation in Cutler group. Occurs above Halgaito formation.

J. H. Stewart, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 1855. Thickness of member about 800 feet in Monument Valley. Underlies Organ Rock tongue and overlies Halgaito tongue; in some areas overlies Rico formation.

Well exposed on Cedar Mesa, Utah, on San Juan River, west of Mexican Hat (Bluff post office).

†Cedar Mountain Beds[1]

Miocene, upper: Central Nevada.

Original references: J. C. Merriam, 1914, California Univ. Pub., Bull. Dept. Geol., v. 8, no. 12, p. 277; 1916, v. 9, p. 163–172.

Cedar Mountains.

Cedar Mountain Complex

Precambrian: Southwestern Minnesota.

E. H. Lund, 1956, Geol. Soc. America Bull., v. 67, no. 11, p. 1487–1489, pl. 1. Name applied to youngest of three groups of Precambrian igneous and metamorphic rocks exposed in Minnesota River valley. Consists of several small roughly circular intrusives; largest forms prominent knob called Cedar Mountain. Gabbro-diorite makes up bulk of rock in Cedar Mountain and forms outer shell 500 feet thick surrounding a granite core. Well-developed banding or primary flow structure is characteristic of Cedar Mountain gabbro and related types in other localities. Complex considered younger than rock types grouped in Minnesota Valley granite series.

Crops out in area south and southeast of Franklin, in Renville, Redwood, and Brown Counties.

Cedar Mountain Formation

Cedar Mountain Shale or Formation (in Dakota Group or Cedar Mountain Group)

Lower Cretaceous: Central Utah and northwestern Colorado.

W. L. Stokes, 1944, Geol. Soc. America Bull., v. 55, no. 8, p. 966–967, 989, table 1. Term Cedar Mountain shale proposed to include variegated beds between Buckhorn conglomerate (new) below and Dakota(?). Predominantly shale. Thins eastward: 272 feet at type locality: 100 feet, Cisco, Utah; 25 feet, Blue Mountain, Colo. Shale-conglomerate contact sharp though position of boundary depends on local position of conglomerates and may vary within vertical interval of 100 feet or more. Upper contact variable; in places is gradational into Dakota(?) beds; elsewhere is sharp but irregular. Together with Buckhorn conglomerate comprises Cedar Mountain group (new).

W. L. Stokes, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 9, p. 1774. Formation redefined to include Buckhorn conglomerate reduced to member status. Name applicable to Lower Cretaceous sediments of Utah west of Colorado River. For region east of Colorado River to an undetermined position in central Colorado, name Burro Canyon formation is applicable.

W. L. Stokes, 1952, Utah Geol. and Mineralog. Survey Bull. 46, p. 9 (table 1), 19–20, pl. 1. Described in Thompsons area where it is 110 feet thick; overlies Brushy Basin shale member of Morrison and underlies Dakota sandstone. Buckhorn conglomerate not represented in this area.

R. G. Young, 1959, Rocky Mountain Assoc. Geologists 11th Field Conf., Symposium, p. 17–21. Formation described in Grand Junction area, Colorado, where it disconformably underlies Naturita formation (new). Consists of basal conglomeratic sandstone unit and overlying variegated mudstone unit. In most localities, basal sandstone is massive cliff-forming unit with undulatory base and sharply defined upper surface. Farther west in Utah, three such sandstones, separated by mudstone units, are present in formation. These sandstones are termed Lower, Middle, and Upper Cedar Mountain sandstones. Lower, which is probably equivalent to Stokes' Buckhorn is present in deeper scours in Grand Junction area and is directly overlain in these scours by Middle sandstone. Where Lower sandstone is absent, the Middle sandstone constitutes the basal sandstone. Where only Middle sandstone is present basal unit averages about 25 feet thick, but where both sandstones are present it may be as much as 80 feet thick. Mudstone unit averages about 35 feet in Grand Junction area but slightly thicker along western edge. Included in Dakota group.

R. G. Young, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 2, p. 157–171, 180–181, 183, 188. Considered facies of Dakota group. Upper part of formation passes laterally into lower part of Naturita formation herein also considered facies of Dakota group. Proposed also to drop name Burro Canyon formation and retain older name Cedar Mountain formation for noncarbonaceous deposits of Dakota group throughout Colorado Plateau.

Type section: Southwest flank of Cedar Mountain, Emery County, Utah, just north of Buckhorn Reservoir.

Cedar Mountain Group

Lower Cretaceous(?): Colorado and Utah.

W. L. Stokes, 1944, Geol. Soc. America Bull., v. 55, no. 8, p. 987–989. Recommended that Buckhorn conglomerate and Cedar Mountain shales (both new) be called Cedar Mountain group and tentatively classed as Lower Cretaceous. On generalized section, group is above Morrison formation and below Dakota(?) sandstone.

Type area not stated. Cedar Mountain shale has its greatest development in central Utah and northwestern Colorado.

Cedar Park Member[1] (of Walnut Clay)

Lower Cretaceous (Comanche Series) : Eastern Texas.

Original reference : W. S. Adkins, 1933, Texas Univ. Bull. 3232, p. 239, 331.

V. E. Barnes, 1958, Texas Univ. Bur. Econ. Geology Guidebook 1, p. 24. Thickness commonly 10 feet or less.

Type locality : Quarries about 2 miles northwest of Cedar Park, Williamson County.

†Cedar Point Shales and Shaly Limestones[1]

Permian : Central Kansas.

Original reference : L. C. Wooster, 1905, The Carboniferous rock system of eastern Kansas.

Probably named for Cedar Point, Chase County.

Cedar Rapids phase (of Otis Limestone)[1]

Middle Devonian : Central eastern Iowa.

Original reference : W. H. Norton, 1921, Iowa Geol. Survey, v. 27, p. 378.

In quarries at Cedar Rapids and at numerous other exposures.

Cedar Spring Member (of Cove Mountain Formation)

Tertiary : Southwestern Utah.

E. F. Cook, 1960, Utah Geol. and Mineralog. Survey Bull. 70, p. 18 (fig. 1). White and pink airfall tuff, sediments, and green-tan-purple rhyolite vitric tuff. Thickness 300 feet. Upper part of formation; overlies Pilot Creek basalt member (new).

Occurs in Washington County. Type locality and derivation of name not stated.

Cedarton Shale Member (of Graford Formation)[1]

Cedarton Shale (in Graford Group)

Upper Pennsylvanian : Central Texas.

Original reference : N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 387, 391.

C. O. Nickell *in* Wallace Lee and others, 1938, Texas Univ. Bur. Econ. Geology Pub. 3801, p. 104–105. Underlies Winchell shale member (new).

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 Adams Branch formation ; underlies Winchell formation.

D. H. Eargle, 1958, San Angelo Geol. Soc. Guidebook, Apr. 17–19, p. 51. In Brown and Coleman Counties, member consists of shale, red in upper part and gray in lower part. Upper part locally contains fern leaf prints; lower part contains crinoid debris and a few fusulinids. Thickness about 70 feet. Overlies Adams Branch limestone member; underlies unnamed limestone at base of Winchell limestone.

Named for Cedarton, Brown County.

Cedartop Gypsum Member (of Blaine Gypsum)[1]

Permian : Southwestern Oklahoma and western Texas.

Original reference : C. N. Gould, 1902, Oklahoma Geol. Survey 2d Bienn. Rept., p. 42, 56.

R. L. Clifton, 1942, Jour. Paleontology, v. 16, no. 6, p. 686 (table 1). Table of upper Leonard series in Kansas, Oklahoma, and Texas shows Cedartop member above Medicine Lodge member and below Acme member.

T. S. Jones, 1953, Stratigraphy of the Permian Basin of West Texas: West Texas Geol. Soc., p. 30. Shown on correlation chart of West Texas.

G. L. Scott, Jr., and W. E. Ham, 1957, Oklahoma Geol. Survey Circ. 42, p. 22–23, pl. 1. New type locality designated. Present study shows that Haystack gypsum caps Cedartop Butte and since all rocks younger than Haystack have been eroded away, this butte cannot be type locality for what is here called Cedartop gypsum. At newly selected type locality, member is 10½ feet thick, separated from underlying Haystack gypsum member by 12½ feet of red and gray-green shale and from overlying Collingsworth gypsum member by 13½ feet of shale.

Type locality (redesignated): In bluffs about 250 yards north of Cedartop Butte, in the SE¼SE¼ sec. 35, T. 8 N., R. 21 W., Beckham County, Okla.

Cedar Vale Shale[1] Member (of Scranton Shale)

Cedar Vale Shale (in Wabaunsee Group)

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

Original reference: G. E. Condra, 1930, Nebraska Geol. Survey Bull. 3, p. 53.

R. C. Moore, 1936, Kansas Geol. Survey Bull. 22, p. 49 (fig. 11), 212. Rank raised to formation in Wabaunsee group. Term Scranton abandoned. Overlies Happy Hollow limestone; underlies Rulo limestone. Average thickness 25 feet.

L. W. Wood, 1941, Iowa Geol. Survey, v. 37, p 309 (fig. 14). Stratigraphic section shows occurrence in Adams County, Iowa.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 8, 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 Rulo limestone member: overlies Happy Hollow limestone member.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 14, fig. 5. Cedar Vale shale, Wabaunsee group, is marked by Elmo coal at top. Shale is gray and blocky and contains nodular limestone near top and center. Thickness 18 feet in drill hole near Coin. Overlies Happy Hollow limestone; underlies Silver Lake shale. Rulo limestone, which underlies Silver Lake in some areas has not been identified in Iowa.

Type locality: East of Cedar Vale, Chautauqua County, Kans.

Cedar Valley Limestone[1]

Cedar Valley Formation

Middle Devonian: Eastern Iowa, southwestern Illinois, and southeastern Minnesota.

Original reference: W. J. McGee, 1891, U.S. Geol. Survey 11th Ann. Rept., pt. 1, p. 314.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 9 (geol. column), 94–97. Geographically extended into southeastern Minnesota where it covers southwestern corner of Fillmore County, about three-quarters of Mower County, and part of southeastern Freeborn County. Thickness generalized section about 100 feet. Senecan series.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1750–1751, chart 4. Shown on correlation chart as Middle Devonian. However, age of Cedar Valley has long been a moot question. Known fauna of Cedar Valley contains no fossils of unequivocal late Devonian age. Evidence for age based on position of Independence shale leads to difficulties. Independence shale contains Chemung fauna, but Stainbrook (1935) believes that the Independence is stratigraphically below the Cedar Valley. Others believe that the Independence represents fillings of caverns in the Cedar Valley and that it is therefore younger than formation it seemingly underlies.

M. A. Stainbrook, 1944, Illinois Geol. Survey Bull. 68, p. 185–187. Formation includes (ascending) Linwood, Littleton, and Coralville members. Overlies Independence shale, probably unconformably; in some areas, overlies Davenport member of Wapsipinicon; in some areas, overlies Spring Grove member where Davenport has been eroded; in northern and western Iowa, may rest on Maquoketa or even Galena where it overlaps the Wapsipinicon. Stratigraphically below Shellrock formation. Upper Devonian.

D. L. Dunn, 1959, Jour. Paleontology, v. 33, no. 6, p. 1001–1017. Discussion of Devonian chitinozoans from Cedar Valley formation in Iowa. In this area, formation includes (ascending) Solon, Rapid, and Coralville members. Investigators are not in agreement concerning age of the Cedar Valley. Correlations discussed. Investigators who support cave-filling origin of underlying Independence shale, hold the Cedar Valley to lie conformably upon Davenport member of Wapsipinicon. The Cedar Valley overlaps the Silurian and Ordovician to north.

Named for exposures in valley of Cedar River, Iowa.

Cedarville Andesite[1]

Miocene: Northeastern California.

Original reference: H. A. Powers, 1932, Am. Min., v. 17, no. 7, p. 253–282.

In Modoc lava-bed quadrangle.

Cedarville Dolomite

Cedarville Dolomite (in Durbin Group)

Cedarville Limestone[1]

Middle Silurian: Southwestern Ohio and southeastern Indiana.

Original reference: E. Orton, 1871, Ohio Geol. Survey Rept. Prog. 1870, p. 271, 277–278, 301, 304–306.

D. A. Busch, 1939, (abs.) Geol. Soc. America Bull., v. 50, no. 12, pt. 2, p. 1976. Stratigraphically expanded below to include 43 feet of dolomite formerly included in the Huntington dolomite, as exposed at Ridgeville, Randolph County, Ind. As redefined, total thickness of Cedarville formation is 95 feet.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Shown on correlation chart as uppermost unit in Durbin group. Underlies Peebles dolomite.

Edwin Kirk, 1946, Washington Acad. Sci. Jour., v. 35, no. 2, p. 34. Referred to as Cedarville dolomite and noted as occurring in Indiana.

R. J. Bernhagen, chm., 1960, Ohio Acad. Sci. Geology Sec. Guidebook 35th Ann. Field Conf., p. 13, 17–19, 21. Silurian section in Yellow Springs region shows Cedarville dolomite, as much as 50 feet thick, above Springfield dolomite. Top of section. Niagaran.

Well exposed at Cedarville, Greene County, Ohio.

Cedarville Sandstone (in Monongahela Formation)[1]

Pennsylvanian : Northern West Virginia and western Maryland.

Original reference: D. B. Reger, 1916, West Virginia Geol. Survey Rept. Lewis and Gilmer Counties, p. 124.

Forms cliff at east end of Cedarville, Gilmer County, W. Va.

Cedarville Series[1]

Oligocene, middle, or Miocene : Northeastern California.

Original reference: R. J. Russell, 1928, California Univ. Pub., Dept. Geol. Sci. Bull., v. 17, no. 11, p. 402–416, map.

C. A. Anderson, 1941, California Univ. Pub., Dept. Geol. Sci. Bull., v. 25, no. 7, p. 352–353. Described in discussion of basement rocks of Medicine Lake Highland area. Exposures outside mapped area indicate Cedarville series probably underlie the highland. Character of underlying rocks unknown. Older than Warner basalt.

D. I. Axelrod, 1949, (abs.) Geol. Soc. America Bull., v. 60, no. 12, pt. 2, p. 1936. Lower Cedarville contains flora that is apparently mid-Oligocene in age.

Mapped over a large part of Warner Range, west of Cedarville, Modoc County.

Ceja Glorieta sandstone[1]

Permian : New Mexico.

Original reference: C. R. Keyes, 1935, Pan-Am. Geologist, v. 64, no. 4, p. 263.

†Cement shale[1]

Upper Devonian : Western Colorado.

Original reference : C. R. Keyes, 1924, Pan-Am. Geologist, v. 41, p. 281, 289.

Takes title from [exposures on?] Cement Mountain, a few miles from Crested Butte, Gunnison County.

Cement City Limestone Member (of Drum Limestone)

Cement City Limestone Bed (in Kansas City Formation)[1]

Pennsylvanian (Missouri Series) : Northwestern Missouri, southwestern Iowa, eastern Kansas, southeastern Nebraska, and northern Oklahoma.

Original reference: H. Hinds and F. C. Greene, 1915, Missouri Bur. Geology and Mines, v. 13, 2d ser., p. 7, 27–28, 118.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2030, 2031 (fig. 4). Member of Drum limestone. Underlies Corbin City limestone member; overlies Quivira shale member of Cherryvale formation. Northeastward tracing proves that Dewey member of the Drum is the same as limestone called Cement City in Kansas City area. Dewey has priority over Cement City (Hinds and Greene, 1915) and is recognized as a formational unit by Oklahoma Geological Survey. Kansas Geological Survey has used Cement City for lower member of Drum limestone and Cement City was recognized by the inter-state conference

(May, 1947). Kansas proposes to deviate from the interstate classification by adopting Dewey instead of Cement City. Other State surveys will continue to recognize Cement City until question of stratigraphic identity of the type of this unit (near Kansas City) and the Dewey is removed.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 37. Thickness near Winterset, Iowa, 6 feet; Sarpy County, Nebr., 11 feet. Persists southward into Oklahoma. Type locality stated.

Type locality: In cement plant quarry at Cement City, Jackson County, Mo.

Cemetery Limestone[1]

Upper Cambrian: Western central Montana.

Original reference: W. H. Weed, 1901, U.S. Geol. Survey 22d Ann. Rept., pt. 2, p. 434, 437.

Named for occurrence at Elkhorn cemetery, Elkhorn region.

Centennial Limestone[1]

Middle and Upper Cambrian and Lower Ordovician: Central northern Utah.

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

Probably named for Centennial mine, Tintic district.

Centennial Series

Precambrian: Southeastern Wyoming.

J. J. Runner, 1928, (abs.) Geol. Soc. America Bull., v. 39, no. 1, p. 202. Name proposed for metalimestone schist series intruded by older gray granites and lying stratigraphically below Deep Lake metaquartzite. Occurs below Snowy Range series (new).

Area is west, northwest, and north of Centennial, Medicine Bow Mountains, Albany County.

Centennial School Sandstone and Shale Member (of Bald Eagle Sandstone)

Upper Ordovician: Central Pennsylvania.

F. M. Swartz, 1957, Pennsylvania State Univ., Dept. Geology Contr. 3, 58p. Lower member of Bald Eagle in vicinity of Tyrone Gap. Underlies Spring Mount sandstone member (new). Overlies Reedsville shale. [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.

Centerfield Coral Bed

See **Mahantango Formation** (in Hamilton Group).

Centerfield Limestone Member (of Ludlowville Shale)[1]

Centerfield Formation

Middle Devonian: Central and western New York and eastern Pennsylvania.

Original reference: J. M. Clarke, 1903, New York State Mus. Handb. 19, p. 22.

G. A. Cooper and A. S. Warthin, 1942, Geol. Soc. America Bull., v. 53, no. 6, p. 876 (fig. 2), 877–878. Formation, at type section, consists of 5 feet of alternating shale and limestone bands, the latter as much as 4 inches thick. This is overlain by about 6 feet of sandy limestone abounding in corals. Formation thins westward to 4½ feet at Blossom in Erie County where it is mostly limestone. West of Blossom on Lake Erie shore, approximate position of the Centerfield is marked by a thin layer of limestone containing abundant *Styliolina*. East of type section, sand content increases, and differentiation into alternate bands of shale and limestone disappears. On Seneca and Cayuga Lakes, formation is fairly homogeneous sandy limestone about 30 feet thick. In Erie County, N.Y., overlies Levanna shale and underlies Ledyard shale; at Skaneateles Lake, overlies Butternut shale and underlies a coral bed. Where exposed in eastern Pennsylvania near Stroudsburg, consists of 23 feet of bluish calcareous sandstone containing corals.

T. B. Coley, 1954, Jour. Paleontology, v. 28, no. 4, p. 453, 454, 455. Referred to as formation. Underlies Ledyard formation; overlies Levanna formation. Ostracodes discussed.

R. S. Boardman, 1960, U.S. Geol. Survey Prof. Paper 340, p. 3–4. Member occurs at base of Ludlowville shale. Thickness at type locality 20 feet. Underlies Ledyard member. Contains lowest occurrence of trepostomatous Bryozoa known in Hamilton group.

Type section: On Schaffer Creek, about 1 mile north of Centerfield, Canandaigua quadrangle, New York.

Center Hall Formation[1]

See Centre Hall Member (of Nealmont Limestone).

Center Iron Sandstone (in Clinton Formation)[1]

Center Iron Sandstone (in Rose Hill Shale)

Middle Silurian: Central southern Pennsylvania.

Original reference: C. K. Swartz and F. M. Swartz, 1931, Geol. Soc. America Bull., v. 42, p. 625, 628, 629, 634, 638.

F. M. Swartz and H. J. Hambleton, 1958, Pennsylvania State Univ. Mineral Industries Expt. Sta. Bull. 71, p. 19, 21–22, 27. At Center, about 36 feet of Center iron sandstones are exposed along road where Center member was originally measured; 2 miles south of New Germantown where road crosses plunging nose of anticlinal Rising Mountain, the sandstone is more than 60 feet thick and occurs in upper part of Rose Hill shale about 150 to 210 feet below Keefer sandstone; thickens eastward to 210 feet at Susquehanna Gap; thins and gradually disappears northwest of Center and New Germantown.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 29. Unit renamed Burnt Ridge sandstone member of Rose Hill.

Named from exposures south of Center village, Perry County.

Center Peak Conglomerate Member (of Panoche Formation)

Lower Cretaceous: Southern California.

W. P. Popenoe, R. W. Imlay, and M. A. Murphy, 1960, Geol. Soc. America Bull., v. 71, no. 10, chart 10e (column 15). Shown on correlation chart at base of Panoche formation. Underlies Curry Mountain shale member.

Centerpoint volcanic facies (of Eagleford Formation)

Upper Cretaceous: Southwestern Arkansas.

R. T. Hazzard, 1939, Shreveport Geol. Soc. Guidebook 14th Ann. Field Trip, p. 143, 147–148. Red and gray clays with interbedded pebbly tuffaceous sandstones. Overlies the Trinity; underlies Tokio formation. Name implies that this group of rocks is a volcanic facies of the Eagleford formation of northeast Texas. Unit has commonly been referred to as the volcanic "Woodbine."

Settlement of Centerpoint in Howard County is located within the area of the outcrops and within relatively short distances of the upper and lower contacts of the formation.

Centerville Clay

Centerville Formation[1]

Lower Silurian (Albion Series): Southwestern Ohio and southeastern Indiana.

Original reference: A. F. Foerste, 1931, Kentucky Geol. Survey, ser. 6, v. 36, p. 173, 184–185.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Shown on correlation chart as Centerville clay; stratigraphically below Brassfield limestone. Included in Albion series.

Named from exposures east of Centerville, Montgomery County, Ohio.

Centerville Limestone[1]

Silurian (Niagaran): Western Tennessee.

Original reference: A. F. Foerste, 1901, Geol. Soc. America Bull., v. 12, p. 397, 402, 407.

Named for exposures at Centerville, Hickman County.

Centinela Gravels[1]

Pleistocene: Southern California.

Original reference: A. J. Tieje, 1926, Am. Assoc. Petroleum Geologists Bull., v. 10, no. 5, p. 510.

Exposed south of Centinela Creek, Los Angeles County.

†Central Limestone and Shale Group[1]

Lower, Middle, and Upper Ordovician: Central and eastern Tennessee.

Original reference: J. M. Safford, 1856, Geology Reconn. Tennessee 1st Rept., p. 149, 154–156.

Named for central basin of middle Tennessee.

Central City Granite[1]

Central City Quartz Bostonite

Precambrian(?): Central northern Colorado.

Original references: J. Underhill, 1906, Univ. Colorado Studies, v. 3, no. 4, p. 272; 1906, Colorado Sci. Soc. Proc., v. 8, p. 103–122.

George Phair, 1952, U.S. Geological Survey Trace Elements Inv. Rept. TEI–247, p. 26. Referred to as quartz bostonite.

Occurs only on each side and a little south of head of Spring Gulch, just south of Central City Railroad station, Gilpin County.

Central Fee sandstone unit (in Sycamore Canyon Member of Puente Formation)

Miocene, upper: Southern California.

C. J. Kundert, 1952, California Div. Mines Spec. Rept. 18, p. 6 (fig. 2), 7, pl. 2. Series of sandstone and sandy siltstone beds in upper part of

Sycamore Canyon member. Thickness approximately 1,050 feet. Underlies Hoover conglomerate unit (new) of Sycamore Canyon member.

Occurs in Whittier-La Habra area, south of Whittier fault, Los Angeles County.

Centralia cyclothem (in McLeansboro Group)

Pennsylvanian: Southwestern Illinois.

J. R. Ball, 1943, Illinois Acad. Sci. Trans., v. 36, no. 2, p. 147, 148. In sequence in Carlinville quadrangle. Centralia cyclothem occurs below Macoupin cyclothem and above Shoal Creek cyclothem. Thickness about 5 feet; cyclothem not fully developed in quadrangle. The included fossiliferous limestone [probably Centralia limestone] is about 17 feet above the Shoal Creek limestone.

Type locality and derivation of name not given.

Centralia Limestone (in McLeansboro Formation)[1]

Pennsylvanian: Southwestern Illinois.

Original reference: J. R. Ball, 1934, Illinois Acad. Sci. Trans., v. 26, no. 3, p. 97.

Derivation of name not stated, but probably is Centralia, southwest corner of Marion County.

Centralian Epoch or Series[1]

Pleistocene (Illinoian and Sangamonian): Illinois and Iowa.

Original reference: G. F. Kay, 1931, Geol. Soc. America Bull., v. 42, pt. 1, p. 449–452.

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 38. In Iowa and Illinois, the Pleistocene is classed as a period (system) and four epochs (series) are used to include a glacial-interglacial pair each. These are Grandian (Nebraskan and Aftonian), Ottumwan (Kansan and Yarmouthian). Centralian (Illinoian and Sangamonian), and Eldoran (Wisconsinan and Recent). Of these units, each of the first three essentially coincides with a glacial cycle; present data indicate that the youngest (Eldoran) includes two distinct cycles, each of which is complex within itself. These terms have not been adopted for official use in Kansas partly because of this inconsistency and partly because retention of Quaternary as the System-Period with Pleistocene as its contained Series-Epoch would necessitate erection of new category of names to include these terms and thus produce further complication of classification system.

Named for Centralia, Marion County, Ill.

†Central Mine Conglomerate[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: A. R. Marvine, 1873, Michigan Geol. Survey, v. 1, pt. 2, p. 80–81, chart.

Houghton County.

Central Mine Group[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: A. C. Lane and A. E. Seaman, 1907, Jour. Geology, v. 15, p. 680, 689.

W. S. White, H. R. Cornwall, and R. W. Swanson, 1953, U.S. Geol. Survey Geol. Quad. Map GQ–27. Name Portage Lake lava series (new) proposed to include Eagle River, Ashbed, Central Mine, and Bohemian Range groups of old reports. These older subdivisions are quite arbitrary and depend on continuity of individual flows or conglomerate beds for validity. They are not useful for purpose of this report.

Well exposed in workings of Central mine on a cross-fissure, exposing a good section (secs. 24, 25, 36, T. 58 N., R. 31 W.).

Central Valley Beds[1]

Precambrian (Keweenawan) : Northern Michigan.

Original reference: R. D. Irving, 1883, U.S. Geol. Survey Mon. 5, p. 187.

Derivation of name not stated.

Central Valley Sandstone

Lower Devonian : Southeastern New York.

A. J. Boucot, 1959, Jour. Paleontology, v. 33, no. 5, p. 728–730, 731 (fig. 2). Consists of white-weathering, mottled violet sandstone with a 1-foot bed of white-weathering chert at top of unit. Fossiliferous. Thickness about 25 feet. Lower contact covered; sandstone may rest on beds of New Scotland age or may rest on strata of pre-New Scotland, Upper Silurian age. Underlies Connelly conglomerate, contact abrupt.

Type section: In Thruway cut at Highland Mills, Orange County. This is only known exposure of unit. Name derived from Central Valley. Section is located on eastern side of Green Pond-Schunemunk Mountain outlier.

Centre Hall Member (of Nealmont Limestone)

Middle Ordovician : Central and central southern Pennsylvania.

Original reference (Center Hall) : R. M. Field, 1919, Am. Jour. Sci., 4th, v. 48, p. 404, 417–419, 422.

G. M. Kay, 1944, Jour. Geology, v. 52, no. 1, p. 3; no. 2, p. 97–101, 103. Rank reduced to member of Nealmont limestone. Overlies Oak Hall member (new) ; underlies Rodman member. Thickness about 45 feet.

Named for village of Centre [Center] Hall, Centre County.

Centre Point division[1]

Pleistocene : Southwestern Arkansas.

Original reference: R. T. Hill, 1888, Arkansas Geol. Survey Ann. Rept. 1888, v. 2, p. 29, 35–42, 188.

Named for exposures at Centre Point, Howard County.

Cerbat Complex

Precambrian : Northwestern Arizona.

B. E. Thomas, 1949, Economic Geology, v. 44, no. 8, p. 666, fig. 2; 1953, Geol. Soc. America Bull., v. 64, no. 4, p. 393–403, pl. 1. Basement assemblage of metamorphic and igneous rocks. Oldest-rocks of vertical to steeply dipping layers of hornblende-diopside schist and amphibolite, biotite schist, quartzite, and lit-par-lit gneiss. These rocks typically occur together but in no particular sequence. Layered rocks are intruded by granite magma, and granite gneiss is predominant rock type in complex. Perhaps fifty percent of gneiss is migmatite, whereas balance is believed to be orthogneiss. Thick sheets of pegmatite injected between layers of metamorphic rocks in many places. Aplite or aplitic granite commonly associated with pegmatite dikes. Diabase dikes, ranging in width from few feet to 150 feet, also common. Narrow zones of mylonite scattered throughout complex. The coarsely porphyritic Diana granite (new), which is preserved in the schists in western half of Chloride district, is only unit of complex that was mapped separately. Capped along extreme eastern and southern borders of range by isolated Tertiary volcanic rocks including Bull Mountain series (new). Intruded by Ithaca Peak granite porphyry (new).

Forms bulk of Cerbat Mountain, Mohave County.

Cerro Glaciation

Cerro Till[1]

Cerro glacial stage[1]

Pleistocene (pre-Wisconsin): Southwestern Colorado.

Original references: W. W. Atwood and K. F. Mather, 1915, U.S. Geol. Survey Prof. Paper 95, p. 14, pl. 1; 1924, Geol. Soc. America Bull., v. 35, p. 122; 1932, U.S. Geol. Survey Prof. Paper 166.

K. F. Mather, 1957, New Mexico Geol. Soc. Guidebook 8th Field Conf., p. 106. Cerro glacial stage mentioned in report on geomorphology of San Juan Mountains. First of three Pleistocene glaciations identified in area. Older than Durango glacial stage.

Named for Cerro Summit, about 12 miles east of Montrose, Montrose County.

Cerro Gigante Basalt

Oligocene or Miocene: Panamá.

S. M. Jones, 1950, Geol. Soc. America Bull., v. 61, no. 9, p. 898 (table 2), 901–902. Unit is discussed under general heading "Bruja Island dolerite, Cerro Gigante basalt, and related igneous rocks." These include lower Miocene flows, plugs, and dikes of basic rock, hard and generally moderately joined; unconformable below Gatun formation and above upper Caimito member. "Basalt" is used in this paper as a 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. 330. Oligocene or Miocene. Derivation of name.

In Gatún Lake area. Cerro Gigante is name of peak about 8 kilometers southwest of Barro Colorado Island.

Cerro Gordo Clay[1]

Lower Cretaceous (Comanche Series): Southwestern Arkansas.

Original reference: R. T. Hill, 1888, Arkansas Geol. Survey Ann. Rept. 1888, v. 2, p. 111, 188.

Underlies the poor lands from Cerro Gordo, Little River County, to within 6 miles of Rocky Comfort, extending east to Cane Creek.

Cerro Gordo Substage[1]

Cerro Gordo Member (of Lime Creek Formation)

Upper Devonian: Central northern Iowa.

Original reference: C. L. Fenton, 1919, Am. Jour. Sci., 4th, v. 48, p. 355–376.

M. A. Stainbrook, 1944, Illinois Geol. Survey Bull. 68, p. 182 (fig. 1), 187. Middle member of Lime Creek formation. Overlies Juniper Hill member; underlies Owen limestone member. Consists of fossiliferous shale.

Named for exposures in Cerro Gordo County.

Cerros Shale Member (of Lodo Formation)

Paleocene and Eocene: Southern California.

R. T. White, 1938, (abs.) Geol. Soc. America Proc. 1937, p. 256–257. Named as basal member of newly defined Lodo formation. Underlies Cantua sandstone member.

R. T. White, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 10, p. 1722–1727, 1734, 1738. Described as lithologically identical with the Lodo and recognizable as a distinct cartographic unit only where it is overlain by the Cantua sandstone. Anderson and Pack (1915) mapped the unit as basal part of the Cantua. Thickness at type locality about 630 feet. Overlies Moreno shale.

J. E. Schoellhamer and D. M. Kinney, 1953, U.S. Geol. Survey Oil and Gas Inv. Map OM–128. Described at type section as consisting of about 50 feet of massive highly glauconitic siltstone and sandy siltstone overlain by 523 feet of gray claystone; a 4-foot medium-grained arkosic sandstone is present 194 feet above base. Paleocene and Eocene.

Type locality: Cerros Hill on west side of Tumey Gulch at the west corner sec. 14, T. 16 S., R. 12 E., M. D. B. and M., Fresno County. No geographic names were available, so the conspicuous hill where the member is exposed was named Cerros Hill.

Cerrotejonian Stage

Pliocene, early: California.

D. E. Savage, 1955, California Univ. Pubs. Geol. Sci., v. 31, no. 1, p. 11–19. Stage based on mammalian faunal assemblage. Subjacent to Montediablan stage (new). Contemporaneous with earlier part of North America Clarendonian age of Wood and others (1941).

Type section: In nonmarine and marine deposits mapped as Santa Margarita by Hoots (1930) in Tejon Hills, Kern County. This is 100 miles from type exposure of Santa Margarita formation.

Chacha Limestone

Pleistocene or early Holocene: 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]. Chatcha limestone named on correlation chart. Pleistocene.

Risaburo Tayama, 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 57–58, table 4 [English translation in library of U.S. Geol. Survey, p. 68–69]. Raised coral reef limestone. Consists primarily of corals and lesser amounts of *Halimeda* on Saipan but on other islands consists primarily of *Halimeda* and secondarily of corals. Correlated with Rota limestone on Rota, Sonson limestone on Tinian, and Barrigada limestone on Guam. Younger than Mariana limestone.

S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 26. Early Holocene.

P. E. Cloud, Jr., R. G. Schmidt, and H. W. Burke, 1956, U.S. Geol. Survey Prof. Paper 280–A, p. 88. Tanapag limestone as used in this report includes rocks which Tayama called Chacha limestone.

Type locality: Chacha, Saipan.

Chaco marl[1]

Eocene: Northwestern New Mexico.

Original reference: C. R. Keyes, 1906, Geol. Soc. America Bull., v. 17, p. 725.

Derivation of name not given.

†Chacra Sandstone Member (of Mesaverde Formation)[1]

Upper Cretaceous: Northwestern New Mexico.

Original reference: C. H. Dane, 1936, U.S. Geol. Survey Bull. 860-C.

E. C. Beaumont, C. H. Dane, and J. D. Sears, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2158–2159. Beds that were included in Chacra sandstone member by Dane (1936) appear to be about equivalent to combined upper two southward-extending tongues of Cliff House sandstone northeast of Newcomb. Cliff House sandstone of Mesaverde group, therefore, will replace Chacra sandstone member throughout the former extent of that unit.

In Chacra Mesa coal field.

Chacra[1] terrane

Cretaceous: New Mexico.

Original reference: C. R. Keyes, 1915, Conspectus of geological formations of New Mexico; Des Moines, Robert Henderson, State Printer.

San Juan region.

Chadakoin Beds[1]

Chadakoin Formation (in Arkwright Group)

Chadakoin Group

Upper Devonian: Western New York and northwestern Pennsylvania.

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, 32–33; 1955, New York State Mus. Sci. Service Circ. 42, p. 11, 12. Upper formation in Arkwright group (new). Composed of approximately 420 feet of gray siltstone beds with some interbedded gray shale, especially near top of formation. Comprises Dexterville member below and Ellicott member above. Overlies Canadaway formation; underlies Cattaraugus formation of Conewango group. Chautauquan series.

L. V. Rickard, 1957, New York Geol. Assoc. Guidebook 29th Ann. Mtg., p. 17 (table 2), 18–19. Rank raised to group. Includes beds between base of Wellsville formation and Germania formation. Approximately same as Conneaut group (Chadwick, 1934, Bulls. Am. Paleontology, v. 21, no. 71). Comprises (ascending) Wellsville formation, Hinsdale sandstone, Whitesville formation, and Germania formation. Thickness about 585 feet. Overlies Canadaway group; underlies Conewango group. Chautauquan series.

Named for exposures in quarries at Dexterville (Jamestown) on Chadakoin River, Chautauqua County, N.Y.

Chadron Formation[1] (in White River Group)

Oligocene, lower: Western Nebraska, northeastern Colorado, Montana, South Dakota, North Dakota, and eastern Wyoming.

Original reference: N. H. Darton, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 4, p. 736, 759, pl. 82.

C. B. Schultz and T. M. Stout, 1938, (abs.) Geol. Soc. America Bull., v. 49, no. 12, pt. 2, p. 1921. In northwestern Nebraska, contact between Chadron and overlying Brule is provisionally drawn at base of a certain continuous purple-tinted white sometimes silicified limestone layer, which is the upper of several such limestone beds in lower part of the local section.

R. L. Nace, 1939, Wyoming Geol. Survey Bull. 27, p. 31–35, 43. Described in Red Desert area, Wyoming, where it is about 218 feet thick and includes Beaver Divide conglomerate member (new) in basal part. Disconformable above Continental Peak formation.

John Clark, 1954, Carnegie Mus. Annals, v. 33, art. 11, p. 197. In Big Badlands area, South Dakota, subdivided into (ascending) Ahearn, Crazy Johnson, and Peanut Peak members, standard section designated for South Dakota.

N. M. Denson and others, 1955, U.S. Geol. Survey Coal Inv. Map C–33. Mapped in Billings and Golden Valley Counties, N. Dak.

C. B. Schultz and T. M. Stout, 1955, Nebraska Univ. State Mus. Bull., v. 4, no. 2, p. 25–38, figs. 3, 10, tables 1, 2. Darton did not specify type locality for Chadron. He stated in 1931 (Wilmarth, 1938, p. 393) that the formation was named for exposures at Chadron, Nebr. However his 1899 illustration of section at Chadron does not show exposure of this formation and his text references show no familiarity with the outcrops shown on his map near there. For all practical purposes his knowledge of the Chadron seems to have been derived in northwestern Nebraska from his "Adelia" section, northwest of Crawford, Sioux County, Nebr. "Adelia" section is section used for discussion in present report. Detailed description in western Nebraska. Three divisions, lower, middle, and upper, recognized. Lower is essentially Yoder of Schlaikjer (1935) and Ahearn of Clark (1954); middle is probably only in part equivalent to Crazy Johnson of Clark (1954); upper corresponds closely to Peanut Peak of Clark. Thickness 143 to 209 feet. Underlies Brule formation. Writers depart from their 1938 action in defining base of Brule as base of upper purplish-white layer and top of upper purplish-white layer is herein suggested as redefined plane of division between Chadron and Brule. In Crawford, Nebraska area, overlies Cretaceous Pierre shale; in Torrington area, Wyoming, underlies Cretaceous Lance formation.

L. J. Bjorklund and R. F. Brown, 1957, U.S. Geol. Survey Water-Supply Paper 1378, p. 26. Underlies flood plain of South Platte River from near Proctor, Colo., eastward to Sedgwick, Colo. Exposures are abundant north of river from Sterling to Proctor.

W. T. Thom, Jr., 1957, Billings Geol. Soc. Guidebook 8th Ann. Field Conf., p. 11 (table 1). Geographically extended into Crazy Mountain Basin, Mont., where it consists chiefly of volcanic ash, silt, and sand.

Standard section: In Big Badlands on south fork of Indian Creek, from sec. 34, T. 3 S., R. 12 E., to sec. 10, T. 4 S., R. 12 E., Pennington County, S. Dak. Named for exposures at Chadron, Dawes County, Nebr.

Chadronian 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 the Chadron formation, type locality near Chadron, Nebraska. Includes the old term "*Titanotherium* *beds*," used in its more extended sense. Covers the interval between the Duchesnean (Eocene) and Orellan (Oligocene) ages. Report defines 18 provincial time terms, based on mammal-bearing units, for the North American continental Tertiary. [For sequence see under Puercan.]

Type area: Northwestern Nebraska and southwestern South Dakota.

Chaffee Formation[1]

Upper Devonian: Central Colorado.

Original reference: E. Kirk, 1931, Am. Jour. Sci., 5th, v. 22, p. 229–230.

Ogden Tweto and T. S. Lovering, 1947, Colorado Mining Resources Board [Bull.], p. 380 (chart). In Gilman district, includes Parting quartzite member below and Dyer dolomite member above. Thickness about 120 feet. Overlies Harding sandstone; underlies Gilman sandstone member (new) of Leadville limestone.

Ogden Tweto, 1949, Colorado Sci. Soc. Proc., v. 15, no. 4, p. 152 (table 1), 169–177. Described in Pando area where it unconformably overlies Harding quartzite or Peerless formation and unconformably underlies Gilman sandstone member of Leadville dolomite. Comprises two members. Parting quartzite below and Dyer dolomite above. Thickness 118 to 137 feet.

I. N. Mackay, 1953, Colorado School Mines Quart., v. 48, no. 4, p. 21–28, pls. Described in Eagle and Pitkin Counties, where it disconformably overlies Manitou dolomite and is in contact with overlying Leadville limestone along an erosional surface. Includes Parting and Dyer members. Thickness 216 to 233 feet.

M. G. Dings and C. S. Robinson, 1957, U.S. Geol. Survey Prof. Paper 289, p. 13–15. Described in Garfield quadrangle where it is 150 to 250 feet thick and includes both Parting quartzite and Dyer dolomite members. Erosional unconformities of low relief separate it from underlying Fremont dolomite and overlying Leadville limestone.

Named for Chaffee County where it is well exposed south of Arkansas River about 5 miles southeast of Salida, and on western slope of Monarch Mountain, at Monarch, about 15 miles southwest of Salida.

Chaffin Limestone Member (of Thrifty Formation)[1]

Chaffin Formation (in Thrifty Group)

Upper Pennsylvanian: Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 410–412.

C. O. Nickell, 1938, *in* Wallace Lee and others, Texas Univ. Bur. Econ Geology Pub. 3801, p. 127–128. Chaffin limestone member, at type locality, crops out above Chaffin coal and is 20 feet thick, Within 200 yards to the north, it is cut out by unconformity and replaced by sandstone of later age. Where Chaffin limestone reappears east of Rockwood, two limestones are present, separated by 12 feet of shale. Some observers have considered these two beds to represent bifurcation of the Chaffin as it appears south of Colorado River, but presence of carbonaceous shale in position of Chaffin coal below the thick upper limestone near Rockwood suggests that lower bed there may be a separate limestone bed in Lohn shale member. Plummer and Moore (1921, Texas Univ. Bull. 2132) correlated upper and lower limestone beds of split Chaffin limestone with Breckenridge limestone and Blach Ranch limestone, respectively, of Brazos River basin, where the Blach Ranch, like the Chaffin, has a thin coaly bed below it. Top member of Thrifty formation. Overlies Parks Mountain sandstone member; underlies Harpersville formation.

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 Obregon formation (new); overlies Breckenridge formation. Consists of an upper thin limestone member about 20 feet above a thicker limestone member, both fusulinid-bearing; these are separated from basal Parks Mountain sandstone member by shale.

D. H. Eargle, 1958, San Angelo Geol. Soc. Guidebook, Apr. 17–19, p. 50. Shown on composite stratigraphic section of Brown and Coleman Counties as limestone member at top of Thrifty formation. Consists of gray, slabby limestone, commonly purple blotched; fusulinids and "seaweed" structures abundant. Overlies Parks Mountain sandstone member; underlies Waldrip shale member of Permian Pueblo formation.

D. A. Meyers, 1958, Jour. Paleontology, v. 32, no. 4, p. 678 (fig. 1). Member shown on stratigraphic column as occurring above Breckenridge member.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 215–D, p. 74, pl. 27. Drake (1893) traced the Chaffin limestone across Coleman and Brown Counties. From vicinity of Home Creek northward, he found two limestones and called the lower one the lower Chaffin limestone. The lower Chaffin is here correlated with Breckenridge limestone member. The generally persistent upper part of Chaffin limestone member has been variously called Breckenridge limestone (Plummer and Moore), Upper Crystal Falls limestone (Hudnall and Pirtle, 1929, Geologic map of Coleman County; 1931, Geologic map of Brown County), Chaffin limestone (Sellards, 1933, Texas Univ. Bull. 3232), Breckenridge limestone (Bullard and Cuyler, 1935, Texas Univ. Bull. 3501), and Crystal Falls limestone (Chaney, 1950, Abilene Geol. Soc. Guidebook Nov. 2–4). Chaffin limestone member immediately south of Colorado River ranges from about 15 feet in thickness at Chaffin mines to about 7 feet at Waldrip. At this locality, it is a slabby irregularly bedded gray limestone, stained purplish red. Contains abundant fusulinids and thin wavy structures of clear calcite. These structures characterize bed over most of Coleman County. Thins northward. Average thickness 1 to 2 feet in Brown County. Overlies Parks Mountain sandstone member; underlies Waldrip shale member of Pueblo formation.

Named for Chaffin coal mine, 2 miles east of Waldrip, McCulloch County.

Chagres Alluvium

Pleistocene and Recent: Panamá.

S. M. Jones, 1950, Geol. Soc. America Bull., v. 61, no. 9, p. 898 (table 2), 904. Alluvial deposits of interbedded clays, silts, sands, and gravels, variably loose to well compacted. Intergrades locally with Atlantic muck. Table 2 shows thickness of Chagres alluvium, Chagres gravel, Atlantic muck, and Pacific muck 300 feet. Pleistocene and Recent.

Present along Chagres River valley and its tributaries, the Río Gatún, and Río Trinidad, and other principal valleys, vicinity of Lake Gatún.

Chagres Sandstone[1]

Pliocene, lower: Panamá.

Original reference: D. F. MacDonald, 1919, U.S. Nat. Mus. Bull. 103, p. 532.

W. P. Woodring, and T. F. Thompson, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 2, p. 244, 246 (fig. 2). Includes Toro limestone member at base. Chagres proper above Toro member consists of very massive mostly fine-grained sandstone and some siltstone. Thickness difficult to determine; MacDonald considered it to be 1,000 feet or more. Overlies and partly overlaps Gatún formation; base sharply defined. Fossil evidence indicates late Miocene age; however, it may be early Pliocene if the coastal Gatún west of Canal Zone is 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. 12, 47–50, pl. 1. Lower Pliocene.

Named for exposures that overlook coast from Toro Point to mouth of Río Chagres. Outcrop area lies west of Canal, and extends from Canal Zone southwestward along Caribbean coast to between Río Indio and Río Miguel.

Chagrin magnafacies[1]

Upper Devonian: Northwestern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 28.

W. L. Grossman, 1944, Geol. Soc. America Bull., v. 55, no. 1, p. 46. An attempt to apply Caster's (1934) system of facies classification to Genesee rocks of New York was not wholly successful. The Chagrin magnafacies not recognized.

Chagrin Shale[1]

Chagrin Shale Member (of Ohio Formation)

Upper Devonian: Northern Ohio and western Pennsylvania.

Original reference: C. S. Prosser, 1903, Jour. Geology, v. 11, p. 521.

R. E. Lamborn, C. R. Austin, and Downs Schaaf, 1938, Ohio Geol. Survey, 4th ser., Bull. 39, p. 37–42; Wilber Stout, Karl Ver Steeg, and G. F. Lamb, 1943, Ohio Geol. Survey, 4th ser., Bull. 44, p. 131, chart facing p. 108. Member of Ohio formation. Overlies Huron member; underlies Cleveland member.

Wallace de Witt, Jr., and D. F. Demarest, 1954, U.S. Geol. Survey Prof. Paper 259, p. 17; K. V. Hoover, 1960, Ohio Geol. Survey Inf. Circ. 27, p. 19–22. In vicinity of Cleveland, the Chagrin is composed largely of soft gray shale and mudstone containing small limy nodules and some gray siltstones that range in thickness from ½ to 3 inches. Although well records show the Chagrin to be about 500 feet thick in eastern Cuyahoga County, only 200 feet of the shale is exposed above level of Lake Erie. In Ashtabula and Trumbull Counties adjacent to Ohio-Pennsylvania State line, about 1,200 feet of Chagrin is exposed. Massively bedded white or gray siltstones and silty mudrock in upper part of Chagrin have been traced eastward into Crawford County, Pa., into rocks that were named Riceville by White (1881). Underlies Cleveland member of Ohio shale; base of Chagrin not exposed in Ohio.

Named for exposures on Chagrin River, Cuyahoga County, Ohio.

Chainman Shale[1]

Chainman Shale (in White Pine Group)

Chainman Shale Member (of White Pine Shale)

Upper Mississippian: Eastern Nevada, eastern California, and western Utah.

Original reference: A. C. Spencer, 1917, U.S. Geol. Survey Prof. Paper 96, p. 24, 26, map.

G. S. Campbell, 1951, Utah Geol. Soc. Guidebook 6, p. 21 (fig. 4), 23. Geographically extended into House and Confusion Ranges, Utah, where it is about 1,200 feet thick, overlies Joanna (Joana) limestone and underlies Bird Spring limestone.

W. H. Easton and others, 1953, Am. Assoc. Petroleum Geologists Bull., v 37, no. 1, p. 147 (fig. 2). Shown as member of White Pine shale on correlation chart of recommended revision of stratigraphic units in Great Basin.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 69–70. Term Chainman shale extended into Eureka district, Nevada, and applied to basal black shale of Upper Mississippian sequence where this unit can be mapped separately (mapped in two areas only). Elsewhere equivalent beds are included in Chainman and Diamond Peak formations undifferentiated. Predominantly black shale with thin interbeds of brown sandstone. Apparent thickness at mouth of Secret Canyon about 5,000 feet. Base not exposed in this western belt, western limit being marked either by igneous rocks or by fault contact with lower Paleozoic rocks. In Windfall Canyon, Permian(?) rocks rest directly on Chainman shale or Diamond Peak formation.

C. W. Merriam and W. E. Hall, 1957, U.S. Geol. Survey Bull. 1061–A, p. 4 (table 1), 5. Geographically extended into Inyo Mountains, Calif., where it is more than 1,000 feet thick; underlies Pennsylvanian Keeler Canyon formation (new) and overlies Perdido formation. Consists of dark-gray silty shale and phyllite with limestone interbeds. Late Mississippian.

W. M. Winfrey, Jr., 1958, Am. Assoc. Petroleum Geologists Rocky Mountain Sec. 8th Ann. Mtg., p. 77, 78 (fig. 2). Uncomformably underlies Sheep Pass formation (new).

R. K. Hose and C. A. Repenning, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 9, p. 2172 (fig. 2), 2173. In Confusion Range, underlies Ely limestone, used in this report to replace Bird Spring formation.

H. J. Bissell, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 8, p. 1427 (fig. 3), 1433 (fig. 9), 1434–1435 (fig. 10). Illipah formation overlies Chainman in Gold Hill district and Confusion Range, Utah, and Moorman Ranch area, Nevada.

Walter Sadlick, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 81–90. Discussion of following aspects of Chainman stratigraphy: history and problems of stratigraphic nomenclature, paleotectonic setting, and geosynclinal concepts, regional distribution and sediments, and paleontologic correlations. The Chainman is recognized as a valid stratigraphic unit. Diamond Peak and Scotty Wash are referred to as facies within the Chainman. White Pine shale seems to be correlative to Pilot shale, Joana limestone, and Chainman formation; if so, White Pine should be suppressed. Any combination of names for mutually intercalated units within the Chainman may be used, for instance: (1) refer to Chainman-Diamond Peak formations undifferentiated; (2) refer to Chainman with Diamond Peak facies, and so on; (3) refer to Chainman with molasse facies, meiorogenic facies, dark euxinic shale facies, and so on, or (4) as the least favorable combination, consider Chainman, Diamond Peak, Scotty Wash as distinct formations.

The author [Sadlick] prefers a combination of procedures 2 and 3. There are lithologic units in the Chainman as thin as 5 feet and others as thick as 120 feet that persist for as much as 150 miles laterally. These units have not been mapped in all instances. One of these units is referred to as "Skunk Springs limestone band" becauses, in Confusion Mountains, the Skunk Springs water tank is on this unit which is about 15 feet at that locality.

R. L. Langenheim, Jr., and Herbert Tischler, 1960, California Univ. Pubs. Geol. Sci., v. 38, no. 2, p. 89–150. 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 the area. On the other hand, Joana limestone, Peers Spring formation, and Chainman shale, with somewhat different limits, are the formations to which these same rocks would be assigned in a regional discussion of Mississippian stratigraphy in the Great Basin. 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. 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.

Named for Chainman mine, near Lane, Ely quadrangle, Nevada. South of Eureka, occurs in discontinuous band from Windfall Canyon to mouth of Secret Canyon, and in Tollhouse Canyon east of Newark Mountain.

Chalfin Member (of Salem Limestone)

Mississippian (Valmeyer Series): Southwestern Illinois.

J. W. Baxter, 1959, Dissert. Abs., v. 19, no. 11, p. 2910. Salem limestone is subdivided into four members [sequence not indicated] to which names Kidd, Fults, Chalfin, and Rocher are assigned. Chalfin member is composed of calcilutites, calcisiltites, and calcarenites containing a predominence of microcrystalline, nonskeletal grains, believed to have been formed by the progressive cementation of chemically precipitated carbonate.

J. W. Baxter, 1960, Illinois Geol. Survey Circ. 284, p. 2–3, 7, 10, 24–27, pl. 1. Consists of varying thicknesses of fine-grained limestone; fine- to medium-grained, fossiliferous, locally oolitic limestone, and semilithographic limestone some of it brecciated. Thickness 30 to 57 feet. Conformably overlies Fults member; conformably underlies Rocher member.

Type section: In Mississippi Bluffs, 1 mile southeast of Chalfin Bridge in NE¼SW¼ sec. 7, T. 4 S., R. 10 W., Monroe County.

†Chalk Bluff Formation[1]

Permian (Wolfcampian Series): Southeastern New Mexico.

Original reference: W. B. Lang, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 7. [As defined in this reference includes (ascending) Queen sandstone, Seven Rivers, and Three Twins (new) members.]

R. K. DeFord and E. R. Lloyd, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 9. Lang's term Chalk Bluff is a suitable synonym for Whitehorse if one is needed. In this symposium, Whitehorse group of West Texas and New Mexico is divided into (ascending) Grayburg, Queen, Seven Rivers, Yates, and Tansill formations.

R. K. DeFord and G. D. Riggs, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 9, p. 1713. Lang's Three Twins member of Chalk Bluff seems to include both Tansill and 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 is essentially the Whitehorse group of subsurface geologists.

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. 43–45; P. T. Hayes and R. L. Koogle, 1958, U.S. Geol. Survey Geol. Quad. Map GQ–112, Queen sandstone considered of formational rank.

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; P. T. Hayes, 1957, U.S. Geol. Survey Geol. Quad. Map GQ–98. Seven Rivers raised to formational rank in Carlsbad group.

Artesia Group (D. B. Tait and others, 1962, Am. Assoc. Petroleum Geologists Bull., v. 46, no. 4) proposed to replace terms Whitehorse, Chalk Bluff, and Bernal in Guadalupe Mountains of New Mexico and West Texas.

Well exposed in Chalk Bluff, on eastern bank of Pecos River southeast of Artesia, Eddy County.

Chalk Creek Member (of Frontier Formation)

Upper Cretaceous: Northeastern Utah.

L. A. Hale, 1960, Wyoming Geol. Assoc. Guidebook 15th Ann. Field Conf., p. 136 (chart 1), 138, 139 (fig. 1), 140, 143 (fig. 2), 145 (fig. 3). Sequence of gray to tan, medium-grained to conglomeratic sandstone alternating with claystone varying in shades of gray, pink, maroon, and green. Sequence has been considered by some workers as belonging to Kelvin formation. Thickness 3,150 feet; entire member is present on east (upthrown) side of "Great" fault. Only 800 to 900 feet present on overturned east flank of anticline. Remainder of section, approximately 2,300 feet, has been omitted by a thrust fault. Wegemann (1915, U.S. Geol. Survey Bull. 581–E) concluded that only 850 feet of strata separated the basal sand (Longwall) from the "Wasatch" coal bed, and later writers followed his thinking. Well data, heretofore unavailable, has made clarification possible. Overlies Spring Canyon member (new); underlies Coalville member (new) with transitional contact.

Named for typical exposures on north side of Chalk Valley between Spring Hollow fault and the "Great" fault, Coalville anticline, Summit County.

Chalk Hills Member (of Catahoula Formation)

Miocene: East-central Louisiana.

W. D. Chawner, 1936, Louisiana Dept. Conserv. Geol. Bull. 9, p. 122–124. Name given to bed of white or cream-colored volcanic ash or tuff about 8 feet thick that occurs near the top of formation. Separated from underlying Cassel Hill member (new) by an interval of gray tuff or tuffaceous siltstone, and massive medium- to coarse-grained sandstone.

Prominently exposed in the Chalk Hills through secs. 7, 16, 17, 18 and 21, T. 10 N., R. 5 E., Catahoula Parish. Extends westward into La Salle Parish and then thins out.

Chalk Mountain Dacite[1]

Recent(?): Northern California.

Original reference: C. A. Anderson, 1936, Geol. Soc. America Bull., v. 47, no. 5, p. 656–657.

Composes most of Chalk Mountain, a small conical hill rising 400 feet east of North Fork of the Cache Creek, Lake County.

Chalk Mountain Nevadite[1]

Eocene: Colorado.

Original reference: W. Cross, 1886, U.S. Geol. Survey Mon. 12, p. 345–349.

Forms mass of Chalk Mountain, Eagle and Summit Counties.

Challis Volcanics[1]

Eocene (?), Oligocene, and Miocene, lower (?) : Southern central Idaho.

Original reference: C. P. Ross, 1930, Idaho Bur. Mines and Geology Pamph. 33.

C. P. Ross, 1934, U.S. Geol. Survey Bull. 854, p. 46–53, pl. 1. Volcanics comprise all Tertiary volcanic rocks in Casto quadrangle except Snake River basalt. Includes Yankee Fork rhyolite member. No complete section exposed. Thicknesses: about 3,400 feet on Camas Creek; 1,482 feet on Merino Creek. Overlie Casto volcanics. Oligocene (?).

C. P. Ross, 1947, Geol. Soc. America Bull., v. 58, no. 12, pt. 1, p. 1095, 1120–1121, pl. 1. Described in Borah Peak quadrangle. Divided into (ascending) latite-andesite member, about 1,000 feet; basalt and related flows, about 2,500 feet; and Germer tuffaceous member, from knife-edge to over 500 feet. Locally succeeded by Donkey fanglomerate (new).

A. L. Anderson, 1956, Idaho Bur. Mines and Geology Pamph. 106, p. 18–28, pl. 1. Age given as Oligocene for exposures in Salmon quadrangle. As in other localities, the formation can be subdivided into units of somewhat variable composition, recognizable as equivalent to similar units in other parts of the region. Yankee Fork rhyolite member missing. Ignimbrites not common. Underlies Carmen formation (new).

A. L. Anderson, 1957, Idaho Bur. Mines and Geology Pamph. 112, p. 16. In Baker quadrangle, unconformably underlies Kenney formation (new).

A. L. Anderson, 1959, Idaho Bur. Mines and Geology Pamph. 118, p. 15, 22–25. In North Fork quadrangle, unconformably overlies Kriley formation (new) and underlies Geertson beds. Thickness 0 to 800 feet. Age of Challis still under study.

U.S. Geological Survey currently designates the age of the Challis Volcanics as Eocene (?), Oligocene, and early Miocene (?) on the basis of a study now in progress.

Named for Challis National Forest and town of Challis, Custer County.

Chalmers Quartz Monzonite

Tertiary: Central Colorado.

J. T. Stark and others, 1949, Geol. Soc. America Mem. 33, p. 84–85, pl. 1. Fine-grained equigranular rock with clearly visible quartz, feldspar, biotite, and hornblende. Varies from pinkish gray through bluish gray to olive green. There are no exposures of Chalmers in place, but abundant float on hills indentifies the underlying rock masses. Surrounding sedimentary rocks are Pierre shale, Fox Hills sandstone, and Denver formation. Shown on plate 1 as Chalmers granite.

Named for occurrences in Chalmers Ridge, in sec. 13, T. 11 S., R. 76 W., and Bald Knob, 1 mile to the north, South Park, Park County.

Chalybeate Limestone Member (of Porters Creek Formation)

Chalybeate Limestone Member (of Clayton Formation)

Paleocene: Eastern Mississippi and western Alabama.

F. S. MacNeil, 1946, U.S. Geol. Survey Strategic Minerals Inv. Prelim. Rept. 3–196, p. 9–10. Proposed to designate beds of the Clayton formation that are in Mississippi and west of the Tombigbee River in Alabama. Consists of hard crystalline extremely fossiliferous limestone, interbedded soft to tough marls, dark leaf-bearing shales, glauconitic sand, and fossiliferous siltstone at top. Thickness at type locality about 80 feet; thins southward to less than 10 feet in Clay County, Miss.; from there southeastward along strike to Tombigbee River, thickens to about 25 feet. Mississippi Geological Survey reports for Tippah, Union, and Pontotoc Counties divided the Clayton into two unnamed members, a basal limestone and marl member and an upper marl, clay, and sand member. The highest fossiliferous siltstone here included in Chalybeate member was regarded as base of the Porters Creek clay in Mississippi reports. This siltstone is here included in the Clayton in order to make base of the clay the base of the Porters Creek throughout Mississippi. Chalybeate may include equivalents of only the lower beds of Pine Barren member.

L. D. Toulmin, P. E. LaMoreaux, and C. R. Lanphere, 1951, Alabama Geol. Survey Spec. Rept. 21, p. 37, 38, 39. Reallocated to member status in Porters Creek formation because Clayton formation is not recognized west of central Alabama. Exposed in Sumter County, Ala., where it rests on eroded surface of Cretaceous Prairie Bluff chalk.

R. J. Hughes, Jr., 1958, Mississippi Geol. Survey Bull. 84, p. 88, pl. 5. Chalybeate limestone member of Clayton formation used in this report.

Type locality: Ravine just north of main street of Chalybeate, probably in south-center of sec. 3, T. 2 S., R. 4 E., Tippah County, Miss.

Chama Clay[1]

Miocene(?): Northwestern New Mexico.

Original reference: C. R. Keyes, 1906, Geol. Soc. America Bull., v. 17, p. 725.

Derivation of name not given.

Chaman series[1]

Eocene: Arizona, Colorado, and New Mexico.

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

Derivation of name not stated.

Chamberlain Shale[1]

Precambrian (Belt Series): Central southern Montana.

Original reference: C. D. Walcott, 1899, Geol. Soc. America Bull., v. 10, p. 199–215.

C. P. Ross, D. A. Andrews, and I. J. Witkind, 1955, Geologic map of Montana (1:500,000): U.S. Geol. Survey. Mapped only in Little Belt Mountain region where it is sole unit that can be correlated with Ravalli group.

Type localities: On ridges between Chamberlain and Sawmill Creeks, southeast of Neihart. In Little Belt Mountains.

Chambers Tuff (in Vieja Group)

Tertiary: Southwestern Texas.

R. K. DeFord, 1958, Texas Jour. Sci., v. 10, no. 1, p. 13, 15 (fig. 3), 20–21, 23–25. Name proposed for formation that comprises strata between top of Buckshot ignimbrite (new) and base of Bracks rhyolite (new). Tuff is moderate to well bedded, pale yellowish brown, grayish green, and pale red to dark reddish brown. In southern part of area, contains a persistent layer of coarse sandstone with lenses of cobble conglomerate about 130 feet above base. Thickness 558 feet. Where Buckshot is absent, the Chambers (new) and Colmena (new) may be differentiated by identifying the horizon of the Buckshot; where identity of Buckshot horizon is problematic, lithostratigraphic name of Vieja will still be applicable to combined sequence; similiarly, where Bracks rhyolite is absent, the undifferentiated Vieja may serve as a map unit; the Chambers-Capote Mountain contact can be established in some places but not everywhere. Although superposition demonstrates that the Chambers is younger than the Colmena, fossils seem to indicate the same geologic age.

P. C. Twiss, 1959, Texas Univ. Bur. Econ. Geology Quad. Map 23. Described in Van Horn Mountains area where it consists of a lower member 510 feet thick and an upper member 140 feet thick. Includes local basalt flow about 100 feet thick in northernmost exposure. About 40 feet of Pantera trachyte is interbedded in Chambers tuff in northern Sierra Vieja. Overlies Buckshot ignimbrite.

Type locality: About 12 miles north of Candelaria, Rim Rock country, Presidio County. Name derived from Chambers Ranch.

Chambersburg Limestone[1]

Middle Ordovician: Central southern Pennsylvania, western Maryland, and northwestern Virginia.

Original reference: G. W. Stose, 1906, Jour. Geology, v. 14, p. 211.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 195–201. In Chambersburg area, the Chambersburg limestone, as name was originally applied, included all limestone between Stones River limestone and Martinsburg shale, thus including Lowville limestone in lower part. The Lowville part was definitely distinguished in the description as the 150 feet at base carrying distinctive Lowville fossils *Cryptophragmus antiquatus* Raymond (*Beatricea gracilis* Ulrich) and *Tetradium cellulosum* (Hall). At present, only part of original Chambersburg above the Lowville is included by Ulrich in the Chambersburg; hence, the Chambersburg is herewith redefined to apply only to part of original Chambersburg limestone overlying the part of Lowville age. Underlies Martinsburg shale. Thickness 563 feet on Tumbling Run, 1½ miles southwest off Strasburg. Overlies Lenoir limestone; underlies Martinsburg shale (Trenton member).

L. C. Craig, 1941, Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1963–1964. Chambersburg limestone divided into three formations with their type sections 2 miles southwest of Marion, Pa. Formations (ascending): Shippensburg (new), Mercersburg (new), and Greencastle.

B. N. Cooper and G. A. Cooper, 1946, Geol. Soc. America Bull., v. 57, no. 1, p. 35–114. Discussion of stratigraphy of Shenandoah Valley. Study shows that so-called Athens and Whitesburg, as developed near Harrisonburg, are laterally continuous with greater part of Chambersburg limestone, which is supposed to be younger than the Athens. New classification is proposed for lower Middle Ordovician. Lincolnshire limestone includes lower beds of Chambersburg as identified by Butts (1940); Edinburg formation (new) corresponds to substantial part of Chambersburg formation of Pennsylvania; Oranda formation (new) corresponds to the "*Christiania*" [*Bimuria*] bed of Chambersburg limestone of southern Pennsylvania.

L. C. Craig, 1949, Geol. Soc. America Bull., v. 60, no. 4, p. 707–779. Type section of Chambersburg limestone was divided into three formations, Shippensburg, Mercersburg, and Greencastle (Craig, 1941) as result of fundamental disagreement with previous faunule zone correlations. Shippensburg and Mercersburg are redefined, and term Greencastle discarded in favor of Oranda. Report describes these units in detail and gives geologic section.

Ernst Cloos, 1951, Maryland Dept. Geology, Mines and Water Resources [Rept. 14], Washington County, p. 63–66. Thickness 100 to 225 feet. Underlies Martinsburg shale; overlies New Market limestone.

F. M. Swartz and R. B. Thompson, 1958, Pennsylvania State Univ. Mineral Industries Expt. Sta. Bull. 71, p. 1–14. In Franklin County, overlies St. Paul group, geographically extended into area, where it replaces Stones River limestone as mapped by Stose (1909, U.S. Geol. Survey Geol. Atlas, Folio 170).

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Formation as mapped consists of dark-gray thin-bedded limestones (Oranda) at top; gray argillaceous limestone (Mercersburg) in middle; dark-gray cobbly thin, irregularly bedded limestone (Shippensburg) below. Occurs only southwest of Susquehanna River.

Named for exposures west of Chambersburg, Franklin County, Pa.

Chambless Limestone

Lower Cambrian: Southern California.

J. C. Hazzard, 1938, (abs.) Geol. Soc. America Proc. 1937, p. 241. Listed as an algal limestone 170 to 220 feet thick underlying Cadiz formation and overlying Kelso shale (new).

J. C. Hazzard, 1954, California Div. Mines Bull. 170, chap. 4, p. 30 (table 1), pl. 3. Described as massive light- to dark-gray limestone in beds 1 to 10 feet thick. Underlies Cadiz formation (redefined); overlies Latham shale (new) which replaces preoccupied name Kelso. Type locality designated.

Type locality: About 2 miles northeast of Chambless at an old quarry which is on north side of a large wash and near its mouth. Named after Chambless Station on U.S. Highway 66, approximately 12 miles east of Amboy, San Bernardino County.

†Chamiso Formation[1]

Chamiso Member (of Mesaverde Formation)

Upper Cretaceous: Southwestern New Mexico.

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

W. S. Pike, Jr., 1947, Geol. Soc. America Mem. 24, p. 71. Winchester's Chamiso formation, comprising 1,850 feet of continental rocks of Montana age overlying Bell Mountain sandstone, is here reduced to rank of member in Mesaverde formation.

C. H. Dane, A. A. Wanek, and J. B. Reeside, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 2, p. 191. Abandoned in favor of Crevasse Canyon formation for Alamosa Creek area.

Named for Chamiso Creek, T. 2 N., R. 9 W., Socorro County.

Champ Clark Group

Mississippian (Kinderhook Series) : Eastern Missouri and western Illinois.

L. E. Workman and Tracey [Tracy] Gillette, 1956, Illinois Geol. Survey Rept. Inv. 189, p. 8 (fig. 1). 14–20. Proposed for succession of conformable formations that overlies unconformity at top of Devonian-Silurian strata and underlies unconformity at top of Louisiana limestone. Comprises (ascending) Sylamore, Grassy Creek, Saverton, and Louisiana formations. Underlies Hannibal group. As thus defined, group includes strata believed by some to be Mississippian and by others to be Devonian. Coincides with Fabius group of Weller and others (1948) named for outcrops on Fabius River in Marion County, Mo. Formations included in this group [Fabius] are not exposed along Fabius River. Because name Fabius has been introduced so recently and because exposures at Louisiana are excellent and much better known, it seems desirable to drop name Fabius.

A. J. Scott, 1958, Dissert. Abs., v. 19, no. 5, p. 1056. Study of conodont zones indicate Devonian-Mississippian boundary should be placed at base of Glen Park formation and that Champ Clark group, which includes Sylamore, Grassy Creek, Saverton, and Louisiana formations be considered youngest Devonian series in Illinois.

Name is derived from Champ Clark Bridge at Louisiana, Mo. All formations of group are exposed in Mississippi River bluff at Louisiana, 1,000 feet northwest of bridge in NE¼ sec. 18, T. 54 N., R. 1 W., Pike County, Mo.

Champion Shell Bed (in Kiowa Shale)[1]

Cretaceous (Comanche Series) : Central southern Kansas.

Original reference: F. W. Cragin, 1895, Am. Geologist, v. 16, p. 358–371.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 28. Occurs at base of Kiowa shale in type area.

Named for Champion Draw, an arroyo on Medicine Lodge River crossed by Atchison, Topeka, and Santa Fe Railway at Belvidere, Kiowa County.

†Champlain Group[1]

Cambrian, Ordovician, and probably some Silurian: New York.

Original reference: E. Emmons, 1842, Geology of New York, pt. 2, div. 4, Geology of the second district, p. 99–126, 429.

Named for Lake Champlain.

Champlainian Series

Champlainic System[1]

Middle Ordovician: North America.

Original references: E. Emmons, 1842, Geology of New York, pt. 2, div. 4, Geology of the second district, p. 100–101, 102–126, 429; J. M. Clarke and C. Schuchert, 1899, Science, new ser., v. 10, p. 875, 876; Charles Schuchert and Joseph Barrell, 1914, Am. Jour. Sci., 4th ser., v. 38, no. 223, p. 16, 25 (table 1).

Charles Schuchert, 1943, Stratigraphy of the Eastern and Central United States: New York, John Wiley and Sons, Inc., p. 38–42. Emmons included in Champlain group all formations from base of Potsdam (Upper Cambrian) to base of Ontario group (Silurian). In present book, term Champlainian is used to embrace Chazy and Mohawk stages. Middle Ordovician.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2. Ordovician comprises three series (ascending) : Canadian, Champlainian, and Cincinnatian. Champlainian has two stages, Chazy and Mohawkian. Chart shows Mohawkian divided into Black River and Trentonian.

Marshall Kay, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 7, p. 28–33. Chazyan, Blackriveran, and Trentonian succeed the Canadian in New York, and are classified as separate series, or as two series (Chazyan and Mohawkian) or as one (Champlainian).

Name derived from Lake Champlain.

Chana Member (of Pecatonica Formation)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., figs. 3, 12. Dolomite, nonargillaceous, sandy, thick-bedded. Thickness about 6 feet. Shown on columnar section as underlying Dane member (new) and overlying Hennepin member (new).

Occurs in Dixon-Oregon area.

Chanac Formation[1]

Pliocene: Southern California.

Original reference: J. C. Merriam, J. P. Buwalda, and B. L. Clark, 1916, California Univ. Pub., Dept. Geol. Bull., v. 10, p. 111–115.

H. E. Wood 2d and others, 1941, Geol Soc. America Bull., v. 52, no. 1, p. 17, pl. Clarendonian (lower Pliocene).

Exposed along Chanac Creek, Tejon Hills, Fresno County.

Chances Branch Dolomite Member (of Maynardville Limestone)

Upper Cambrian: Southwestern Virginia and northeastern Tennessee.

R. L. Miller and J. O. Fuller, 1947, U.S. Geol. Survey Oil and Gas Prelim. Map 76 (2 sheets). Gray fine-crystalline laminated dolomite with interbedded mottled limestone near base and interbedded dark coarse-crystalline dolomite near top. Thickness 142–172 feet. Overlies Low Hollow limestone member (new) ; underlies Copper Ridge dolomite.

R. L. Miller and J. O. Fuller, 1954, Virginia Geol. Survey Bull. 71, p. 37–39; R. L. Miller and W. P. Brosgé, 1954, U.S. Geol. Survey Bull. 990, p. 16, 89, 90, pl. 1. Thickness given as much as 209 feet. Type locality and derivation of name given.

Type section: In Rose Hill district, Lee County, Va. Name derived from Chances Branch in western part of district, where a complete section is exposed in roadcut a few hundred feet east of creek and just south of Smith Chapel. Also exposed along Low Hollow, and along Fourmile Creek both north and south of Fourmile fenster and south of Virginia-Tennessee State line.

Chanchelulla Formation[1]

Devonian(?) : Northwestern California.

Original reference: N. E. A. Hinds, 1931, Geol. Soc. America Bull., v. 42, pt. 1, p. 292.

D. P. Cox, 1956, Dissert. Abs., v. 16, no. 10, p. 1884. Pennsylvanian.

Name suggested because of wide exposure on and near Chanchelulla Peak in northeast corner Red Bluff quadrangle, Klamath Mountains.

Chanchelulla Greenstone[1] or Meta-Andesite[1]

Devonian(?) : Northwestern California.

Original references: N. E. A. Hinds, 1932, California Univ. Pubs., Dept. Geol. Sci. Bull., v. 20, no. 11, p. 375–410; 1933, California Jour. Mines and Geology, v. 29, nos. 1, 2.

Named because of wide exposure on and near Chanchelulla Peak in northeast corner of Red Bluff quadrangle.

†Chandler Formation[1]

Pennsylvanian: Central Oklahoma.

Original reference: C. T. Kirk, 1904, Oklahoma Dept. Geol. and Nat. Hist. 3d Bien. Rept., p. 9.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 100. Abandoned by Oklahoma Geological Survey. System boundary not established and concept not useful.

Named for Chandler, Lincoln County.

Chandler 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), 154, figs. 2, 3. Most of formation in southern exposures is nonmarine sandstone and conglomerate. To the north, it grades into shale with interbedded sandstone and coal. Contains a few fresh- to brackish-water mollusks in northerly exposures. Thickness along Chandler River about 4,700 feet but includes units of marine strata of Umiat formation (new). Intertongues northward with Umiat formation in two major (marine) tongues—Hatbox (new) below and Niakogon (new) above—and several minor tongues (unnamed). Overlies Tuktu member (new) of Umiat formation in southern part of outcrop area. Underlies Prince Creek and Schrader Bluff formations (new). Lower and Lower(?) Cretaceous.

R. L. Detterman *in* George Gryc and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 237, fig. 2. Redefined. Northward and eastward, it intertongues with, and grades into marine equivalents, the Grandstand and Ninuluk formations (new). Lithologic unit remains much the same as originally defined, but lower tongue renamed Killik tongue (new) and type localities for both major tongues have been changed. Lower and Upper Cretaceous.

Type locality: On Chandler River where river crosses Northern Foothills section of Arctic Foothills province.

Chandler Falls Member (of Trenton Formation)

Middle Ordovician: Northern Michigan.

R. C. Hussey, 1952, Michigan Dept. Conserv., Geol. Survey Div. Pub. 46, Geol. Ser. 39, p. 13, 14, 23–25. At Chandler Falls, consists of 45 feet of limestone, dolomite, shale and shaly limestone; calcareous layers vary in thickness from 1 to 18 inches and occur chiefly in lower part of section;

shale and argillaceous limestone make up central and upper portions of exposure. Conglomerate about 5 feet thick occurs about 11 feet above base. This conglomerate probably marks base of Trenton. Underlies Groos Quarry member (new); overlies Bony Falls member (new) of Black River formation. Deposition was practically continuous at some localities from Black River to Trenton time and dividing line between the two formations becomes an arbitrary one.

Type locality: At Chandler Falls, T. 39, N., 22 W., Delta County, on Escanaba River, 3 miles north of Escanaba. Chandler Falls is site of hydroelectric powerplant.

Chaney Gypsum Member (of Blaine Gypsum)[1]

Chaney Gypsum Member (of Flowerpot Shale)

Permian: Southwestern Oklahoma and western Texas.

Original reference: C. N. Gould, 1902, Oklahoma Geol. Survey 2d Bienn. Rept., p. 41, 55.

T. S. Jones, 1953, Stratigraphy of the Permian Basin of West Texas: West Texas Geol. Soc., p. 30. Shown on chart as member of Flowerpot shale in western Texas.

G. L. Scott, Jr., and W. E. Ham, 1957, Oklahoma Geol. Survey Circ. 42, p. 15–16, 17 (fig. 3), 18, pl. 1. Described in Carter area, Oklahoma, as gray white massive gypsum 1 to 3 feet thick, 42 to 50 feet below top of Flowerpot; stratigraphically below Kiser gypsum member. Blaine formation redefined in this report.

Name derived from Chaney Salt Plain on Elm Fork of Red River, 4 miles east of Texas line, Harmon County, Okla.

Chaney Ranch Sandstone

Eocene: Central California.

M. B. Payne, 1951, California Div. Mines Spec. Rept. 9, p. 3, 15–18, 21, 22, pl. 4. White, fine- to medium-grained, anauxitic sandstone. Measured thickness at type section 232 feet. Disconformably underlies Kreyenhagen formation; conformably overlies Capita member (new) of Domengine formation. North of Chaney Ranch Canyon toward Gres Canyon, the Temblor overlaps both the Kreyenhagen and the Chaney Ranch; in this area only 20 feet of the Chaney Ranch are exposed.

Type section: Chaney Ranch Canyon in NW cor. sec. 19, T. 14 S., R. 12 E., Panoche quadrangle, Fresno County. Named from nearby Chaney Ranch.

Chaneysville Sandstone Member[1] (of Mahantango Formation)

Middle Devonian: South-central Pennsylvania.

Original references: Bradford Willard, 1935, Geol. Soc. America Proc. 1934, p. 361; 1935, Geol. Soc. America Bull., v. 46, no. 8, p. 1279, 1282, 1283.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Shown on correlation chart above Gander Run shale and below Frame shale. Middle Devonian.

Named for village (which is also spelled Cheneysville) in Bedford County.

Channahon Limestone[1]

Lower Silurian: Northeastern Illinois.

Original reference: T. E. Savage, 1910, Illinois Geol. Survey Bull. 16, p. 334.

Outcrops in south bank of Des Plaines River, 1 mile southeast of Channahon, Will County.

Chanute Formation (in Ochelata Group)

Chanute Shale (in Kansas City Group)[1]

Chanute Shale Member (of Kansas City Formation)[1]

Pennsylvanian (Missouri Series): Eastern Kansas, southern Iowa, northwestern Missouri, southeastern Nebraska, and northeastern Oklahoma.

Original reference: E. Haworth and M. Z. Kirk, 1894, Kansas Univ. Quart., v. 2, p. 109.

R. C. Moore and others, 1937, Kansas Geol. Soc. Guidebook 11th Ann. Field Conf., p. 40 (table), 43. Lowermost formation in Ochelata group. Thickness about 200 feet near Kansas-Oklahoma State line; 40 feet or less in vicinity of Bartlesville. Normally overlies Drum limestone and underlies Iola limestone. Over Chautauqua Arch County, in parts of which Drum limestone is absent, a prominent sandstone that forms lower part of Chanute is here named Noxie sandstone lentil; near State line, includes Cottage Grove sandstone in upper part.

L. W. Wood, 1941, Iowa Geol. Survey, v. 37, p. 294 (table), 295. Chanute shale as used here [Adams County] follows practice of Missouri Survey in including all beds between Wyandotte above and Westerville below. Includes Raytown and Cement City limestones which may be present in section but are difficult to recognize in well logs. Kansas City group.

J. R. Clair, 1943, Missouri Geol. Survey and Water Resources, 2d ser., v. 27, pl. 1. Columnar section, Jackson and Cass Counties, shows Chanute shale comprises (ascending) Quivera shale, Cement City limestone, Union Station shale (new), Paola limestone, Muncie Creek shale, Raytown limestone, and Liberty Memorial shale (new) members. Overlies Cherryvale shale, which includes Westerville limestone at top; underlies Iola limestone. Kansas City group.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2031 (fig. 4), 2032–2033; F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. vi (fig. 2), 12–13. Miscorrelation of Iola formation by Haworth and Bennett (1908, Kansas Univ. Geol. Survey, v. 9) 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 units of Kansas City group so as to bring interstate agreement in nomenclature. Union Station shale (Clair, 1943) is suppressed because it is synonymn for Chanute shale as a whole. Paola limestone, Muncie Creek shale, and Raytown limestone, which were classed as members of Chanute shale, are recognized as belonging to Iola formation. Liberty Memorial shale (Clair, 1943) is suppressed as junior synonym of Lane shale. Thus, Chanute shale overlies Drum limestone and underlies Iola formation.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 36. Thickness of formation 6 to 7 feet east of Louisville, Nebr.; about 10 feet near Kansas City; 25 feet in northeastern Kansas; about 100 feet in southern Kansas.

T. L. Welp, L. A. Thomas, and H. R. Dixon, 1957, Iowa Acad. Sci. Proc., v. 64, p. 418 (fig. 1), 420. Thickness about 2 feet in Madison and Adair

Counties, Iowa. Underlies Iola formation; overlies Drum formation. Kansas City group.

M. C. Oakes, 1959, Oklahoma Geol. Survey Bull. 81, p. 28–31, pls. 1, 2, measured sections. Rocks assigned to Chanute formation, in Oklahoma, were included by Ohern (1910) in lower part of Ochelata member of his Ramona formation (southern area) and in lower part of unnamed interval between Dewey and Avant limestone lentils of Copan member of his Wann formation (northern area). According to classification used on Geologic Map of Oklahoma (Miser, 1926), these beds lie at base of Ochelata formation (Ochelata group), occupying lower part of interval between Dewey and Avant limestones. On Geologic Map of Oklahoma, (Miser, 1954), they are shown as Chanute formation, lying between Dewey formation below and Iola limestone (formation) above. Thickness in Creek County 45 to 110 feet. Formation crops out across Oklahoma in direction slightly west of south from Kansas-Oklahoma line to North Canadian River. Name is not applied farther south.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 26, fig. 5. Consists of greenish-gray, fossiliferous upper shale bed of varying thickness separated from lower greenish-gray shale by thin coal smut. Thickness about 5 feet. Underlies Iola limestone; overlies Drum limestone. Kansas City Group.

Named for development in vicinity of Chanute, Neosho County, Kans.

Chaos Crags Dacites

Cenozoic: Northern California.

Howel Williams, 1932, California Univ. Pub., Bull. Dept. Geol. Sci., v. 21, no. 8, p. 298, 343, 380; R. D. Evans and Howel Williams, 1935, Am. Jour. Sci., 5th, v. 29, no. 173, p. 449, 450, 451. Dacite described at and in vicinity of Chaos Crags.

J. A. S. Adams, 1955, Geochim. et Cosmochim. Acta., v. 8, nos. 1–2, p. 77 (table 2), 79, 80. Listed on tables and mentioned in text in report on uranium geochemistry of Lassen volcanic rocks.

Chaos Crags are in northwestern part of Lassen Volcanic National Park.

Chaos Jumbles Flows, Dacite

Recent: Northern California.

Howel Williams, 1932, California Univ. Pub., Bull. Dept. Geol. Sci., v. 21, no. 8, p. 356. Name applied to flows forming Chaos Jumbles. Age of Jumbles approximately 200 years.

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.

Chaos Jumbles is in northwestern part of Lassen Volcanic National Park.

Chaparral 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. 30–31, pl. 1. Comprises interbedded rhyolitic and andesitic tuffaceous sedimentary rocks. Andesitic tuffaceous rock somewhat variable in texture, structure, and mineral composition. Most abundant type is fine-grained well-foliated fissile rock that ranges in color from green or greenish gray to green mottled with irregular patches and streaks of grayish yellow green or pale yellowish green. Intercalated in these finer grained andesitic tuffaceous rocks in subordinate amounts are beds from 1 to 50 feet thick of medium- to coarse-grained andestic tuff. Rhyolitic tuffaceous rock is fine-grained finely laminated fissile phyllite that ranges in lithologic composition from relatively pure rhyolitic rock to mixed rhyolitic and andesitic rock; yellowish gray to very light gray, and locally has greenish cast. Thickness not known nor can it be approximated. Lies between two major faults, Chaparral on northwest and Spud on southeast.

Named from exposures in Chaparral Gulch, Jerome area, Yavapai County. Crops out in northeastward-trending belt in southwest corner of area. Crops out over strike length of 4½ miles and over width ranging from 1,500 to 3,500 feet.

Chapel Coal Member (of Modesto Formation)

Pennsylvanian: Western and northern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 37, 38, 49 (table 1), pl. 1. Replaces name Trivoli (No. 8) coal so that name Trivoli can be retained for the sandstone. In southeastern area, occurs above Trivoli sandstone member and below New Haven coal member; in southwestern area, above the Trivoli and below Carlinville limestone member; in western and northern area, above the Trivoli and below Cramer limestone member (new). Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification is retained but is entirely independent of rock-stratigraphic classification.

Type locality: SW¼ sec. 3, T. 8 N., R. 5 E., Peoria County. Name derived from Graham Chapel, about 2 miles north of type locality.

Chapel Rock Member (of Munising Formation)

Upper Cambrian: Northern Michigan.

W. K. Hamblin, 1958, Michigan Dept. Conserv., Geol. Survey Div. Pub. 51, p. 6 (fig. 1), 77–95, 114, fig. 70. Well-sorted medium-grained sandstone characterized by large-scale crossbedding. Varying amounts of scattered pebbles near base of section. Thickness from 40 to 60 feet along Pictured Rocks and throughout most of Alger County. Thins gradually to the east. Underlies Miners Castle member (new); overlies Jacobsville formation.

Type locality: Chapel Rock near eastern end of Pictured Rocks cliffs in Alger County. Name derived from Chapel Rock, of type locality, which is along southern coast of Lake Superior.

Chapin Member (of Hampton Formation)

Chapin Beds (in Kinderhook Group)[1]

Mississippian (Kinderhook): Central northern Iowa.

Original reference: F. M. Van Tuyl, 1925, Iowa Geol. Survey, v. 30, p. 52, 91, 104, 108.

L. R. Laudon, 1935, Kansas Geol. Soc. Guidebook 9th Ann. Field Conf., p. 246; L. R. Laudon and B. H. Beane, 1937, Iowa Univ. Studies in Nat. History, v. 17, no. 6, p. 236–237. Hampton is redefined by excluding from it the North Hill member, as exposed at Burlington, and the lower gray limestone ledges of Chapin member of north-central Iowa which are correlatives of the Chouteau of Missouri. As thus restricted, the Hampton includes the dolomitic upper part of the Chapin, the Maynes Creek, Eagle City, and Iowa Falls members. [This restriction of the Hampton seemingly restricts the Chapin.]

Named for exposures in abandoned quarry 1 mile west of Chapin, Franklin County.

Chapin Wash Formation

Pliocene, lower(?) : West-central Arizona.

S. G. Lasky and B. N. Webber, 1949, U.S. Geol. Survey Bull. 961, p. 14 (table 2), 23–34, pls. 1, 2. Alluvial-fan and playa deposits—fanglomerate, conglomerate, sandstone, siltstone, mudstone, clay, and limestone; in part gypsiferous. Consists mainly of pink to red and brown clay, mudstone, siltstone, and sandstone, with gradations into one another. Thickness ranges from fraction of a foot to possibly 1,500 feet or more. Rests with angular unconformity upon older rocks. Overlain in part conformably by Cobwebb basalt (new) and in part unconformably by Sandtrap conglomerate (new) and younger rocks. These formations assigned to Pliocene because they rest with angular unconformity upon Miocene(?) rocks and are overlain with angular unconformity by early Pleistocene(?) basalt. Because Chapin Wash formation is oldest of the formations, it is tentatively assigned to lower Pliocene. Shown on plate 1 as Pliocene(?) and on plate 2 as early Pliocene(?).

Named for exposures along Chapin Wash in Artillery Mountains, about 30 miles east of Colorado River. Formation crops out roughly in form of elongated "U," 6 to 7 miles long and 3 to 5 miles wide, in valley between Rawhide and Artillery Mountains.

Chapman Dolomite[1]

Permian: Central Oklahoma.

Original reference: F. W. Cragin, 1897, Am. Geologist, v. 19, p. 353, 358.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 100. Oklahoma Geological Survey abandoned name in its earlier sense. Not a recognizable unit. If validated, name would preoccupy Chapman sandstone of Maine.

Named for Chapman's amphitheater, at head of Salt Creek, Blaine County.

Chapman Sandstone[1]

Lower Devonian: Northeastern Maine.

Original reference: H. S. Williams, 1899, Am. Jour. Sci., 4th ser., v. 8, p. 360, footnote.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Shown on correlation chart above Square Lake limestone and below Moose River sandstone.

Type locality: Along east bank of south branch of Presque Isle Brook, about 1 mile from south line of Chapman Township and about 1 mile west of Tweedy on road running southwest from Presque Isle, Aroostook County.

Chapman Trachyte[1]

Devonian(?) : Northeastern Maine.

Original reference: H. E. Gregory, 1900, U.S. Geol. Survey Bull. 165, p. 109, 110, 162–163.

Occurs in northwest corner of Chapman Township, Aroostook County.

Chapman Gulch Glaciation

Pleistocene (Cochrane?) : West-central Colorado.

R. L. Nelson, 1954, Jour. Geology, v. 62, no. 4, p. 333–334, 340, fig. 2, table 4. Time of post-Wisconsin glaciation in Frying Pan Valley. Older than the climatic optimum and Neoglaciation; younger than Hell Gate glacial substage (new). Marked by moraine and outwash deposits.

Name derived from a till deposit at 11,400 feet in Chapman Gulch. In Frying Pan River drainage just west of Continental Divide in Sawatch Range.

Chapman Ranch Formation[1] (in Arbuckle Group)

Chapman Ranch Member (of McKenzie Hill Formation)

Lower Ordovician: Central southern Oklahoma.

Original reference: Josiah Bridge, 1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 7, p. 982–983.

C. E. Decker, 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1313, table 1; 1939, Oklahoma Geol. Survey Circ. 22, p. 15, 16 (table 1). Reallocated to McKenzie Hill as basal member of formation, because it seems apparent that Ulrich intended to apply this name to the heavy limestone beds above the dolomite rather than for the dolomite; name Butterly is proposed for the underlying dolomite. Underlies McMichel member (new).

Named from Chapman Ranch on U.S. Highway 77, Murray County.

Chapman Ridge Sandstone

Middle Ordovician: Eastern Tennessee.

J. M. Cattermole, 1955, U.S. Geol. Survey Geol. Qual. Map GQ–76; 1960, Map GQ–126. New formational name for strata in the Knoxville area that were previously called Tellico sandstone; this renaming is outgrowth of belief that the sandstone now included in the Chapman Ridge does not correlate with Tellico sandstone at its type locality. Consists of from 700 to 900 feet of calcareous sandstone interbedded with shale and silty shale. Includes all strata below lower tongue of Ottosee shale, or where this unit is missing, between the Holston "marble" through to the contact of sandstone with the shale and limestone beds of the Ottosee.

Type locality: Exposures along Alcoa Pike, State Highway 73, where highway cuts through Chapman Ridge south of Looney Island, Knoxville quadrangle [Knox County].

Chapparal Sandstone (in Saavedra Member of Lowell Formation)

Lower Cretaceous: Southeastern Arizona.

A. A. Stoyanow, 1949, Geol. Soc. America Mem. 38, p. 11. White sacchariodal sandstone weathering into round-edge slabs. Large fossil tree trunks. Thickness 24 feet.

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.

Chappel Limestone

Chappel Formation[1]

Lower Mississippian: Central Texas.

Original reference: E. H. Sellards, 1933, Texas Univ. Bull. 3232, p. 91–92, 96.

F. B. Plummer, 1939, *in* West Texas Geol. Soc. [Guidebook] Nov. 11–12, p. 15. Subdivided to include Ives conglomerate at base.

P. E. Cloud, Jr., and V. E. Barnes, 1948, Texas Univ. Bur. Econ. Geology Pub. 4621, p. 27, 42, 44 (fig. 2), 49–52. Proposed here that unit formerly designated Chappel formation be termed Chappel limestone because unit is persistently calcitic and that Ives conglomerate member be termed Ives breccia, a unit of formational rank. At type locality, Chappel is approximately 24 inches thick and consists of crinoidal limestone wherein abundant to scattered larger pelmatozoan fragments are tightly bonded by a matrix of fine-grained limestone; upper 10 to 11 inches is tough, medium- to dark-gray rock with brownish, olive, or bluish cast, fairly typical of much of the Chappel on east side of Llano uplift; lower 13 to 14 inches have been leached to a marly appearance and a lighter yellowish gray color. At type locality, Chappel is directly overlain by about 50 feet of shales of Barnett formation; a few hundred feet to the south, a lens of Ives breccia intervenes between the Chappel and the Honeycut. In eastern half of Llano uplift, the Chappel is similar to type section, but thickness may be as much as 14 feet, although it seldom exceeds 3 to 5. In eastern areas overlaps Honeycut, but, in western areas, overlaps limestone of Gorman formation. Because limestones of Gorman formation are readily soluble, the Chappel is commonly preserved in solution structures that developed previous to Barnett time. Approximately 45 feet of Chappel was measured in one of these structural sinks about 1,500 feet east of Joe Davis Hollow on north bank of San Saba River in McCulloch County.

F. B. Plummer, 1950, Texas Univ. Bur. Econ. Geology Pub. 4329, p. 20–32. Chappel formation differentiated into two facies: normal and sink-hole; the facies are determined in part, at least, by topography of Ellenburger surface on which Chappel was deposited. Subdivided into four members (ascending): King Creek marl (new), Ives conglomerate, Espey Creek limestone (new), and Whites Crossing coquina (new). Lower Mississippian, ranges perhaps from lower Kinderhook through Burlington.

P. E. Cloud, Jr., V. E. Barnes, and W. H. Hass, 1957, Geol. Soc. America Bull., v. 68, no. 7, pl. 1. Overlies Houy formation (new). King Creek marl member of Plummer's (1950) Chappel formation is surely identified only at its type locality where it constitutes a few inches of the Houy formation.

W. H. Hass, 1959, U.S. Geol. Survey Prof. Paper 294–J, p. 365–396. Discussion of conodont fauna of the Chappel. Also discusses formation as described by Cloud and Barnes (1948) with relationship to formation as described by Plummer (1950).

Type locality: Three miles southeast of San Saba, San Saba County. Name derived from village of Chappel. Exposed at many places along east, north, and west margins of Llano uplift.

Chaquaqua Member[1] (of Lykins Formation)

Triassic(?): Southeastern Colorado.

Original reference: J. T. Duce, 1924, Colorado Geol. Survey Bull. 27, pt. 3, p. 81–82.

Named for exposures in Chaquaqua Canyon, Las Animas County.

Chaquaqua shale[1]

Upper Jurassic: Northeastern New Mexico.

Original references: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 257–259; 1915, Conspectus of geological formation of New Mexico, p. 3, 6.

Exposed in Chaquaqua Canyon in northeast New Mexico.

Charcoal Canyon Formation

Ordovician: Central Nevada.

Marshall Kay, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 12, p. 97 (fig. 3). Discussion of Paleozoic continental margin in central Nevada. Clipper Canyon sequence comprises (ascending) Charcoal Canyon, Petes Summit, Sams Spring, and Joes Canyon formations (all new). Clipper Canyon sequence is isolated by surrounding Tertiary volcanic rocks.

Clipper Canyon, Toquima Range, Nye and Lander Counties.

Charco Azul Formation

Pliocene: Panamá and Costa Rica.

R. A. Terry, 1941, Geog. Rev., v. 31, no. 3, p. 381 (fig. 5), 382; A. A. Olsson, 1942, 8th Am. Sci. Cong. Proc., v. 4, p. 249–250. Base is heavy conglomerate; grades upward into sandstones and foraminiferal shales. Maximum thickness more than 4,000 feet. Overlies Armuelles formation. Pliocene.

Along shore of Charco Azul Bay and elsewhere in Burica Peninsula. Extends into Costa Rica.

Chardon Siltstone Member (of Orangeville Shale)

Chardon Sandstone[1] Member (of Orangeville Shale)

Mississippian: Northeastern Ohio.

Original reference: C. S. Prosser, 1912, Ohio Geol. Survey, 4th ser., Bull. 15, p. 219–229.

Wallace de Witt, Jr., 1951, Geol. Soc. America Bull., v. 62, no. 11, p. 1363–1364; J. F. Pepper, Wallace de Witt, Jr., and D. F. Demarest, 1954, U.S. Geol. Survey Prof. Paper 259, p. 42. Renamed Chardon siltstone member. Consists of thin- to thick-bedded gray siltstones and intercalated silty shale. Thickness about 8 feet. Occurs in Orangeville about 30 feet above Berea sandstone. Lithologically similar to Aurora member; names Chardon and Aurora may have been applied to different parts of a single unit.

Typically exposed in Stebbins Gulch near Chardon, in northwestern Geauga County.

Chariton Conglomerate Member (of Pleasanton Formation)[1]

Chariton Conglomerate (in Pleasanton Group)

Pennsylvanian (Missouri Series): Southeastern Iowa and northern Missouri.

Original reference: H. F. Bain, 1896, Iowa Geol. Survey, v. 5, p. 394–398.

L. M. Cline, 1951, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 30. Referred to as Chariton conglomerate in Pleasanton group.

Named for exposures along Chariton River near mouth of Snort Creek, Appanoose County, Iowa.

Charles Formation (in Madison Group)

Charles Formation (in Big Snowy Group)

Mississippian: Subsurface in central and eastern Montana and adjacent areas.

O. A. Seager, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 5, p. 861–864. Term introduced to describe series of interbedded limestones, dolomite, anhydrite, and shales that lie between basal member (Kibbey) of Scott's Big Snowy group and the Madison. Lies at depths of 6,350 to 6,815 feet in Carter Oil Co.'s Northern Pacific test No. 1, sec. 19, T. 4 N., R. 62 E., Fallon County, Mont. Possible that Charles sediment fills gap between Madison and Big Snowy time and should be included in Madison; however, widespread development of porosity in upper part of Madison indicates that the time break is here; hence, Charles is considered basal member of Big Snowy group.

L. L. Sloss, 1952, Billings Geol. Soc. Guidebook 3d Ann. Field Conf., p. 65 (chart), 66–67, 68 (cross sections). Assigned to Madison group. Overlies Mission Canyon limestone. Reconsideration of relationships strongly suggests that the Charles is recognizable in many outcrop areas of central and western Montana.

J. M. Andrichuk, 1958, Habitat of Oil: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 230. Perry and Sloss (1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 10) defined Charles in type well between depths of 3,050 and 3,810 feet. Nordquist (1953, Billings Geol. Soc. Guidebook 4th Ann. Field Conf.) showed that depth of 3,050 feet in type well marks top of so-called Kibbey limestone. In this report, boundaries of Charles in type well are selected at 3,200 and 3,800 feet in agreement with Nordquist.

L. S. Gardner, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 2, p. 330–332, 333 (fig. 2). This report follows Sloss and places Charles in Madison group. Formation is believed to be transitional laterally in subsurface into upper beds of Mission Canyon limestone, middle unit of Madison group as here recognized.

Named for occurrence in Arro Oil and Refining Co. and California's Co. Charles No. 4 [referred to by later authors as type well], sec. 21, T. 15 N., R. 30 E., Garfield County, Mont.

Charleston Sandstone[1]

Pennsylvanian: Western West Virginia.

Original reference: M. R. Campbell and W. C. Mendenhall, 1896, U.S. Geol. Survey 17th Ann. Rept., pt. 2, p. 487, 508.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 79. Massive sandstone near Charleston, Kanawha County, W. Va., formed where Buffalo and Mahoning (Conemaugh), Freeport, and East Lynn (Allegheny), and Roaring Creek (Kanawha) sandstones join to form one sandstone bluff, the intervening coals and shales being absent.

Named for exposures at Charleston, Kanawha County.

Charlevoix Limestone

Charlevoix Stage[1]

Middle Devonian: Northwestern Michigan.

Original reference: E. R. Pohl, 1930, U.S. Nat. Mus. Proc., v. 76, art. 14, p. 2–25.

L. S. Sloss, 1939, Jour. Paleontology, v. 13, no. 1, p. 52. For purposes of this report, Pohl's divisions of Traverse beds, Petoskey, Charlevoix, and Gravel Point are referred to as faunal zones.

G. A. Cooper and A. S. Warthin *in* G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1752, chart 4. Charlevoix limestone occurs on shore of Lake Michigan in Emmet and Charlevoix Counties between the "upper blue shale" (zone 6) of Gravel Point limestone and base of Petoskey limestone; the "upper blue shale" is correlated with upper Alpena (approximately Dock Street clay) of Alpena County; lower part of Petoskey at Bayshore is correlated with Norway Point formation of Alpena County. Thus Charlevoix occupies position of Four Mile Dam limestone. It is suggested that Charlevoix may represent a western shore phase of Four Mile Dam although there is no fossil evidence to support this contention.

Probably named for Charlevoix County.

Charlottesville Formation

[Precambrian]: Western Virginia.

W. A. Nelson, 1949, (abs.) Virginia Acad. Sci. Proc. 1948–1949, p. 140. Overlies Johnson Mill graphite schist (new); underlies Catoctin schist.

Discussion of structure and stratigraphy of the Blue Ridge in Albemarle and adjacent counties. Main Blue Ridge mountain is an overturned anticline, with axial plane dipping 28° to southeast, and a thrust fault bordering it on its western edge.

Charlton Formation[1]

Pliocene: Southeastern Georgia and northeastern Florida.

Original reference: J. O. Veatch and L. W. Stephenson, 1911, Georgia Geol. Survey Bull. 26, p. 60, 392–400.

F. S. MacNeil, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 72. Mapped in Georgia as Pliocene.

R. O. Vernon, 1952, *in* A summary of the geology of Florida and a guidebook to the Cenozoic exposures of a portion of the state: Florida Geol. Survey, p. 58, 59. Prior to 1942, Pliocene series in Florida was considered composed of Citronelle formation, Tamiami limestone, Buckingham marl, Bone Valley gravel, Alachua formation, Charlton formation, and Caloosahatchee marl. Additional well data and fieldwork has presented evidence that places beds formerly called Tamiami limestone, Buckingham marl, and upper beds of Hawthorn into Tamiami formation. The Charlton is similar in fauna and lithology to the Buckingham and is also placed in the upper Miocene.

Named for exposures in Charlton County, Ga.

Charrette Limestone[1]

Middle Ordovician: Eastern Missouri.

Original reference: G. C. Broadhead, 1873, Missouri Geol. Survey Rept. 1855–1871, p. 49–50.

Named for Charrette, Warren County.

Charter Member (of Mount Simon Formation)

Upper Cambrian: Northern Illinois (subsurface).

J. S. Templeton, Jr., 1950, Illinois Acad. Sci. Trans., v. 43, p. 153 (fig. 2), 154 (fig. 3), 156. Name applied to the coarse-grained to conglomeratic uppermost member of formation. Type section extends from depths of 1,381 to 1,648 feet. Thickness of member 145 to 315 feet. Overlies Gunn member (new); underlies Eau Claire formation.

Type well: McQueen No. 1 (well 6) in SW¼NE¼NE¼ sec. 27, T. 42 N., R. 3 E., DeKalb County. Name derived from Charter Oak School, 3½ miles north of type well.

Chartresan series[1]

Mississippian: Illinois.

Original reference: C. R. Keyes, 1933, Pan-Am. Geologist, v. 60, no. 1, p. 45, 49.

Name derived from old French Fort Chartres, which once occupied a spot near mouth of Kaskaskia River just above the present hamlet of Chester.

Chase Group[1]

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

Original reference: C. S. Prosser, 1895, Jour. Geology, v. 3, p. 771–786.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 39, p. 68–71; R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 41–45. Stratigraphically expanded upward to include the Odell and Nolans formation; that is, the upper boundary is at top of Herington limestone member of Nolans limestone. As redefined, includes (ascending) Wreford limestone, Matfield shale, Barneston limestone, Doyle shale, Winfield limestone, Odell shale, and Nolans limestone. Underlies Wellington formation of Sumner group (Leonard series); overlies Speiser shale of Council Grove group (Wolfcamp series). Thickness in Kansas about 335 feet.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. In Oklahoma, Herington limestone and Fort Riley limestone are only units of group mapped.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 73 (table 3), 105–119. As presently defined, group includes beds from base of Wreford limestone upward to top of Nolans (Herington) limestone. In southern Kansas and northern Oklahoma, group consists of over 340 feet of red and green shales and persistent chert-bearing limestones. Southward, limestones thin and chert content diminishes abruptly. In Pawnee County, includes (ascending) Wreford limestone, Matfield shale, Fort Riley limestone, Doyle shale, and Winfield limestone. Wolfcamp series. South of Pawnee County, rocks of group grade laterally into Asher formation of central Oklahoma.

C. C. Branson, 1960, Oklahoma Geology Notes, v. 20, no. 9, p. 229–235. Suggested that term Lyon series be used for Permian rocks in Kansas, Oklahoma, and Nebraska. Series would comprise Admire, Council Grove, and Chase groups.

Named for Chase County, Kans.

Chase Channel Formation

Pleistocene (Nebraskan and Aftonian): Central Kansas (subsurface).

R. C. Moore, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 7, p. 1278. Deposits established as age equivalents of the Blanco formation (type locality in Texas) are termed Rexroad formation in Oklahoma and southwestern Kansas, Chase Channel formation (Holdrege and Fullerton members) in central Kansas, and Broadwater formation or Holdrege and Fullerton formations in Nebraska.

O. S. Fent, 1950, Kansas Geol. Survey Bull. 85, p. 64, 127, 128, 129. In type well, is lowermost Pleistocene. Occurs below Grand Island member of Meade formation and above Permian Harper sandstone. Thickness 59 feet.

Type well: Test hole 20–9–10dc (N) in SW¼SE¼ sec. 10, T. 20 S., R. 9 W., drilled by Kansas Geological Survey, October 1946. Type locality is buried filled valley named Chase Channel from its development at town of Chase, Rice County.

Chatcha Limestone

See Chacha Limestone

Chatham Granite[1] or Group

Upper Devonian(?): East-central New Hampshire.

Original reference: M. P. Billings, 1928, Am. Acad. Arts Sci. Proc., v. 63, p. 82, map.

David Modell, 1936, Geol. Soc. America Bull., v. 47, no. 12, p. 1892–1893. Referred to as a group which includes quartz diorite, granodiorite, and quartz monzonite. A petrographically distinct unit, but not mapped separately from Meredith porphyritic granite and pegmatites of the area. Assigned to New Hampshire magma series in Belknap Mountains.

Alonzo Quinn, 1937, Geol. Soc. America Bull., v. 48, no. 3, p. 378. Granite includes Winnipesaukee quartz diorite of Winnipesaukee region.

M. P. Billings, 1945, Am. Jour. Sci., 5th ser., v. 243–A, p. 43. Upper Devonian(?).

Crops out in Chatham Township, North Conway quadrangle.

†Chatham series[1]

Upper Triassic: North Carolina.

Original reference: E. Emmons, 1857, Am. Geology, p. iv, v, vi, 19.

Chatham County.

Chatham Hill Formation

Middle Ordovician (Mohawkian): Southwestern Virginia.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 53, chart 1 (facing p. 130). Base of formation generally not well exposed; transitional with underlying black graptolitic shales of Rich Valley formation (new). Upper part is cherty dark-bluish-gray limestone. Top prominently defined by succeeding ledges of calcarenite forming lower part of Wassum formation (new). Total thickness about 450 feet. Occurs in area for which Porterfield stage is named. Name attributed to B. N. Cooper and G. A. Cooper.

Type section: Two miles south of Chatham Hill, Chatham Hill (TVA 218–NE) quadrangle. Named from exposures adjacent to Viriginia Highway 16 along lower northwestern slopes of Walker Mountain.

Chatsworth Drift

Pleistocene (Wisconsin): Northern Illinois.

H. B. Willman and others, 1942, Illinois Geol. Survey Bull. 66, p. 145 (fig. 85), 146 (fig. 86), 162. Consists largely of till. Thickness probably as much as 40 feet. Overlies Bloomington and Farm Ridge drifts; underlies Marseilles drift. [Report lists six drifts in the Tazewell; for sequence see under Shelbyville.]

Occurs in moraine along east side of Streater quadrangle, La Salle County. Named for village of Chatsworth, which is located on moraine, in southeastern Livingston County.

†Chattahoochee Bed (proper)[1]

Miocene, lower: Northwestern Florida and southwestern Georgia.

Original reference: A. F. Foerste, 1894, Am. Jour. Sci., 3d, v. 48, p. 41–54.

Named for exposures at Old Chattahoochee Landing, Gadsden County, Fla.

†Chattahoochee Formation[1]

Eocene, lower: Alabama.

Original reference: E. A. Smith, 1888, Alabama Geol. Survey Rept. Prog. 1884–1888, map.

Type locality not stated.

Chattahoochee facies (of Tampa Stage)

†Chattahoochee Formation[1]

Miocene, lower: Florida and Georgia.

Original reference: D. W. Langdon, Jr., 1889, Am. Jour. Sci., 3d, v. 38, p. 322-324.

H. S. Puri, 1953, Florida Geol. Survey Bull. 36, p. 16 (table 1), 17–20, figs. Term Chattahoochee revived to include updip silty and clayey facies of Tampa stage. Thickness 119 feet near Jim Woodruff Dam, Fla. Name St. Marks is here revived to include calcareous downdip facies of Tampa stage.

C. W. Hendry, Jr., and J. W. Yon., Jr., 1958, Florida Geol. Survey Rept. Inv. 16, p. 28–33. Detailed discussion in vicinity of Jim Woodruff Reservoir. Facies underlies clastics of Hawthorn formation and unconformably overlies Suwannee limestone. Exposed thickness about 160 feet. Type locality stated.

Type locality: Jim Woodruff Dam section located on dam access road in SW¼ sec. 29, T. 4 N., R. 6 W., directly below U.S. Engineers office on east side of Apalachicola River. Named for exposures along Chattahoochee River, especially at Chattahoochee Landing, Gadsden County, Fla.

Chattanooga Shale[1]

Upper Devonian and Mississippian: Tennessee, Alabama, Arkansas, Kentucky, Mississippi, and Oklahoma.

Original reference: C. W. Hayes, 1891, Geol. Soc. America Bull., v. 2, p. 143.

J. H. Swartz, 1924, Am. Jour. Sci., 5th ser., v. 7, no. 37, p. 24–30. In type area, Chattanooga shale is overlain by thin hard gray shale containing *Lingula melie*. This shale is herein named Glendale. This shale has been regarded as part of overlying Fort Payne chert. Glendale is lower Cuyahogan in age. In type area and along Cumberland escarpment, the Chattanooga is divisible into at least three members: upper black shale of Sunbury (in places perhaps post-Sunbury) age: lower black shale of Cleveland (and in places perhaps pre-Cleveland) age; and middle gray clay shale of Bedford-Berea age. Upper part of Chattanooga in Clinch Mountain area is of late Cuyahogan age. Maury shale is separated from

Chattanooga by marked unconformity which increases to west and decreases to east, probably disappearing before eastern Tennessee is reached. It [Maury] is basal Ridgetop, not upper member of Chattanooga.

J. H. Swartz, 1927, Am. Jour. Sci., 5th ser., v. 14, no. 84, p. 485–499. Big Stone Gap shale of Ulrich and Stose (1923) has been shown by direct and continuous tracing to be northward continuation of Chattanooga shale of type area. Big Stone Gap shale abandoned for prior term Chattanooga shale. Thoughout whole area, Chattanooga shale is divisible into three members: upper black shale member to which term Big Stone Gap is here restricted; midde gray shale member here called Olinger member; and lower black shale member here designated Cumberland Gap member. Olinger member is same age as Cumberland Gap member, with which it intertongues to south. Big Stone Gap member separated from underlying Olinger member by unconformity which is most marked in southeastern Tennessee and which may be absent in northeastern Tennessee and southwestern Virginia.

K. E. Born and H. B. Burwell, 1939, Tennessee Div. Geology Bull. 47, p. 48–49. Chattanooga shale, throughout most of central Tennessee, consists of three members: thin conglomeratic phosphatic dark-colored sandstone at base (Hardin sandstone); ubiquitous black shale member; and thin green phosphatic nodular soft shale unit at top (Maury green shale). In Clay County, underlies Fort Payne formation and overlies the Richmond group: Mississippian (Kinderhook group).

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1752–1753, chart 4. At its type section (Swartz, 1924) determined Chattanooga shale to be in part Upper Devonian and in part Lower Mississippian. Here section consists of about 11 feet of shale; the lowest 8 feet corresponds to Cleveland shale; next overlying 9 inches of mottled shale are assigned to the Bedford-Berea; next three-eighths inch of black shale is said to be of Sunbury age; over the Sunbury 2⅓ feet of hard shale (Glendale) is correlated with lower Cuyahoga of Ohio. These are long-ranging correlations and are not based on best of evidence, but, if Swartz is correct, main body of the Chattanooga at its type locality is correlated with Cleveland shale, which is herein regarded as Devonian. Correlation of these black shales is so difficult that age of each occurrence must be considered on its own merits. In northeastern Arkansas, black shales called Chattanooga contain Middle Devonian or lowest Upper Devonian fossils; these occurrences should be renamed or referred to Trousdale shale, Geneseo equivalent in west Tennessee.

Guy Campbell, 1946, Geol. Soc. America Bull., v. 57, no. 9, p. 880–895. Belt of outcrop of Chattanooga shale extends from Cumberland, Monroe, and Allen Counties, Ky., through Clay, Macon, and Sumner Counties, Tenn.; encircles Central basin along the Highland Rim, and joins again from Lincoln to Hardin County before entering Alabama, where it extends to Birmingham. Crops out in eastern Tennessee from Chattanooga to Cumberland Gap and along Clinch Mountain, extending into Virginia. Type Chattanooga is detached from both the shale of eastern Tennessee and that around Central basin and has not been correlated definitely with either. Thickness 20 to 35 feet in Chattanooga district, but only 10 feet exposed in type section on Cameron Hill; it is not a representative section for any region. Chattanooga shale has same time limits as New Albany shale in Indiana and Kentucky. All divisions of the New Albany, their stratigraphic relations, and lithic characters are duplicated in the Chattanooga. Terms New Albany and Chattanooga may be used interchangeably. Chattanooga in central Tennessee comprises (ascending) Trousdale, Dowelltown (new), Gassaway (new), Eulie (new), and Westmoreland (new) formations. Underlies Maury or New Providence shale.

W. H. Hass, 1947, (abs.) Geol. Soc. America Bull., v. 58, no. 12, pt. 2, p. 1189. Chattanooga shale in vicinity of Chattanooga, consists of three members: upper and lower black shale, and a middle gray shale. Conodonts present in all three members. Conodonts were collected at type locality in Chattanooga and near Apison, 16 miles east of Chattanooga. At Apison locality, upper black shale member contains lower Mississippian conodonts and is correlated with Sunbury shale of Ohio. Lower black shale at both localities contains conodonts that correlate it with Huron shale of Ohio, a formation classified as Upper Devonian by U.S. Geological Survey. Middle gray shale contains Huron conodonts, but its age is equivocal as J. H. Swartz has reported macrofossils from it which he considers to be of early Mississippian age. Presence of Huron conodonts in lower black shale member of Chattanooga shale is younger than the black shale sequence of the North Central States.

G. G. Huffman, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 2, p. 448. In Muskogee County, Okla., unconformably overlies Sylvan shale.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000) : U.S. Geol. Survey. Chattanooga shale (Mississippian and Devonian) mapped in northeastern and central eastern Oklahoma.

W. H. Hass, 1956, U.S. Geol. Survey Prof. Paper 286, p. 2–23. First reference to Chattanooga shale is brief. It appears as part of descriptive matter on geologic column that the "Chattanooga black shale" is of Devonian age, that it is overlain by Fort Payne chert of Carboniferous age and underlain by Rockwood formation of Silurian age, and that it is 35 feet thick. The "Chattanooga black shale" consists of two lithologic units: upper gray shale, 3 to 4 feet thick, and a lower black shale. Swartz (1924) named upper gray-shale unit of Hayes' Chattanooga the Glendale shale. Swartz was of the opinion that beds he identified as Glendale were, prior to his work, a part of Fort Payne chert. Name Glendale shale not used in present report; beds so named by Swartz are called Maury formation. At reference section herein designated, Chattanooga consists of lower Dowelltown member and upper Gassaway member. Thickness throughout much of area 25 to 35 feet. In some areas, includes Hardin sandstone member (about 16 feet thick) below the Dowelltown. As delimited in present report, the Chattanooga shale of type locality (locality 226) is the Cumberland Gap member of Swartz's (1927) section. The immediately overlying beds which Swartz assigned to his Olinger and Big Stone Gap members are herein placed in Maury formation. Underlies Maury formation; the two problably are separated by a unconformity throughout much of south-central Tennessee and north-central Alabama. Considered to be of Late Devonian age though oldest beds could be of late Middle Devonian. Conodonts discussed.

G. T. Malmberg and H. T. Downing, 1957, Alabama Geol. Survey County Rept. 3, p. 30–33. Name, as applied in Alabama, includes sandstone and black shale deposits that occur stratigraphically between Red Mountain formation of Silurian age and Fort Payne chert of Mississippian age.

Overlies Chickamauga limestone in northwestern part of Madison County. Thickness about 8 feet in Madison County. Devonian.

G. G. Huffman and others, 1958, Oklahoma Geol. Survey Bull. 77, p. 14 (fig. 2), 38–40, pls. 1, 2, 4, 5. Formation described on south and west flanks of Ozark uplift where it is as much as 70 feet thick and consists of basal Sylamore sandstone member and overlying black shale member. Unconformably underlies St. Joe or Reeds Spring limestone; unconformably overlies beds ranging in age from Lower Ordovician Cotter, as near Spavinaw, to Sallisaw formation of Devonian age near Marble City. Kinderhookian.

G. G. Huffman and J. M. Starke, Jr., 1960, Oklahoma Geology Notes, v. 20, no. 7, p. 159-163. Proposed that term Chattanooga be retained for Late Devonian-Early Mississippian lying immediately below the St. Joe group and that the formation be divided into two members; the lower, or Sylamore, sandstone member and the upper, or Noel, black shale member.

J. C. Cobb and J. L. Kulp, 1960, Geol. Soc. America Bull., v. 71, no. 2, p. 223–224. Discussion of U-Pb age of Chattanooga shale. Possible that true age of the Chattanooga is about 350 million years.

Type locality: Hillside exposure at north end of Cameron Hill, Chattanooga, Hamilton County, Tenn. Standard section: Cut on Tennessee Highway 26, at east approach to Sligo Bridge over Caney Fork, 7.1 miles east of courthouse at Smithville, DeKalb County, Tenn.

Chattanoogan Series[1]

Devonian-Mississippian: North America.

Original references: E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, pl. 29; C. Schuchert, 1924, Textbook geology, p. 335.

Chauga zone[1]

Cambrian(?): Northwestern South Carolina.

Original reference: C. 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.

Named for exposures along upper half of Chauga River, Oconee County.

Chaumont Formation[1] or Limestone (in Black River Group)

Middle Ordovician: New York, and Ontario, Canada.

Original references: G. M. Kay, 1929, Jour. Geology, v. 37, no. 7, p. 644–671; 1929, Am. Assoc. Petroleum Geologists Bull., v. 13, no. 9, p. 1214.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, pl. 2. Plate 2 shows Chaumont underlies Amsterdam limestone in Lake Champlain region.

G. M. Kay, 1942, Geol. Soc. America Bull., v. 53, no. 4, p. 588 (fig. 2), 593 (table 2), 594 (table 3), 595–597, 599. Uppermost formation of Black River group in New York. Separable into two members, Leray and Watertown limestones, only in limited area near Watertown. Underlies Rockland formation (type section in Ontario); overlies Lowville. Geographically extended into Ontario.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 24. Name was proposed to include (ascending) Leray, Glenburnie, and Watertown members. Leray consists of 13 feet of heavy-bedded dark-brownish-gray to black limestone containing chert. In type region of Chaumont, Leray is separated from Watertown by 2 feet of fossiliferous shale, the Glenburnie. Watertown comprises 13 feet of massive limestone. Outside type area, it is difficult to separate Leray and Watertown. Underlies Rockland formation; overlies Lowville.

D. W. Fisher, 1957, New York State Mus. Bull. 359, p. 13–15. Discussion of Mohawkian (Middle Ordovician) biostratigraphy of Wells outlier, Hamilton County. Chaumont limestone consists of about 9 feet of massive blocky argillicalcilutite with much black chert. Not certain whether the Chaumont at this locality consists of the Leray or Watertown members, or includes both. Overlies Lowville limestone; underlies Rockland (Napanee) limestone.

Named for Chaumont Bay, Lake Ontario, Jefferson County, N.Y.

Chaumontian 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 uppermost division of Black Riveran series. Younger than Lowvillian [stage]; older than Rocklandian stage of Trentonian series.

Name probably derived from Chaumont Bay, Lake Ontario, Jefferson County, for which Chaumont formation is named.

†Chautauqua Conglomerate[1]

Pennsylvanian: New York.

Original reference: J. P. Lesley, 1875, Pennsylvania 2d Geol. Survey Rept. I, p. 89, 96.

Probably Chautauqua County.

†Chautauqua Sandstone[1]

Pennsylvanian: Southeastern Kansas.

Original reference: G. I. Adams and E. Haworth, 1898, Kansas Univ. Geol. Survey, v. 3, p. 57–60.

Named for Chautauqua Sandstone Hills, which extend through parts of Chautauqua, Woodson, Wilson, Montgomery, Greenwood, and Elk Counties.

Chautauquan Group[1]

Chautauquan Series

Chautauquan Stage

Upper Devonian: North America.

Original reference: J. M. Clarke and C. Schuchert, 1899, Science, new ser., v. 10, p. 874–878.

K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 54, 60–61, table (facing p. 62). Chautauquan series embraces strata from base of Chemung to base of Bradfordian series of former classifications. Chautauquan was viewed by New York State geologists as marking close of Devonian and overlying Bradfordian was considered of Mississippian age. Name Bradfordian series is here abandoned, and term Conewango series is applied to Devonian part of the Bradfordian "series." Conewango series is a closing phase of Upper Devonian sedimentation in New York and Pennsylvania. Chautauquan series comprises Girard stage below and Chadakoin stage above.

Bradford Willard, 1939, *in* Bradford Willard, F. M. Swartz, and A. B. Cleaves, Pennsylvania Geol. Survey 4th ser., Bull. G–19, p. 240–253. Major units of Chautauquan stage (division) of marine Upper Devonian in northwestern, north-central, and central Pennsylvania are (ascending) Chemung, Canadaway, Conneaut, and Conewango groups.

G. A. Cooper, 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. Chautauquan comprises Cassadaga (new) and Conewango stages. Upper Devonian.

I. H. Tesmer, 1954, Dissert. Abs., v. 14, no. 12, p. 2317–2318. Chautauquan series reduced to Chautauqua group and incorporated in upper part of Senecan series.

I. H. Tesmer, 1955, New York State Mus. Sci. Service Circ. 12, p. 8, 9. Chautauquan series redefined to include all Upper Devonian rocks. As redefined, includes in western New York (ascending) Seneca, Arkwright, and Conewango groups. Occurs above Middle Devonian Erian series.

L. V. Rickard, 1957, New York State Geol. Assoc. Guidebook 29th Ann. Mtg., p. 17. General stratigraphic column of Wellsville area shows Chautauquan series comprises (ascending) Canadaway, Chadakoin, and Conewango groups. Above Senecan series; below Knapp "formation," Kinderhookian series.

Named for exposures in Chautauqua County, N.Y.

Chaves shale[1]

Permian: Southeastern New Mexico.

Original references: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 258; 1915, Conspectus of the geologic formations of New Mexico: Des Moines, Robert Henderson, State printer, p. 3, 6.

In Guadalupe Mountains. Derivation of name not given.

Chavez 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. Series of variegated sandstone and siltstone beds underlying Prewitt sandstone member (new) and overlying Thoreau formation (new).

C. T. Smith, 1954, New Mexico Bur. Mines Mineral Resources Bull. 31, p. 15–16, pl. 1. Alternating variegated greenish siltstone, purplish-to-reddish sandy mudstone, and white-to-buff coarse-grained conglomeratic sandstone; locally, units contain silty layers and mud-ball zones; much sandy material is strongly laminated; variegated red, purple, and green mudstone bed about 15 feet thick present near top of formation; beds of sandstone are 3 to 6 feet thick; siltstone 1 to 3 feet, mudstone layers 3 inches to 2 feet. Thickness 160 feet at type section (herein designated); thins to west; about 200 feet along eastern boundary of quadrangle; less than 100 feet near Chaco Canyon Road.

J. A. Momper and W. W. Tyrrell, Jr., 1957, Four Corners Geol. Soc. Guidebook 2d Field Conf., p. 18. Upper Jurassic.

Type section: In sec. 19, T. 14 N., R. 13 W., south of Mount Powell near western edge of Thoreau quandrangle. Named for exposures on crest of Chako Canyon Road about 5 miles north of Chavez Siding on Atchison, Topeka, and Santa Fe Railway.

Chazy Group[1] or Limestone[1]

Middle Ordovician: Eastern New York and western Vermont.

Original reference: E. Emmons, 1842, Geology of New York, pt. 2, div. 4, geology 2d dist., p. 107, 315, 429.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, 119–178. Series includes Stones River group with Murfreesboro, Mosheim, and Lenior limestones, and Blount group with Holston limestone, Whitesburg limestone, Athens formation, and Ottosee limestone. Overlies Beekmantown group; underlies Lowville-Moccasin formation of Black River group.

B. N. Cooper and C. E. Prouty, 1943, Geol. Soc. America Bull., v. 54, no. 6, p. 819–866. In Tazewell County, Va., strata embraced by the Chazyan and Black River groups of Butts (1940) are divisible into 29 distinctive zones. Detailed work indicated that supposedly diagnostic criteria for recognition of the Chazyan and Black River formations of Ulrich and Butts are unreliable and that succession of formations given by Ulrich and Butts is incorrect. The newly recognized zones are grouped into eight formations (ascending): Cliffield, with Blackford, Five Oaks, Lincolnshire, Ward Cove and Peery members; Benbolt limestone with Shannondale and Burkes Garden members; Gratton limestone; Witten limestone; Moccasin formation; and Eggleston formation. Terms Stones River, Murphreesboro, Mosheim, Lenoir, Blount, Holston, Ottosee, Lowville and Lowville-Moccasin should not be used in Tazewell County and other parts of southwestern Virginia. The succession beds described is clearly post-Beekmantown, but beds above *Camarocladia* zone (upper part of Witten) may by younger than hitherto believed. Moccasin and Eggleston may be early Trenton but present evidence not conclusive. Boundary between Chazy and Black River not clearly defined in Tazewell County. Series and group classification of formations can be made only after regional studies between New York localities and Tazewell County have been completed.

W. M. Cady, 1945, Geol. Soc. America Bull., v. 56, no. 5, p. 522 (fig. 3), 524 (table), 548–554. Chazy group, in eastern New York, comprises (ascending) Day Point, Crown Point, and Valcour limestones. Inasmuch as Day Point beds thin and pinch out, north of west-central Vermont, and inasmuch as Valcour undergoes considerable change in lithology and obliteration of fossils eastward from Lake Champlain, Crown Point limestone is only term used along Lake Champlain appropriate in west-central Vermont [this report]. Here Chazyan sequence (Chazy group) is Crown Point limestone, Beldens formation with Weybridge member (both new), and Middlebury limestone (new). Overlies Beekmantown group (Beekmantownian).

Marshall Kay, 1945, (abs.) Geol. Soc. America Bull., v. 56, no. 12, pt. 2, p. 1171–1172. Highgate Springs sequence of Middle Ordovician rocks lies structurally below and west of thrusts bounding the Rosenberg, Philipsburg, and Granby slices for 100 miles from Chittendon County, Vt., to Bagot County, Quebec. Three formations are Chazyan: Beldens, Carman (new), and Youngman (new). Disconformably overlying Chazyan at Highgate Springs is 80 feet of Isle la Motte limestone having Trenton fossils.

B. N. Cooper and G. A. Cooper, 1946, Geol. Soc. America Bull., v. 57, no. 1, p. 35–114. In proposed reclassification, lower Middle Ordovician of Shenandoah Valley is divided into six time-stratigraphic units (ascending) New Market limestone (new), Whistle Creek limestone (new), Lincolnshire limestone, Edinburg formation (new), Oranda formation (new), and Collierstown limestone (new). At least part of New Market limestone is linked with part of New York Chazy and type Lenoir; Lincolnshire seems to be post-Chazy. Whistle Creek, if at all Chazy, could be represented only in upper part of the Valcour; probably Whistle Creek, as well as some of succeeding beds, is younger than Chazy and older than typical Black River.

Marshall Kay, 1947, (abs.) Geol. Soc. America Bull., v. 58, no. 12, pt. 2, p. 1198. Bolarian series (new, Bolar Valley, Va.) comprises rocks younger than Lincolnshire, about late Chazyan, and older than Nealmont, early Trentonian.

Marshall Kay and W. M. Cady, 1947, Science, v. 105, no. 2736, p. 601. Cady (1945) included Crown Point, Beldens, and Middlebury formations in Chazy "group" in west-central Vermont. Name Crown Point is herein replaced by Burchards limestone, and the Burchards and Beldens are included in Chipman group (new). Kay (1945) studied "Chazy" rocks of northern Lake Champlain and described the Carman quartzite and Youngman formation as succeeding the Beldens in Highgate Springs slice. Carman and Youngman compose Maquam group (new). Chazy sequence in New York is Day Point, Crown Point, and Valcour. Inasmuch as these three sequences have been called Chazy for nearly a century, it is recommended that Chazyan series consists of Chipman and Maquam groups, as well as the Chazyan series of New York. This use of Chazy is considered to have priority over the Chazyan of Grabau (1909) which added the Black River group and of Ulrich (1911) which was a composite of widely scattered stratigraphic units.

Marshall Kay, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1400–1406. Rocks younger than Canadian or Beekmantownian and older than Cincinnatian series are commonly referred to Middle Ordovician and placed in two series, Chazyan and Mohawkian. The Mohawkian is herein divided into Bolarian and Trentonian series. Chazyan, as originally defined, included Black River group as well as Chazy, but name should be restricted to the latter. Chazyan has two groups, Chipman and Maquam. The Chipman, present in Vermont and southeastern Quebec, is thought to be older than base of Chazy limestone in New York, correlated Maquam group of Vermont. Black River and Trenton formations in New York and Ontario lie with regional unconformity on the Chazyan, Canadian, and Upper Cambrian, and Precambrian. The Chazy, Black River, and Trenton commonly have been classified as groups of Middle Ordovician. They are comparable in stratigraphic magnitude and are separated by persistent regional unconformities. The Chazyan along Allegheny synclinorium includes Five Oaks-Blackford and Lincolnshire formations. Chazyan is followed by Bolarian series which term is used in preference to Black Riveran.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 66, no. 3, p. 253–254, chart 2. In type area, in Champlain Valley, Chazyan stage includes about 1,000 feet of relatively pure thick-bedded limestone. These deposits are separated from shale belt on the east by major thrust zone (Logan's Line) and from contemporaneous deposits both north and south by gap of more than 100 miles. Hence, recognition of Chazyan rocks outside Champlain Valley rests entirely on faunal criteria. Chazyan fauna has turned out to be somewhat restricted, and provincial facies not clearly recognizable elsewhere. This is illustrated by Lincolnshire formation of Virginia and Tennessee which has been referred to Chazyan by most students and is so placed in present chart but which Cooper believes should be lifted to base of Black River stage because of numerous faunal affinites with that stage that are unknown in type Chazyan. In Champlain Valley, the middle Chazyan, Crown Point, limestone is characterized by gastropod *Maclurites magnus*. In this region, there is no similar species above or below and, thus, from early days of Ordovician stratigraphy, *Maclurites magnus* came to be regarded as guide to Middle Chazyan. It is now known that similar large species of *Maclurites* occur higher in Ordovician in central and southern Appalachians, *Tetradium cellulosum* and *Cryptophragmus* led Ulrich and others to identify Lowville formation in Appalachians and central basin of Tennessee. In southern Appalachians *Cryptophragmus* is common in Witten formation, which was hitherto called Lowville. On basis of its supposed Lowville age, all rocks below were placed in Chazyan. This accounted for Chazyan age of Ottosee and Athens of Virginia. The latter formations with *Nemagraptus* and other graptolites of Normanskill assemblage were thus dated as Chazyan. Similarly, the Carters formation of Tennessee was dated as Lowville because of abundant *Tetradium cellulosum* in its lower beds. By this correlation, entire Stones River group was assigned to Chazyan in spite of fact that Stones River contained no Chazyan species other than *Maclurites*. Now known that *Cryptophragmus* and *T. cellulosum* have considerable range. Fauna of Witten limestone accompanying *Cryptophragmus* is that of the Chaumont or Rockland beds, and Carters limestone is now recognized as equivalent to Tyrone limestone and correlated with Rockland. Result has been to leave scope of Chazyan stage outside Champlain Valley in confusion and uncertainty. Suggested that it might be desirable to abandon Chazyan as stage name in standard section and choose term with new type section somewhere in central or southern Appalachian trough. However, name Chazyan stage is retained for present chart.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 1, 7–8, chart 1. Five stage terms proposed (ascending): Whiterock, Marmor, Ashby, Porterfield, and Wilderness. Older terms, Chazyan and Black River, are no longer useful because they have been so defined that they do not describe the stratigraphy. Recent studies have shown that Chazyan of Ulrich included rocks from Chazyan to Trenton and that Black River of Ulrich was in large part of Trenton age. Grabau's (1909) usage of Chazyan included Black River, which is herein regarded more closely related to overlying Rockland than to Chazy group below. Ulrich's (1911) conception of Chazy was for interval between Lowville and top of Canadian (Beekmantown or Knox dolomite) which is far too inclusive. Marmor stage includes Chazy group of rocks and its correlatives. Ashby stage includes Elway and Lincolnshire formations which Kay (1948) placed in his Chazyan.

Marshall Kay, 1956, Geol. Soc. America Bull., v. 67, no. 1, p. 55–106. Middle Ordovician limestones of the Chazyan, Bolarian, and Trentonian series are exposed in western anticlines in Appalachian Mountains of West Virginia and in Virginia northeast of the New River. The Chazyan comprises Lurich formation or group (new) with Blackford, Elway, and Five Oaks formations, and overlying Lincolnshire formation. In Appalachian Valley, the Chazyan includes St. Paul group and Lincolnshire formation. The Chazyan epoch is represented in two stages, the Lurichian and Lincolnshirian.

Marshall Kay, 1958, Am. Jour. Sci., v. 256, p. 65–96. Discussion of Ordovician classification. Chazyan series corresponds to the Chazy limestone as originally used for rocks above the Calciferous and below the Black River near Lake Champlain. Classification of rocks younger than Canadian and older than Trentonian concerns sequences (a) along Lake Champlain, containing type Chazy, (b) northwestern New York, containing typical Black River and Trenton, and (c) Appalachians, particularly the Virginias, where there are type sections of the Bolarian series and a number of recently named stages (Cooper, 1956). Classification and correlation discussed within past few years (Cooper, 1956; Kay, 1956; Twenhofel and others, 1954) must be reconsidered. Chazy limestones lie on the Canadian along Lake Champlain; now that Canadian age of Beldens limestone has been recognized, there is no problem in placement of boundaries. Chazy lies on a regional unconformity with an overlapping basal quartz sandstone. Chazy has long been divided into three lithologic and faunal stages (Brainerd and Seely, 1888, Am. Geologist, v. 2) which were given "substage" names Day Point, Crown Point, and Valcour (Cushing, 1905). As stages, these have been called Dayan, Crownian and Valcourian (Oxley, 1952, unpub. thesis). Appalachian region has been thought to have fuller sequences of post-Canadian rocks than New York, but recent studies cast doubt on this assumption. If an Appalachian standard were established, it would be possible to correlate to New York sequences but there are problems of correlation within Appalachian sections. To the southwest, there is disagreement whether base of Trentonian is within Witten formation or at top. Cooper (1956) placed lowest Trentonian as well as Black River equivalents in Wilderness stage. Kay (1947) defined Bolarian series as extending from top of Lincolnshire limestone to base of Nealmont which seems lowest Trentonian. Lincolnshire was classified as Chazyan. Rocks younger than Canadian have been assigned by Cooper (1956) to Marmor, Ashby, Porterfield, and Wilderness stages. Because type Marmor is isolated from that of others, the rocks between the Elway and Lincolnshire formations of type Ashby are herein referred to as Blackford "stage." Thus, Virginia sequence consists of Blackford, Ashby, Porterfield, and Wilderness stages. If Youngman formation and St. Dominique limestone of Highgate Springs sequence are Chazyan, as they seem, they contain fossils that have been considered distinctive of Marmor, Ashby, and Porterfield stages in Appalachians, rather than of Marmor alone. Fossils in Youngman generally resemble those in the Porterfield; those in St. Dominique resemble those in type Chazy and the "Ashby". The Highgate sequence suggests that base of Bolarian series may be within upper Chazyan series rather than above it. In the north, it is possible to subdivide Chazyan and Blackriveran series each into three stages. In the Appalachians, it is best to establish provincial stages from single sequence as in the Virginias; Blackford, Ashby, and Porterfield are in such a sequence. Place of Marmor stage is in dispute. Porterfield and pre-Trentonian part of Wilderness constitute type Bolarian series. Blackford and Ashby stages are believed to be Chazyan but not to constitute the whole of that series; they are in a provincial series that is approximately St. Paul group (Neuman, 1951).

W. M. Cady and E-an Zen, 1960, Am. Jour. Sci., v. 258, no. 10, p. 728–739. In west-central Vermont, Chipman formation, with Burchards, Weybridge, Beldens, and Bridport members, is Beekmantown rather than

Chazy as stated in previous reports. In this area, the Middlebury limestone is Chazy.

Marshall Kay, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 7, p. 28–33. Chazyan series or "Chazy stage" was divided into three "substages" by Cushing that have become Dayan, Crownian, and Valcourian stages (Oxley and Kay, 1959), recognizable in type area by their distinctive fossil assemblages. Cooper (1956) places whole type Chazy in his Marmor "stage" considering the succeeding Ashby and Porterfield "stages" of southern Appalachians to be post-Chazy and at least partly pre-Black River. But fossils thought diagnostic of Porterfield "stage" are in argillaceous strata of type Chazyan (Kay, 1958). Cooper introduced an earlier post-Canadian "stage," the Whiterock, below the Marmor, basing it on faunas found in Nevada; whether these are older than type Chazyan, or represent different faunal facies or province is difficult to determine because of their isolation. Flower (1957, New Mexico Bur. Mines Mineral Resources Mem. 2) concurs in believing them younger than Canadian and older than Dayan; the Whiterockian is so placed in table in present report. Chazyan series comprises (ascending) Whiterockian, Dayan, Crownian, and Valcourian stages; occurs above Canadian series and below Blackriveran.

Named for exposures at Chazy, Clinton County, N.Y.

Chazyan Series[1], Stage, Epoch

Middle Ordovician: North America.

Original reference: A. W. Grabau, 1909, Jour. Geology, v. 17, no. 3; E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22.

See **Chazy Group** or **Limestone.**

Cheaha Sandstone Member (of Talladega Slate)[1]

Cheaha Quartzite Member (of Talladega Series)

Paleozoic(?): Eastern Alabama.

Original reference: Charles Butts, 1926, Alabama Geol. Survey Special Rept. 14, p. 54, 58, map.

R. H. Griffin, 1951, Alabama Geol. Survey Bull. 63, p. 28–30. Described in the Hillabee area where Talladega series is divided into Cheaha quartzite, Erin slate, and a group of quartzites, phyllites, and slates lying below, between, and above the two members. Maximum thickness of quartzites about 2,600 feet; variations in thickness caused in part by folding and thrust faulting. Upper limit of Cheaha placed at point in section where phyllite becomes dominant rock type owing to the marked diminution in number and thickness of the quartzite beds; boundary is expressed topographically by the generally well-defined eastern base of Talladega-Rebecca Mountain.

Named from fact that Cheaha Mountain, Clay County, is formed by the sandstone.

Checkerboard Limestone (in Pleasanton Group)

Checkerboard Limestone (in Skiatook Group)

Checkerboard Limestone Member (of Coffeyville Formation)[1]

Pennsylvanian ((Missouri Series): Northeastern and central Oklahoma, and southern Kansas.

Original reference: L. L. Hutchinson, 1911, Oklahoma Geol. Survey Bull. 2, p. 151–164.

R. C. Moore and others, 1937, Kansas Geol. Soc. Guidebook 11th Ann. Field Conf., p. 40 (table), 42. Rank raised to formation in Skiatook group. Overlies Seminole sandstone; underlies Coffeyville shale (restricted).

M. C. Oakes and J. M. Jewett, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 5, p. 634 (fig. 1), 638–639. Geographically extended into southern Kansas where it overlies Hepler sandstone.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 91. In Kansas, included in Pleasanton group; underlies shales below Knobtown sandstone. Thickness ranges from featheredge to about 6 feet.

M. C. Oakes, 1959, Oklahoma Geol. Survey Bull. 81, p. 16–17. Name Checkerboard seems to have crept into general usage without formal definition. Hutchinson (1911) made reference to it by name. Smith (1914, U.S. Geol. Survey Bull. 541) used name without describing it, Fath and Emery (1917, Oklahoma Geol. Survey Bull. 35) described the Checkerboard and designated type exposure. Checkerboard limestone in Creek County [this report] is single bed about 2½ feet thick. Conformably overlies Seminole formation; conformably underlies Coffeyville formation. Skiatook group.

Type locality: Exposures along Checkerboard Creek in T. 15 N., R. 11 E., Washington County, Okla.

Chediski White Sandstone Member (of Troy Quartzite)[1]

Middle Cambrian: Central eastern Arizona.

Original reference: F. F. Burchard, 1931, U.S. Geol. Survey Bull. 821–C.

Age currently considered by U.S. Geological Survey to be Middle Cambrian.

Forms cliff on northeast face of Chediski Mountain, Fort Apache Indian Reservation.

Chehalis Formation[1]

Miocene, lower: Southwestern Washington.

Original reference: C. E. Weaver, 1912, Washington Geol. Survey Bull. 15, p. 10–22.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 100. As a result of later studies, Chehalis formation has been abandoned as a stratigraphic name.

Named for Chehalis River in Chehalis, Grays Harbor County.

Chehalis Sandstone[1]

Eocene: Southwestern Washington.

Original reference: A. C. Lawson, 1894, Am. Geologist, v. 13, p. 436–437.

In vicinity of Chehalis, Lewis County.

Chelan (batholithic) Complex

Chelan Granodiorite[1]

Upper Jurassic(?): Central Washington.

Original reference: A. C. Waters, 1932, Jour. Geology, v. 40, no. 7, p. 605.

J. D. Barksdale, 1948, Northwest Sci., v. 22, no. 4, p. 165. Northeastern contact of Chelan batholithic complex makes straight line N. 40°–45° W. across Methow quadrangle from near its southeast corner. Granitic rocks of complex can be traced southwest into area mapped by Waters (1932) as Chelan granodiorite. Detailed study of granitic rocks was not made in quadrangle, but some samples revealed that rock is true biotite granodiorite of medium grain and quite different from typical basic granodiorite described by Waters. Waters assigned Chelan granodiorite of type area to Jurassic(?). Some granite rocks of Chelan complex in Methow quadrangle apparently cut formations as young as Upper Cretaceous.

Named from Chelan Mountains, Chelan County, where it is typically exposed.

Chelsea Sandstone Member (of Senora Formation or Cabaniss Formation)

Chelsea Sandstone Lentil (of Cherokee Formation)[1]

Chelsea Sandstone Member (of Scammon Formation)

Pennsylvanian (Des Moines Series): Northeastern Oklahoma, southeastern Kansas, and southwestern Missouri.

Original reference: G. C. Clark and C. L. Cooper, 1927, Oklahoma Geol. Survey Bull. 40–H, fig. 3.

W. V. Searight and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 12, p. 2748 (fig. 1). Included in Scammon formation (new) above Tiawah limestone.

W. B. Howe, 1956, Kansas Geol. Survey Bull. 123, p. 53, 57–58, 59. In Scammon formation. Present in exposures in strip mines in Crawford County, Kans., and Barton County, Mo., where in many areas it rests upon an erosion surface extending down through lower beds and locally through the Tiawah limestone and underlying Tebo coal. Typically a gray to brown very fine grained micaceous finely to coarsely crossbedded sandstone. Thickness 5 to 30 feet.

J. V. A. Trumbull, 1957, U.S. Geol. Survey Bull. 1042–J, pl. 16. Shown on correlation chart as sandstone member near base of Senora formation. The Cherokee formation of former usage in northeastern Oklahoma included rocks from the McAlester through the Senora formation.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. Member of Cabaniss formation in Kansas.

Forms prominent escarpment from upper branches of Whiteoak Creek, thence south and west to Chelsea, Rogers County, Okla.

Cheltenham Clay Member (of Spoon Formation)

Cheltenham Fire Clay[1]

Cheltenham Formation (in Cherokee Group)

Pennsylvanian: Missouri and Illinois.

Original reference: H. A. Wheeler, 1896, Missouri Geol. Survey, v. 11, 1st ser., p. 247.

H. S. McQueen, 1943, Missouri Geol. Survey and Water Resources, v. 28, 2d ser., p. 39–71, pl. 6. Rank raised to formation Cherokee group. Made up of three distinct clays: lower, very dark or fairly dark, black, brown, or gray semiflint and flint fire clay; middle, light-gray fairly hard semiplastic clay, 6 to 20 feet thick; and upper, light- to dark-gray plastic clay, 0 to 15 feet. Overlies Graydon formation; underlies Loutre formation (new).

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 33, 46 (table 1). Name Cheltenham clay member of Spoon formation (new) is applied locally to dominantly clay unit that is composite of several underclay members. Stratigraphic range varies from place to place. In southwestern Illinois, occurs above DeKoven coal member (new); in western Illinois, occurs above Browning sandstone member.

Named for fire-clay seam in Cheltenham district in southern part of St. Louis, Mo.

Chemard Lake Lignite Lentil (of Naborton Formation)

Paleocene (Midway): Northwestern Louisiana.

D. P. Meagher and L. C. Aycock, 1942, Louisiana Dept. Conserv. Geol. Pamph. 3, p. 13, 14. Lentil at top of Naborton formation.

G. E. Murray, 1948, Louisiana Dept. Conserv. Geol. Bull. 25, p. 98–100, pl. 4. Consists of lignite and lignitic clays that interfinger and mutually replace each other or are both replaced by other sediments in upper part of Naborton. Maximum thickness 10 feet. Limited at top by basal sands of Dolet Hills member of Logansport formation.

Type locality: One mile northwest of Chemard Lake at Coal Bed Springs in bluffs facing Dolet Brake and Dolet Bayou, in NW¼ sec. 3, T. 11 N., R. 11 W., 2½ miles southwest of Evelyn and 2 miles northwest of Rambin's store, De Soto Parish. Has been traced around outcrop area of Naborton formation from Chemard Lake to Rockdale.

Chemehuevi Formation

Chemehuevi Gravel[1]

Pleistocene: Western Arizona and southeastern Nevada.

Original reference: W. T. Lee, 1908, U.S. Geol. Survey Bull. 352, p. 18.

C. R. Longwell, 1936, Geol. Soc. America Bull., v. 47, no. 9, p. 1443–1450. Chemehuevi formation consists chiefly of sand, silt, and clay. Strongly unconformable on the old river gravels.

C. R. Longwell, 1946, Am. Jour. Sci., v. 244, no. 12, p. 820 (fig. 2), 827. Although sediments are unconsolidated and easily eroded, hundreds of remnants lie at various levels along the valley below the Grand Canyon.

Named for Chemehuevi Valley, south of The Needles, along the Colorado River, Mohave County, Ariz.

Chemehuevis Formation

See Chemehuevi Formation.

Chemung Formation[1]

Chemung Formation (in Conneaut Group or Seneca Group)

Chemung Stage

Upper Devonian: New York, western Maryland, Pennsylvania, and Virginia.

Original reference: J. Hall, 1839, New York Geol. Survey 3d Rept., p. 322–326.

Bradford Willard, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 246, 247. Group, in south-central New York and adjacent Pennsylvania, consists of Cayuta formation and Wellsburg formation with Fall Creek conglomerate locally at top.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 322–333. Chemung, except where removed by erosion on the anticlines, persists throughout full width of Appalachian Valley northwest of Little North Mountain in Virginia and West Virginia, and in the continuation of that belt southwest to vicinity of New River. Approximate thickness 2,000 feet in its full development in Appalachian Valley. In West Virginia, thins out entirely near Narrows of New River. In Virginia, overlies Brallier shale; underlies Hampshire (Catskill) formation.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1734, chart 4. Devonian subdivided into 10 stages that represent grouping of formations on faunal and paleogeographic basis. Group term Chemung is elevated to stage rank because of widespread and distinctive character of its fossils. Stage has same limits that Chadwick (1935, Am. Mid. Nat., v. 16, no. 6) gave to group. Chemung stage follows Finger Lakes stage (new) and is followed by Cassadaga (new) stage.

Charles Butts, 1945, U.S. Geol. Survey Geol. Atlas, Folio 227. Formation described in Hollidaysburg and Huntingdon quadrangles, Pennsylvania, where it is 2,400 to 3,500 feet thick. Includes Piney Ridge sandstone, Allegrippis sandstone, and Saxton conglomerate members. Overlies Brallier shale; underlies Hampshire formation.

Ernst Cloos, 1951, Maryland Dept. Geology, Mines and Water Resources [Rept.] Washington County, p. 91–92; T. W. Amsden, 1951, Maryland Dept. Geology, Mines and Water Resources [Rept.] Washington County, p. 99 (table 4), 122. Uppermost member of Jennings formation. Overlies Parkhead member; underlies Catskill formation.

I. H. Tesmer, 1954, Hobbies, v. 35, no. 2, p. 30, 31. Oldest rocks in Chautauqua County, N.Y., are assigned to Seneca group. The group is divided into four formations, youngest of which is Chemung. The Chemung in turn is divided into three formations; the two youngest, Angola shale and Hanover shale are exposed in Chautauqua County. Pipe Creek shale included in Hanover shale. Thickness about 340 feet. Underlies Dunkirk shale member of Canadaway group.

I. H. Tesmer, 1955, New York State Mus. Sci. Service Circ. 42, p. 10 (fig. 1). Chemung formation includes Wiscoy member in some areas and Hanover member in others.

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

Named for occurrence in valley of Chemung River and in town of Chemung, Chemung County, N.Y.

Chenango Sandstone Member (of Skaneateles Formation)

Middle Devonian: Central New York.

G. A. Cooper, 1941, Washington Acad. Sci. Jour., v. 31, no. 5, p. 180. Proposed to replace Colgate sandstone of Cooper, 1930 (not Calvert, 1912).

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Correlation chart shows Chenango sandstone above Butternut shale and below Stone Mill limestone. Middle Devonian.

[G. A. Cooper], 1955, *in* New York State Geol. Assoc. [Guidebook] 27th Ann. Mtg., p. 10, 11. Uppermost member of formation. Grades downward into Butternut member. Thickness 60 feet.

Type section: Quarry at top of hill just south of buildings on Colgate University campus and overlooking Chenango Valley to northwest, Hamilton County.

Cheneyan Stage

Paleocene: California.

P. P. Goudkoff, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 7, p. 960 (table 1), 967–982, 1005. A stage, based on a foraminiferal assemblage. Comprises beds below base of Martinez and top of typical Moreno shale. Occurs above Upper Cretaceous Ciervian stage (new).

Occurs in Great Valley in both surface and subsurface. Named from Jergins Oil Co.'s Cheney Ranch Well 1, sec. 29, T. 14 S., R. 13 E. [Fresno County].

Cheney Gulch Granite

Precambrian: West-central Arizona.

C. A. Anderson, E. A. Scholz, and J. D. Strobell, Jr., 1955, U.S. Geol. Survey Prof. Paper 278, p. 1, 19–20, pl. 3. Fine- to medium-grained biotite granite with a hypidiomorphic granular texture. Occurs as small masses intrusive into Lawler Peak granite (new). Intrudes Hillside mica schist (new).

Largest outcrops lie in a belt 1 mile long and nearly one-half mile wide in upper part of Mineral Creek basin. Named from exposures along west bank of Cheney Gulch, a tributary to Mineral Creek, Bagdad area, Yavapai County.

Chengwatana Series[1]

Precambrian (Keweenawan): Eastern Minnesota.

Original reference: C. W. Hall, 1900, Am. Assoc. Adv. Sci. Proc., v. 49, p. 191.

Crops out on Snake River at Chengwatana, Pine County.

Chepultepec Dolomite[1] (in Knox Group)

Chepultepec Formation

Lower Ordovician: Northern Alabama, Georgia, eastern Tennessee, western Virginia, and southern West Virginia.

Original reference: E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, p. 549, 638–640, pl. 27.

W. P. Woodward, 1939, West Virginia Geol. Survey [Rept.], v. 12, p. 9, 10–11. Discussed with Cambro-Ordovician limestones. In northeastern belt, overlies Conococheague formation; underlies middle Beekmantown, or Canadian (Nittany dolomite). Included in or represents, what has been mapped as Stonehenge member of Beekmantown group.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, p. 56 (table 5), 57–58, pt. 1, pls. Included in Knox group. Underlies Longview dolomite; overlies Copper Ridge dolomite. Consists largely of well-bedded fairly light mostly fine- to medium-grained dolomite, much of it slightly silty; thin layers of dark dolomite; dark bluish aphanitic limestone prominent in upper part in southeastern belts. Thickness commonly 700 to 750 feet.

A. T. Allen, 1953, Georgia Geol. Survey Bull. 60, p. 185–186. Geographically extended into Georgia where it is referred to as formation. Near Graysville, Catoosa County, approximately 1,400 feet thick, only upper 153 feet measured. Overlies Copper Ridge formation; underlies Longview formation.

R. L. Miller and J. O. Fuller, 1954, Virginia Geol. Survey Bull. 71, p. 47–54, pls. Dolomite described in Rose Hill district where it forms roughly parallel belts on opposite sides of axis of Powell Valley anticline. Two-fold division apparent in all sections: lower or sandy member and upper or argillaceous dolomite member. Thickness 697 to 776 feet. Overlies Copper Ridge dolomite; underlies Longview dolomite.

W. B. Brent, 1960, Virginia Div. Mineral Resources Bull. 76, p. 11 (table 1), 26–29. Thickness 266 to about 500 feet in Rockingham County. Overlies Conococheague limestone; underlies Beekmantown formation.

Named for exposures near Chepultepec, Blount County, Ala., 30 miles northeast of Birmingham.

Chequamegon Sandstone[1] (in Bayfield Group)

Precambrian: Northwestern Wisconsin.

Original reference: F. T. Thwaites, 1912, Wisconsin Geol. Nat. History Survey Bull. 25, p. 33.

S. A. Tyler and others, 1940, Geol. Soc. America Bull., v. 51, no. 10, p. 1479, 1481. Uppermost formation in Bayfield group. Thickness 1,000 feet. Overlies Devils Island sandstone.

G. O. Raasch, 1950, Illinois Acad. Sci. Trans., v. 43, p. 147. Examination of evidence on which Thwaites established his Chequamegon formation reveals that his Chequamegon brownstone formation is none other than Port Wing brownstone member (new) of Orienta formation repeated by faulting. Contact of Chequamegon formation with the supposedly underlying Devils Island formation is reported by Thwaites only from type locality, Devils Island. The beds here that he [Thwaites] considers to be Chequamegon, he assigns to basal Chequamegon. Suggested in present report that these basal beds are Devils Island formation rather than the Chequamegon brownstone and that a fault contact lies offshore to the south and there separates the Devils Island from the brownstone that forms southern islands of Apostle group. Chequamegon formation is dropped from Bayfield group.

Named from exposures on Chequamegon Bay.

†Cheraw Cobbles[1]

Pliocene(?) and Pleistocene: Northeastern South Carolina.

Original references: E. Sloan, 1905, South Carolina Geol. Survey geognostic map of South Carolina, advance copies, published in 1908 in South Carolina Geol. Survey, ser. 4, Bull. 2; 1907, Summary of mineral resources of South Carolina, p. 12, 20.

Named for development around Cheraw, Chesterfield County.

†Cherokee Limestone[1]

Cambrian (probably lower): Northwestern South Carolina.

Original reference: E. Sloan, 1908, South Carolina Geol. Survey, ser. 4, Bull. 2, p. 432.

†Cherokee Limestone[1]

Mississippian: Southeastern Kansas and southwestern Missouri.

Original reference: W. P. Jenney, 1893, Am. Inst. Mining Engrs. Trans., v. 22 (author's ed. August 1893), p. 178, 186, 191–202.

Named for Cherokee County, Kans.

Cherokee Shale[1] **or Group**

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

Original reference: E. Haworth and M. Z. Kirk, 1894, Kansas Univ. Quart., v. 2, p. 105–106.

W. G. Pierce and W. H. Courtier, 1937, Kansas Geol. Soc. Guidebook 11th Ann. Field Conf., p. 17; 1938, Kansas Geol. Survey Bull. 24, p. 33–35, fig. 2. Cherokee shale, southeastern Kansas, includes Little Cabin sandstone member near base. Bluejacket sandstone member near middle, and Breezy Hill limestone member (new) at top. Thickness about 425 feet. Overlies Mississippian limestone; underlies Fort Scott limestone.

G. E. Abernathy, 1937, Kansas Geol. Soc. Guidebook 11th Ann. Field Conf., p. 18–23; 1938, Kansas Acad. Sci. Trans., v. 41, p. 193–195. Group in southeastern Kansas subdivided into 15 formations or cyclothems (cyclic formational units) as follows (ascending): Riverton, Neutral, Columbus, Bluejacket, Knifeton, Weir-Pittsburg, Pilot, Scammon, Mineral, Fleming, Coalvale, Croweburg, Ardmore, Bevier, and Mulky.

H. S. McQueen, 1943, Missouri Geol. Survey and Water Resources, 2d ser., v. 28, p. 29–92. pls. 5, 6, measured sections. Group, as defined in this report, is composed of several new formations. Names of well-known coal beds have been used in order to reduce to minimum the introduction of new names. Sequence (ascending) unnamed shale and sandstone of local occurence, Graydon formation, Cheltenham, Loutre (new), Tebo (new), Ardmore, Bevier, and Lagonda. Group is restricted by removal of Squirrel sandstone which is placed in overlying Henrietta group.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 31). Correlation chart shows that group in Iowa includes Munterville and Seahorne limestones.

R. C. Moore, 1949, Kansas Geol. Survey Bull. 83, p. 37–47. Group is defined to include all strata from base of Pennsylvanian north of Kansas-Oklahoma line to base of Fort Scott limestone. In Kansas, comprises 16 cyclothems. Classification is modified from that of Abernathy (1937) in that Croweburg and Ardmore are combined into Ardmore cyclothem; Stice cyclothem (new) occurs above the Bevier; term Mulky is discarded and terms Breezy Hill and Blackjack Creek are used.

T. R. Beveridge, 1951, Missouri Geol. Survey and Water Resources, v. 32, 2d ser., p. 51–55, pl. 11. Cherokee group, in Weaubleau Creek area, comprises Dederick subgroup (undifferentiated) and Graydon formation. Overlies Burlington formation; underlies Tertiary(?) unconsolidated upland gravels.

W. B. Howe, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 9, p. 2087. Formation in northern Oklahoma includes (ascending) older Pennsylvanian units, Little Cabin sandstone, Bluejacket sandstone, Broken Arrow coal, Verdigris limestone, sandstone (Squirrel sand), Iron Post coal, Kinnison shale (new), and Breezy Hill limestone members.

A. G. Unklesbay, 1952, Missouri Geol. Survey and Water Resources, 2d ser., v. 33, p. 68–90. McQueen defined top of the Cherokee as the base of Squirrel sandstone, but this boundary is not now recognized by Missouri Geological Survey. Cherokee is defined as extending from base of Pennsylvanian to base of Fort Scott.

M. C. Oakes, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 6, p. 1523–1526. Rocks of Krebs and Cabaniss groups (both new) are nearly but not quite the same, stratigraphically, as Cherokee rocks of southeastern Kansas. Hartshorne sandstone and possibly some lower McAlester rocks are older than any Cherokee rocks of Kansas; Thurman sandstone, Stuart shale, and lower part of Senora formation are probably not represented in Cherokee rocks of Kansas because of progressive northward overlap in post-Boggy rocks. Otherwise the Krebs and Cabaniss rocks are equivalent to Cherokee rocks of Kansas.

W. V. Searight, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 12, p. 2747–2749. In reclassification of Desmoinesian (Pennsylvanian) of northern midcontinent, term Cherokee is replaced by Krebs and Cabaniss groups.

W. B. Howe, 1956, Kansas Geol. Survey Bull. 123, 132 p. Term Cherokee readopted for Kansas and Missouri. Krebs and Cabaniss relegated to subgroup status. Cherokee subdivided into (ascending) Riverton, Warner, Rowe, Dry Wood, Bluejacket, Seville, Weir, Tebo, Scammon, Mineral, Robinson Branch, Fleming, Croweburg, Verdigris, Bevier, Lagonda, Mulky, and Excello formations. Underlies Marmaton group.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. Chart shows that group in Kansas includes Krebs and Cabaniss formations.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 34, fig. 5. Section between base of Marmaton group to top of Mississippian system is designated Cherokee group. Although this may include a part of either the Atoka or Morrow series, Iowa Geological Survey has not differentiated them. Other States have further subdivided the Cherokee in Krebs-Cabaniss subgroups. Mulky coal, Bedford coal, Bevier coal, Ardmore limestone, and Whitebreast coal have been recognized.

Named for exposures in Cherokee County, Kans.

†Cherokee Slates[1]

Lower Cambrian: Western North Carolina.

Original reference: W. C. Kerr, 1869, North Carolina Geol. Survey Rept. 2, p. 13–35.

Named for development in Cherokee County, along Valley River.

Cherric period[1]

Precambrian: Montana.

Original reference: C. R. Keyes, 1926, Pan-Am. Geologist, v. 46, p. 207.

Cherry shale[1]

Lower Ordovician: Eastern Nevada.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 53, 78.

Fully exposed on Cherry Creek, north of Ely, White Pine County.

Cherry Canyon Formation (in Delaware Mountain Group)

Lower Permian (Guadalupe Series): Western Texas and southern New Mexico.

P. B. King *in* R. K. DeFord and E. R. Lloyd, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 4 (fig. 2), 8. Delaware Mountain group divided into (ascending) Brushy Canyon, Cherry Canyon, and Bell Canyon formations (all new).

P. B. King *in* F. E. Lewis, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 92. Subdivided into (ascending) Getaway, South Wells, and Manzanita (new) members.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 579–581 (fig. 7), pl. 2. Consists largely of sandstone with several prominent limestone members; sandstones are fine grained, thin bedded, and finely laminated and have straight smooth bedding planes; in lower half, ripple marking and channeling is common feature; limestones are commonly interbedded with the sandstones, either in nodules and thin lenticular layers or in members that locally have considerable prominence. Thickness about 1,000 feet. Overlies Brushy Canyon formation; underlies Bell Canyon formation. Along west side of Guadalupe Mountains, members of formation thicken northward, the intervening sandstones disappear, and the units coalesce into a solid mass, here termed the Goat Seep limestone.

P. B. King, 1948, U.S. Geol. Survey Prof. Paper 215, p. 38, pl. 3 [1949]. On west side of Guadalupe Mountains, upper three-fourths of Cherry Canyon interfingers with the Goat Seep; lower fourth persists as a layer of sandstone 200 or 300 feet thick; its outcrop extends northward past Cutoff Mountain into New Mexico and forms a weak sandy break in the limestone succession.

Named for Cherry Canyon, a shallow gorge that drains eastward from Pine Spring, south of new route of U.S. Highway 62, to a point 3 miles east of D Ranch headquarters, where gorge joins Lamar Canyon, Culberson County, Tex. Crops out in wide belt along crest of Delaware Mountains and forms upper half of slope below the Capitan limestone cliffs near Guadalupe Peak.

Cherry Canyon Schists

Precambrian: Western Utah and eastern Nevada.

R. B. Nelson, 1959, Dissert. Abs., v. 20, no. 3, p. 997. Name appears only in stratigraphic section. Thickness over 3,000 feet. Underlies unnamed metaquartzite; overlies Trout Creek schists (new).

Stratigraphic section covers northern Snake Range and the Kern Mountains in eastern Nevada and southern Deep Creek Range in western Utah.

Cherry Creek Group[1]

Cherry Creek Metamorphics or Gneiss

Cherry Creek Series

Precambrian: Central southern and southwestern Montana.

Original reference: A. C. Peale, 1896, U.S. Geol. Survey Geol. Atlas, Folio 24.

E. S. Perry, 1948, Montana Bur. Mines and Geology Mem. 27, p. 2–3. Series includes Axes Creek phase (new) in area of Axes Creek, Beaverhead County.

E. W. Heinrich, 1948, (abs.) Geol. Soc. America Bull., v. 59, no. 12, pt. 2, p. 1329. Cut by Blacktail granite gneiss (new).

E. W. Heinrich, 1949, Montana Bur. Mines and Geology Mem. 30, p. 6–8. Thickness of series about 30,000 feet in southern end of Ruby Range; contains seven main marble horizons. Younger than Pony series.

A. M. Hanson, 1952, Montana Bur. Mines and Geology Mem. 33, p. 20, 27, 29, 34. South of line connecting Melrose, Whitehall, Three Forks, and Livingston, series underlies Flathead sandstone.

Robert Scholten, K. A. Keenmon, and W. O. Kupsch, 1955, Geol. Soc. America Bull., v. 66, no. 4, p. 350–351, pl. 1. Group described and mapped in Lima region, Montana. Intruded by Dillon granite gneiss (term replaces Blacktail granite gneiss, preoccupied). Stratigraphic relations between Pony group and Cherry Creek not clear in this area.

R. R. Reid, 1957, Montana Bur. Mines and Geology Mem. 36, p. 4–7, 14, geol. map. Metamorphics and gneiss mapped and described in Tobacco Root Mountains. Within map area, Cherry Creek and Pony metamorphics are separated by a 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 metamorphics in vicinity of contact. Discordance suggested by Tansley and Schafer (1933, Montana Bur. Mines and Geology Mem. 9) not observed. Most significant structural fact is that Cherry Creek metamorphics dip beneath Pony metamorphics. Unless some kind of large scale structural overturning has occurred, 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.

First described in vicinity of Cherry Creek, southwestern corner Three Forks quadrangle.

Cherry Creek Member (of Venango Formation)

Upper Devonian (Conewangan): Southwestern New York.

I. H. Tesmer, 1954, Dissert, Abs., v. 14, no. 12, p. 2317, 2318. Name proposed for succession of gray siltstones and shales which overlie Panama conglomerate member.

Occurs in Cherry Creek quadrangle.

Cherry Mound shale

Cretaceous: Northeastern Texas.

F. E. Lozo, 1951, Fondren Sci. Ser. 4, p. 74. Exposures of post-Grayson clay or shale of Bergquist (1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 98) in Grayson County at Pawpaw Branch and along Rock Creek in northwestern part of county, near Pottsboro cutoff railroad underpass of M. K. & T., at type locality of foraminifera *Flabellammina denisonensis* in city of Denison, and in branch of Choctaw Creek north of Cherry Mound, northeastern Grayson County, are believed to be contemporaneous and as such are informally called Cherry Mound shale. Evidence indicates this shale is Buda equivalent.

Cherry Ridge Conglomerate[1] (in Cherry Ridge Group)

Upper Devonian or Mississippian: Northeastern Pennsylvania.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. G_5, p. 64.

Caps Collins high knob just west of Cherry Ridge post office, Wayne County.

Cherry Ridge Group[1]

Cherry Ridge Redbeds (in Catskill facies group)

Upper Devonian: Northeastern Pennsylvania.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. G_5, p. 64.

Bradford Willard, 1936, Geol. Soc. America Bull., v. 47, no. 4, p. 577–581. Cherry Ridge red beds applied to dominantly red succession of somewhat varied lithology which separates Elk Mountain and Honesdale sandstones. Unit discussed under heading of Catskill facies group.

Bradford Willard and R. E. Stevenson, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 12, p. 2272. Sequence lists Cherry Ridge red shale, 275 feet thick, in interval between Honesdale and Elk Mountain sandstones.

Well exposed near Cherry Ridge post office, Wayne County.

Cherry Ridge Limestone[1] (in Cherry Ridge Group)

Upper Devonian or Mississippian: Northeastern Pennsylvania.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. G_5, p. 65–66.

Extends over large part of Wayne County. Probably named from Cherry Ridge post office.

Cherry Ridge Red Shale[1] (in Cherry Ridge Group)

Upper Devonian or Mississippian: Northeastern Pennsylvania.

Original reference: I. C. White, 1881, Pennsylvania Geol. Survey Rept. G_5, p. 66.

Probably named from Cherry Ridge post office, Wayne County.

Cherry Ridge Sandstone[1] (in Cherry Ridge Group)

Upper Devonian or Mississippian: Northeastern Pennsylvania.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. G_5, p. 64.

Forms a conspicuous rock ledge at hundreds of places in all parts of Wayne County. Probably named from Cherry Ridge post office, Wayne County.

Cherry Ridge Shales[1] (in Cherry Ridge Group)

Upper Devonian or Mississippian: Northeastern Pennsylvania.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. G_5, p. 64.

Probably named for Cherry Ridge post office, Wayne County.

Cherryvale Shale[1] (in Kansas City Group)

Cherryvale Shale (in Skiatook Group)

Cherryvale Shale Member (of Kansas City 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. 47–48, 102.

R. C. Moore and others, 1937, Kansas Geol. Soc. Guidebook 11th Ann. Field Conf., p. 40 (table), 42. Included in Skiatook group. Occurs between Dennis limestone below and Drum (equivalent to Dewey) limestone above. Precisely equivalent to Nellie Bly formation (Gould, 1925, from unpub. ms. of D. W. Ohern) of northeastern Oklahoma, which by misunderstanding of section near Coffeyville was formerly thought to be an expansion of shale equivalent to part of Drum of Kansas. Thickness about 90 feet at Cherryvale; 10 feet or less west of Coffeyville; southward increases to about 125 feet east of Bartlesville and to more than 300 feet in latitude of Tulsa.

J. R. Clair, 1943, Missouri Geol. Survey and Water Resources, 2d ser., v. 27, pl. 1. Columnar section, Jackson and Cass Counties, Mo., shows Cherryvale shale, in Kansas City group, comprises (ascending) Fontana shale, Block limestone, Wea shale, and Westerville limestone members. Overlies Dennis limestone; underlies Chanute shale.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, p. 191. South of Linn County, where Westerville and Block limestones have not been identified, the interval between the Drum and Winterset limestones is known as Fontana-Quivira or Cherryvale shale. Near Cherryvale, unit comprises about 60 feet of bluish-gray silty shale containing layers of blue dense limestone near top.

R. C. Moore, 1948. Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2030, 2031 (fig. 4). Cherryvale formation (shale), at type locality, consists entirely of shale, but farther north there are persistent limestones (Block, Westerville) that extend into Iowa and Nebraska. Formation, as recognized by interstate agreement of Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma, May 1947, comprises (ascending) Fontana shale, Block limestone, Wea shale, Westerville limestone, and Quivira shale members. Overlies Dennis formation; underlies Drum limestone. Kansas City group. Classification of Missourian strata in northern Oklahoma diverges from interstate usage.

T. L. Welp, L. A. Thomas, and H. R. Dixon, 1957, Iowa Acad. Sci. Proc., v. 64, p. 418 (fig. 1), 420–421. Thickness of formation about 24½ feet in Madison and Adair Counties, Iowa. Comprises (ascending) Wea-Fontana members, Westerville limestone, and Quivira shale members. Overlies Dennis formation; underlies Drum formation. Kansas City group.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 27, fig. 5. Comprises (ascending) Fontana shale, Block limestone, and Wea shale members. Members not differentiated in Madison County but tentatively identified in Crescent quarry, Pottawatamie County. Formation in Madison County consists of thinly bedded dark-gray shale with several thin beds of dense dark-blue-gray fossiliferous limestone. *Derbyia* and *Chonetes* abundant, latter occurring in such large numbers as to form thin coquinalike zones. Thickness about 9 feet. Underlies Westerville limestone; overlies Dennis limestone.

Named for exposures in vicinity of Cherryvale, Montgomery County, Kans.

Cherry Valley Limestone Member (or Marcellus Shale)[1]

Middle Devonian: Central and east-central New York.

Original reference: J. M. Clarke, 1903, New York State Mus. Handb. 19, chart.

G. A. Cooper, 1941, Washington Acad. Sci. Jour., v. 31, no. 5, p. 179–180. West of Onesquethaw Creek limestones of the Stony Hollow member (new) of Marcellus become the Cherry Valley limestone as exposed in Stony Creek, Schoharie Valley.

L. V. Rickard, 1952, Am. Jour. Sci., v. 250, no. 7, p. 511–522. Overlies Union Springs member; underlies Chittenango shale. Thickness at type section 4⅔ feet; 14 to 25 feet in Berne quadrangle. This study shows Cherry Valley limestone extends farther east than was previously known. It was found at 19 new localities in Schoharie and Albany Counties.

Type section: Cox's Ravine, three-fourths mile northwest of Cherry Valley, Otsego County.

Cherryville Quartz Monzonite

Mississippian(?) to Permian(?): Western North Carolina and western South Carolina.

W. R. Griffitts and W. C. Overstreet, 1952, Am. Jour. Sci., v. 250, no. 11, p. 783–786, 787. A monazite-free rock in which three varieties have been recognized: the commonest, a gray even-grained massive to faintly gneissic muscovite-biotite rock; a muscovite-quartz monzonite; and a quartz-biotite. Unit was included in Whiteside granite as mapped by Keith and Sterrett (1931, U.S. Geol. Survey Bull. 660–D); hence, Whiteside granite is herein restricted to area of its type locality. Considered to be very late Paleozoic and younger than Toluca quartz monzonite (new).

W. C. Overstreet and W. R. Griffitts, 1955, Geol. Soc. America Guidebook 1955 Ann. Mtg., p. 566. A probable Devonian age (about 285 million years) was obtained on a sample of monazite from the Cherryville quartz monzonite.

J. L. Stuckey, 1958, Geologic map of North Carolina (1:500,000): North Carolina Div. Mineral Resources. Mapped as Paleozoic.

U.S. Geological Survey currently designates the age of the Cherryville as Mississippian(?) to Permian(?) on the basis of a study now in progress.

Named for exposures near Cherryville, Gaston County, N.C.

Chesapeake Group[1]

Miocene, middle and upper: Delaware, eastern Maryland, North Carolina, and Virginia.

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

C. W. Cooke, 1952, Maryland Dept. Geology, Mines and Water Resources Bull. 10, p. 33–37. Described in Prince Georges County and District of Columbia. Comprises (ascending) Calvert, Choptank, and St. Marys formations. Overlaps unconformably across Eocene Nanjemoy formation and Aquia greensand and Upper Cretaceous Monmouth formation on to the Patapsco formation of Potomac group; overlain unconformably by Brandywine formation or by Pleistocene sand and gravel.

L. W. Stephenson and F. S. MacNeil, 1954, Geol. Soc. America Bull., v. 65, no. 8, p. 733–738. Yorktown formation geographically extended into eastern Maryland. [Hence, group in Maryland includes four formations as it does in Virginia.]

Named for fact that strata border the Chesapeake Bay in Maryland and Virginia.

Cheshewalla Sandstone Member (of Vamoosa Formation)

Cheshewalla Sandstone Member (of Nelagoney Formation)[1]

Pennsylvanian (Virgil Series): Northeastern Oklahoma.

Original reference: D. E. Winchester, K. C. Heald and others, 1918, U.S. Geol. Survey Bull. 686–G, p. 60–61.

W. F. Tanner, 1956, Oklahoma Geol. Survey Circ. 40, p. 12 (fig. 1), 41–43, pl. 1. Reallocated to member status in Vamoosa formation. Commonly a buff thin-bedded to massive, crossbedded fine to very fine grained sandstone or siltstone. Thickness 7 to 20 feet; average 15 feet. In northeastern part of county, closely overlain by Bowring limestone member (new); since the Bowring is commonly absent, best criteria for identifying Cheshewalla is position: 60 to 100 feet below top of Labadie limestone member; beyond northern limit of the Labadie, the Bowring is at many places present 5 to 15 feet above top of Cheshewalla; overlies Tallant formation.

Named for exposures along Cheshewalla and Nelagoney Creeks, SE¼ sec. 10, T. 25N., R. 10 E., in east central Osage County.

Cheshire Quartzite[1]

Lower Cambrian: Western Massachusetts, western Connecticut, southeastern New York, and southwestern Vermont.

Original references: B. K. Emerson, 1892, U.S. Geol. Survey Hawley sheet, that is, proof sheets of geologic maps and text intended for a geological folio, but never completed and published in that form, although cited in U.S. Geol. Survey Bull. 191, 1902; 1898, U.S. Geol. Survey Mon. 29, p. 18; 1899, U.S. Geol. Survey Bull. 159.

E. C. Jacobs, 1935, (abs.) Geol. Soc. America Proc. 1934, p. 85. In Green Mountains, westernmost nappe is made up of Cheshire quartzite, infolded with a fine-grained graywacke, which has been traced from Essex Junction into southern Quebec, where it is known as Gilman "quartzite." In Vermont, this rock has been named Brigham Hill graywacke.

E. C. Jacobs, [1937], Vermont State Geologist 20th Rept., p. 100–101. Includes Brigham Hill graywacke phase.

H. E. Hawkes, Jr., 1941, Geol. Soc. America Bull., v. 52, no. 5, p. 649–666. Concluded that roots of Taconic thrust fault most probably lie between dolomite of Pico Peak series (new) and Cheshire quartzite.

W. M. Cady, 1945, Geol. Soc. America Bull., v. 56, no. 5, p. 525, 526–528. In stratigraphic succesion in west-central Vermont, Cheshire quartzite, about 1,000 feet thick, occurs above "Mendon series" and below Dunham dolomite.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, p. 12 (fig. 2), 13 (table 1), 17–18, geol. map. Thickness in Castleton area about 400 feet. Underlies Dunham dolomite; overlies Mendon series with unconformity. As defined here, the Cheshire contains only massive pure quartzite, and subjacent dark-gray quartzites and phyllites hitherto included in Cheshire by other workers are assigned to underlying Mendon series.

P. H. Osberg, 1952, Vermont Geol. Survey Bull. 5, p. 21 (table 1), 36–38. Thickness about 1,000 feet in Green Mountain anticlinorium. Underlies Dunham dolomite; contact transitional; grades downward into Moosalamoo member of Mendon formation; where Moosalamoo member is absent, Cheshire rests on Forestdale member.

Typical exposures at and near Cheshire, Berkshire County, Mass.

†Cheshire Schist[1]

[Middle Ordovician]: Massachusetts.

Original reference: R. Pumpelly, 1894, U.S. Geol. Survey Mon. 23.

Cheshire, Berkshire County.

Chester Amphibolite[1]

Original references: B. K. Emerson, 1892, U.S. Geol. Survey Hawley sheet, that is, proof sheets of geologic maps and text intended for a geologic folio, but never completed and published in that form, although cited in U.S. Geol. Survey Bull. 191, 1902; 1894, U.S. Geol. Survey Mon. 23, p. 29–30; 1898, U.S. Geol. Survey Geol. Atlas, Folio 50; 1898, U.S. Geol. Survey Mon. 29, p. 78–156, pl. 34.

Named for occurrence at Chester, Mass.

Chester Hornblendite

Age not stated: South-central Connecticut.

W. G. Foye, 1949, Connecticut Geol. Nat. History Survey Bull. 74, p. 50. Black medium- to coarse-grained igneous rock. Crops out within an area of Sterling gneiss for about 100 feet in a dikelike exposure.

Only outcrop is east of Saybrook State Highway and south of road leading from village of Chester to the Chester Railroad Station, town of Chester, Middlesex County.

†Chester Sandstone[1]

Mississippian: Illinois and Missouri.

Original reference: G. C. Swallow, 1858, Am. Assoc. Adv. Sci. Proc., v. 11, pt. 2, p. 5.

Named for exposures at Chester, Randolph County, Ill.

Chester Series

Chester Group[1]

Upper Mississippian: Illinois, Indiana, Iowa, Kentucky, Missouri, and Tennessee.

Original reference: A. H. Worthen, 1860, Am. Assoc. Adv. Sci. Proc., v. 13, p. 312–313.

J. M. Weller, 1939, Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 131, 134–137. Chester series comprises (ascending) New Design, Homberg, and Elvira groups (all new). Chester series everywhere overlies Meramec strata (herein classified as group in Valmeyer series) unconformably, and in Monroe County, Ill., it overlaps from the Ste. Genevieve onto the St. Louis. Pennsylvanian strata are everywhere separated from older beds in upper Mississippi valley by an unconformity. In southwestern Illinois, the Chester series is completely overlapped, and Pennsylvanian beds rest upon all formations from the Kinkaid to Ste. Genevieve or possibly St. Louis limestone.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 91–196, chart 5. In standard Mississippian section, Chesterian series comprises (ascending) New Design, Homberg, and Elvira groups and some post-Elvira strata. The group names introduced by Weller (1939) have had little usage to date. Following formations included in standard section (ascending): Aux Vases sandstone, Renault limestone, Bethel sandstone, Paint Creek formation. Cypress sandstone, Golconda formation, Hardinsburg sandstone, Glen Dean limestone, Tar Springs sandstone, Vienna limestone, Waltersburg sandstone, Menard limestone, Palestine sandstone, Clore formation, Degonia sandstone, and Kinkaid limstone. Chesterian series follows Meramecian series.

H. H. Gray, R. D. Jenkins, and R. M. Weidman, 1960, Indiana Geol. Survey Bull. 20, p. 35–52. In southern Indiana, rocks of Chester series have been subdivided into many formations, most of which are too thin to map on scales ordinarily used. Since names are well established in Indiana geologic literature, it is considered best to form mapping units by combining formations into groups rather than to alter the established names. In area of this report [Huron area, south-central Indiana], exposed rocks of late Mississippian age divided into (descending) Stephensport, West Baden, and Blue River (new) groups. Boundary between Chester series and underlying Meramec series falls within Blue River group.

Named for Chester, Randolph County, Ill.

Chester County Gneiss[1]

Precambrian(?): Southeastern Pennsylvania.

Original reference: T. D. Rand, 1900, Philadelphia Acad. Nat. Sci. Proc. 1900, pt. 1.

Well exposed in William's quarry, on Phoenixville Branch of Pennsylvania Railroad near Aldham Station.

Chesterfield Group[1]

Upper Triassic: Eastern Virginia.

Original reference: N. S. Shaler and J. B. Woodworth, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 2, p. 435–436.

In Richmond Basin.

Chesterfield Limestone[1]

Precambrian: Northern New York.

Original reference: H. L. Alling, 1918, New York State Mus. Bull. 199, p. 114–115, fig. 25.

Adirondack Mountains.

Chesterian Series

See **Chester Series.**

Chestnut Sandstone Member (of Pottsville Formation)[1]

Lower Pennsylvanian: Central Alabama.

Original reference: C. Butts, 1910, U.S. Geol. Survey Geol. Atlas, Folio 175, p. 10.

Named for Chestnut Ridge, Jefferson County.

†Chestnut Hill Schists and Gneisses[1]

Precambrian (Glenarm Series): Southeastern Pennsylvania.

Original reference: C. E. Hall, 1881, Pennsylvania 2nd Geol. Survey Rept. C_6, p. 24–27, map.

Judith Weiss, 1949, Geol. Soc. America Bull., v. 60, no. 10, p. 1691. Discussion of structure, petrology, and metamorphism of the Wissahickon schist. Chestnut Hill schists correspond to the rocks of the garnet and staurolite zones of this paper.

Extends from vicinity of Chestnut Hill to Delaware County line at Bryn Mawr.

Chestnut Ridge Sandstone

Lower Mississippian (Kinderhook): Southwestern Pennsylvania.

W. M. Laird, 1941, Pennsylvania Topog. and Geol. Survey Prog. Rept. 126, p. 16–17. Name will probably be used, following more definitive study of area, for unit here termed Sandstone J. Consists of massive nonfossiliferous crossbedded sandstones with few interbedded gray micaceous thin-bedded shales; formerly included in upper part of Pocono formation. Thickness 142 to 700 feet. Underlies Loyalhanna limestone; disconformably overlies Conglomerate I (Lick Run conglomerate).

Well exposed in flanks of Chestnut Ridge in gorges of Youghiogheny River, Fayette County, and Conemaugh River, forming border of Indiana and Westmoreland Counties, and along Route 40 over crest of ridge east of Uniontown, Fayette County.

Chesuncook Limestone

Silurian: North-central Maine.

Bradford Willard, 1945, Jour. Paleontology, v. 19, no. 1, p. 67–68. Described as limestone, fossiliferous in part. Total thickness about 350 feet. Part of Ripogenus [Ripogenous] series. Associated igneous intrusives. Age designated Silurian. Name attributed to L. W. Fisher (written commun., 1941).

A. J. Boucot, 1954, Am. Jour. Sci., v. 252, no. 3, p. 144–148. Discussion of stratigraphic relationships with Toppan's Ripogenous [Ripogenus] series, and Fisher's Chesuncook limestone and Ripogenus volcanics.

Occurs along shore of Chesuncook Lake, Piscataquis County.

Chetoh Formation

Miocene, lower, to Pliocene, lower: Northeastern Arizona and northwestern New Mexico.

P. W. Howell, 1959, Dissert. Abs., v. 20, no. 2, p. 641. Composed largely of sands and silts with lenses of white, rhyolitic ash. Much of the ash converted to montmorillonite. Younger than Zuni pebble zone (new); older than Bidahochi formation.

In Chetoh country, a section of Colorado Plateau north of Little Colorado River, extending from Zuni Uplift west to Painted Desert.

Chetopa shales[1]

Middle Pennsylvanian: Kansas.

Original references: C. R. Keyes, 1931, Pan-Am. Geologist, v. 56, p. 349; 1932, v. 57, p. 217, 219, 223.

Named for railroad station near Kansas-Oklahoma line, across Grand River from Cherokee County.

Chewacla Marble[1]

Precambrian: Eastern Alabama.

Original reference: W. F. Prouty, 1916, Alabama Geol. Survey Bull. 18, p. 94–95.

J. W. Clarke, 1952, Georgia Geol. Survey Bull. 59, p. 14. Incidental mention in discussion of Hollis quartzite with which it is associated in Alabama.

First described in vicinity of Olepika, Lee County.

Chewaucan Formation[1]

Pleistocene: Central southern Oregon.

Original reference: W. D. Smith, 1926, Oregon Univ. Commonwealth Rev., v. 8, p. 207–214.

Typically exposed along Chewaucan River in vicinity of Chewaucan Marsh, Lake County.

Chewelah Argillite[1] (in Stevens Series)

Upper Mississippian: Northeastern Washington.

Original reference: C. E. Weaver, 1920, Washington Geol. Survey Bull. 20, p. 63, map.

K. P. McLaughlin and M. E. Simons, 1951, Jour. Paleontology, v. 25, no. 4, p. 515. Age designated as Upper Mississippian on basis of faunal collections.

Exposed between North and South forks of Chewelah Creek and to north and south of Chewelah, Stevens County.

Cheyenne Sandstone[1]

Cheyenne Sandstone Member (of Purgatoire Formation)

Lower Cretaceous: Southwestern Kansas, southeastern Colorado, and western Oklahoma.

Original reference: F. W. Cragin, 1889, Washburn Coll. Lab. Nat. History Bull. 2, no. 10, p. 65.

Bruce Latta, 1947, Kansas Geol. Survey Bull. 65, p. 75-86. In Kiowa County, Cheyenne sandstone unconformably overlies Permian Whitehorse sandstone and conformably underlies Kiowa shale. Thickness 32½ to 94 feet.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped in Cimarron County as member of Purgatoire formation.

T. G. McLaughlin, 1954, U.S. Geol. Survey Water-Supply Paper 1256, p. 17 (table 3), 97-99. Extended into Baca County, Colo., where it is lower member of Purgatoire formation. Underlies Kiowa shale member; overlies Morrison formation. Thickness 50 to 134 feet.

Named for Cheyenne Rock at Belvidere, Kiowa County, Kans.

Chicago Formation[1]

Silurian (Niagaran): Northeastern Illinois.

Original reference: D. O. Taylor, 1930, Illinois Acad. Sci. Trans., v. 22, p. 473-477.

Chicago area, Cook County.

†Chicago Group[1]

Silurian: New York.

Original reference: E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, pl. 28.

Chicago Limestone[1]

Lower Mississippian: Central northern Utah.

Original reference: S. G. Olmstead, 1921, Econ. Geology, v. 16, p. 443, 452, 453.

Ophir district.

Chicago Mound Formation

Permian (Big Blue Series): Northeastern Kansas and southeastern Nebraska.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 36 (fig. 14), 37. Name used for formation between West Branch shale above, and Towle shale below. Includes (ascending) Falls City limestone, Hawxby shale, and Aspinwall limestone. Thickness about 22 feet. Names Falls City, Hawxby, and Aspinwall were given for what were supposed to be members, but Moore ranked them on a cyclothemic basis as formations in Kansas. It is believed that they are members of a formation in

Nebraska and Kansas, and formational name Chicago Mound is applied to them.

Crops out in slopes and cuts along Highway 10, southeast of Chicago Mound, a well-known topographic feature southwest of Maple Hill, Wabaunsee County, Kans.

Chickachoc Chert

Chickachoc Chert Lentil (in Atoka Formation)[1]

Pennsylvanian: Central southern 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. 903. In extreme northwestern Ouachitas, this formation [Wapanucka], together with the Barnett Hill formation (new), as well as the Primrose, was erroneously designated by Taff (1902, U.S. Geol. Survey Geol. Atlas, Folio 79) as Chickachoc chert lentils. Since proper position of beds, now designated as Primrose, Wapanucka, and Barnett Hill, has been established, it seems advisable to discard Chickachoc as a formational name.

T. A. Hendricks, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 66, sheet 3. Rank raised to formation. Described in block southeast of Katy Club fault in western part of Ouachita Mountains where it overlies Springer formation and underlies Atoka formation. Consists of greenish gray to tan clay shale that weathers to a tan clay and contains beds and lenses of spiculite; where fresh, spiculite is dark bluish gray and very hard; where weathered, resembles a coarse-grained sandstone or porous chert. As many as 10 beds of spiculite, each more than 5 feet thick, are present locally. In general, base of a bed of spiculite, about 10 feet thick, is assumed to be base of formation; a bed of spiculite 20 to 50 feet thick is present in middle part; a massive spiculite bed 30 to 120 feet thick constitutes top member. Estimated thickness 600 feet.

Named for post office called Chickachoc in 1901 and located at or near present station of Chockie on Missouri, Kansas, and Texas Railroad, just east of border of Coalgate quadrangle, Atoka County.

Chickahominy Formation

Eocene, upper: Southeastern Virginia (subsurface).

J. A. Cushman and D. J. Cederstrom, 1945, Virginia Geol. Survey Bull. 67, p. 2–3. Proposed for beds approximately 80 feet thick that consist of blue, gray, and dull-brown clays containing a fauna of Jackson age. Overlain by Miocene Chesapeake group; underlain by lower and middle Eocene Pamunkey group.

Type locality: Wells 2 and 4 at Navy Mine Depot, Yorktown, York County.

Chickaloon Formation[1]

Eocene or Paleocene(?): Central southern Alaska.

Original reference: G. C. Martin and F. J. Katz, 1912, U.S. Geol. Survey Bull. 500, p. 15, 42–52, map.

T. G. Payne, 1955, U.S. Geol. Survey Misc. Geol. Inv. Map I–84. Age given as Paleocene(?) on map legend.

F. F. Barnes and T. G. Payne, 1956, U.S. Geol. Survey Bull. 1016, p. 14–18, pls. 1, 2. Comprises between 3,000 and 5,000 feet of claystone, siltstone, sandstone, a few thin beds of fine-grained conglomerate, and many beds of coal in Wishbone Hill district. Underlies Wishbone formation (new); in fault contact with Arkose Ridge formation (new). Of continental origin and contains abundant flora that may be either Paleocene or Eocene in age.

Covers greater part of valley of Chickaloon River south of Castle Mountain, Cook Inlet region.

Chickamauga Limestone[1]

Middle and Upper Ordovician: Eastern Tennessee, northern Alabama, northwestern Georgia, and southwestern Virginia.

Original reference: C. W. Hayes, 1891, Geol. Soc. America Bull., v. 2, p. 143, 148.

Charles Butts, 1910, U.S. Geol. Survey Geol. Atlas, Folio 175. In north-central Alabama, includes Attalla chert conglomerate member at base.

Charles Butts and Benjamin Gildersleeve, 1948, Georgia Geol. Survey Bull. 54, p. 18–19, geol, map. In its type area, the Chickamauga includes a number of stratigraphic units elsewhere recognized. They are named (in descending order) and grouped into map units on accompanying geologic map as follows: Maysville formation, Trenton limestone, Lowville limestone, Lebanon limestone, Lenoir (Ridley) limestone, Mosheim limestone, Murfreesboro limestone, and Newala limestone.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, p. 64–97, pls. Mapped in eastern Tennessee. Occurs above Knox group and below Reedsville shale. Equivalents to the east are (ascending) Lenoir limestone, Holston formation, Ottosee shale, Moccasin formation, and Martinsburg shale. Explanatory text gives detailed explanation of previous usage of term and present status of stratigraphy of the Chickamauga. Middle Ordovician.

R. B. Neuman, 1955, U.S. Geol. Survey Prof. Paper 274–F, p. 144–145. Discussion of Middle Ordovician rocks of Tellico-Sevier belt, eastern Tennessee, and analysis of stratigraphic nomenclature. Recent work indicates that Keith's Athens shale, Tellico sandstone, Sevier shale, and Bays sandstone of southeastern belt (under discussion) are equivalents of Keith's Chickamauga and Moccasin limestone of northwestern belts.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 53–56. Except for Butts' use of name Chickamauga in Alabama, term Chickamauga has passed into disuse. Name was used so broadly throughout Southern Appalachians that it lost its value when Middle and Upper Ordovician limestones and shales were studied in detail. As originally defined by Hayes, term embraced all strata between Knox and Rockwood formations. This included what is now known as the Murfreesboro, Lenoir, Mosheim, Lebanon, Lowville, Trenton, and Upper Ordovician.

Josiah Bridge, 1956, U.S. Geol. Survey Prof. Paper 277, p. 56–57. As originally defined, Chickamauga included all limestone above Knox dolomite and beneath Sevier shale (which at that time was extended to include Martinsburg and Reedsville shales) and in this sense was used in all folios of southern Appalachian region beginning with Hayes (1894, Folio 2) and ending with Butts (1910, Folio 175). The Chickamauga as mapped in the folios, included equivalents of Kingsport and Mascot formations of this report [Mascot-Jefferson City zinc district, Tennessee] in those areas in southeastern Tennessee, northwestern Georgia, and northeastern Alabama where they were represented by Newala limestone (Butts and Gildersleeve, 1948). With close of folio mapping in Appalachian region, name Chickamauga fell into disuse, but it was revived by

Rodgers (1953) as a convenient general term for mapping. Unit, as now defined, includes limestone strata of Middle and Late Ordovician age. Unit is thinnest along southeastern edge of Appalachian Valley where it represents a very short span of time; it is thickest in sections near Cumberland Plateau Front where it represents practically all of Middle and Late Ordovician time. Ulrich, about 1900, began dividing Chickamauga limestone into a number of formations. Some of these were described by him in 1911 (Geol. Soc. America Bull., v. 22); others appeared only as names in correlation charts; and others were names used in note books and unpublished manuscripts. Only a few were ever adequately described, and fewer still have been mapped in detail. Ulrich's general concept of stratigraphy of the Chickamauga limestone was given by him in 1911; by Butts (1928, Washington Acad. Sci. Jour., v. 18, no. 37); and by Ulrich (1930, U.S. Natl. Mus. Proc., v. 76, art. 21). In general, Ulrich believed that strata included in Chickamauga group consisted of a few widely distributed formations at base, correlating with formations of Black River or later age elsewhere, and a great thickness of strata in between not equivalent to any formations elsewhere, the so-called Blount group, wedged in middle between Chazy and Black River beds. No complete section of the Blount has even been found, and at present the idea that such a unit exists has been discarded. Present theory is that a thick limestone sequence, Chickamauga limestone, developed in central and western parts of Appalachian Valley of east Tennessee and adjacent states and that this grades laterally southeastward into a complementary shale and sandstone sequence, the Sevier shale and higher formations, developed along the southeastern side of valley. The two sequences intertongue in a central belt, and by close of Middle Ordovician time shale deposition had lapped westward almost completely across the valley. In Mascot-Jefferson City district, the Chickamauga limestone—the Middle Ordovician limestone sequence—is made up of three units originally classed as formations: Mosheim limestone, Lenoir limestone, and Holston marble. In present report, the Mosheim is regarded as a member of the Lenoir.

G. T. Malmberg and H. T. Downing, 1957, Alabama Geol. Survey Rept. 3, p. 21–25. Chickamauga limestone, as used in this report [Madison County], includes deposits that have stratigraphic paleontologic relation to same rocks in interior basin of Tennessee and Kentucky. Formation includes thick sequence of rocks, primarily limestone, which lie below Red Mountain formation of Silurian age and, in Hamilton County, Tenn., is known to lie above Newala limestone of Early Ordovician age. In area of outcrop in Madison County, Red Mountain limestone is missing, and the Chickamauga lies unconformably below Chattanooga shale. Complete thickness does not crop out in county.

G. B. Martin, 1960, Gulf Coast Assoc. Geol. Soc. Trans., v. 10, p. 201–205. In northwestern Alabama, upper part of "Chickamauga" limestone, a catchall term, can be divided into Leipers and Fernvale formations on basis of diagnostic bryozoan species. Recommended that use of name "Chickamauga" be avoided in favor of Leipers and Fernvale formations.

Named for exposures along Chickamauga Creek east of Chattanooga, Tenn., and branches of that creek in Ringgold quadrangle, Georgia.

†Chickasaw Formation[1] or Group[1]
†Chickasawan Formation[1] or Stage[1]

Eocene: Mississippi, southern Alabama, Arkansas, and Louisiana.

Original reference: W. H. Dall, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 2, p. 344–345.

Named "for the four Chickasaw bluffs, of which Memphis bluff is the last," along Mississippi River in northwestern Mississippi, within the the "Chickasaw Purchase."

Chickasaw Creek Shale or Formation (in Stanley Group)

Mississippian (Meramecian) : Southeastern Oklahoma.

B. H. Harlton, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 7, p. 854 (fig. 1), 856, 874–878. Name Chickasaw Creek siliceous shale proposed for uppermost formation in group. Measurable thickness at type locality about 270 feet; thins along southern rim of Tuskahoma syncline to only a few feet. Overlies Moyers formation (new) ; contact not exposed at type locality but is well exposed at site designated as second type locality. Underlies Wildhorse Mountain formation (new) of Jackfork group. Included in Pushmataha series (new). Bendian period.

L. M. Cline, 1960, Oklahoma Geol. Survey Bull. 85, p. 38–40. Formation consists of from 80 to more than 300 feet of dark-blue-gray shales interbedded with thinner laminated black siliceous shales, containing some cherty beds, and with sandstones. Thickness 270 feet at type locality; thins eastward to where it is only a few feet thick at south end of Tuskahoma syncline, and then thickens eastward in Kiamichi Mountain and in Botukola syncline. Overlies Moyers formation; underlies Wildhorse Mountain formation of Jackfork group. Mississippian (Meramecian).

Type locality: Immediately south of Chickasaw Creek in center of south line of the SW¼, 600 feet north of section line of sec. 7, T. 1 S., R. 13 E., Atoka County. Second type locality: Center of W½NE¼NE¼ sec. 26, T. 1 S., R. 12 E.

Chickasawhay Limestone

Chickasawhay Formation (in Limestone Creek Group)

Chickasawhay Marl (in Vicksburg Group)

Chickasawhay Marl Member (of Byram Marl)[1]

Oligocene, upper: Southeastern Mississippi and southwestern Alabama.

Original reference: B. W. Blanpied and others, 1934, Shreveport Geol. Soc. 11th Ann. Field Trip, p. 3, 4, 12, 16–19, charts.

B. W. Blanpied and R. T. Hazzard, 1938, (abs.) Am. Assoc. Petroleum Geologists 23d Ann. Mtg., Program, p. 11. Chickasawhay formation included in Limestone Creek group. Overlies Bucatunna formation. Miocene.

C. W. Cooke, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 10, p. 1560, 1561. Lower Chickasawhay beds are equivalent of Flint River formation of Alabama, Georgia, and Florida and of Suwannee limestone of Florida. Considered to be of Vicksburg age. Oligocene-Miocene boundary discussed. Oligocene.

F. S. MacNeil, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 9, p. 1314, 1315 (fig. 1), 1346–1349. Chickasawhay limestone as herein defined is Lower Chickasawhay of Shreveport Geological Society Guidebook (1934) ; the Upper Chickasawhay is renamed Paynes Hammock sand. Overlies

Bucatunna clay member of Byram formation. Thickness about 15 to 20 feet. Believed that too many names are in use for equivalents of Chickasawhay limestone in southeast. Name Chickasawhay limestone could replace Flint River formation and unless Suwannee is emended to include the Byram, it could replace that name as well. Upper Oligocene.

C. W. Cooke, 1959, U.S. Geol. Survey Prof. Paper 321, p. 2 (table 1). Age shown as Late Oligocene.

Type section (Lower Chickasawhay): On Highway 45, 3 miles north of Waynesboro, Wayne County, Miss. Named for exposures on Chickasawhay River.

Chickasha Formation[1] (in El Reno Group)

Permian: Central southern and southwestern Oklahoma.

Original reference: C. N. Gould, 1924, Am. Assoc. Petroleum Geologists Bull., v. 8, p. 324–341, map.

L. V. Davis, 1955, Oklahoma Geol. Survey Bull. 73, p. 51–54, fig. 4 (correlation chart), pl. 1. Described in Grady and Stephens Counties where it crops out in a broad band circling southeastern end of Anadarko basin and has a maximum width of about 30 miles. An extremely heterogeneous mixture of sandstones, shales, siltstone, and siltstone conglomerates. Thickness in area of type locality 135 to 230 feet. Overlies Duncan sandstone; contact gradational. Conformable with overlying Dog Creek shale and Blaine formation undifferentiated.

Type locality: Southwestern part of T. 4 N., R. 5 W., Grady County. Named because city of Chickasha is built on formation.

Chickies Quartzite[1] **or Slate**

Lower Cambrian: Southeastern Pennsylvania.

Original reference: J. P. Lesley, 1876, Pennsylvania 2d Geol. Survey Rept. A., p. 60.

G. W. Stose and A. I. Jonas, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. C–67, p. 34 (chart), 36–43; A. J. Stose and G. W. Stose, 1944, U.S. Geol. Survey Prof. Paper 204, p. 6–13, pl. 1. Described as quartzite north of Hanover-York Valley and as slate south of Hanover-York Valley. In both areas, includes Hellam conglomerate member at base. Thickness about 350 feet to about 1,000 feet. Overlies Precambrian; in some areas, base not exposed. Underlies Harpers phyllite.

B. F. Howell, Henry Roberts, and Bradford Willard, 1950, Geol. Soc. America Bull., v. 61, no. 12, pt. 1, p. 1361. Chickies quartzite used rather than Hardyston in Buckingham area, Bucks County, Carries basal conglomerate believed to be the Hellam.

Bradford Willard and others, 1959, Pennsylvania Geol. Survey, 4th ser., Bull. C–9, p. 10, 38–41. Term Chickies quartzite used in Buckingham and Langhorne areas, Bucks County. Approximately correlative of Hardyston quartzite but distinguished by its basal member, Hellam conglomerate. Only recorded fossils: *Scolithus* and *Olenellus*. Thickness about 900 feet. Upper contact not exposed; lower contact, now hidden, is said to be with Precambrian crystalline rocks.

Name from outcrops at Chickies Rock above Columbia on Susquehanna River, Lancaster County.

Chico Formation[1]

Chico Group[1]

Chico Series[1]

Lower(?) and Upper Cretaceous: Northern California.

Original reference: W. M. Gabb, 1869, California Geol. Survey Pal., v. 2, p. XIV, as reported by J. D. Whitney from unpublished paper by Gabb, and footnote by Gabb, on p. 129.

F. M. Anderson, 1937, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 21, no. 12, p. 1612. Chico series is nowhere found in single section but on the whole aggregates 25,000 feet or more. Begins with unconformity and overlaps in late Albian time; embraces all succeeding stages known in Europe, probably up to highest. Subdivided into Gaines group (new), western Shasta County, 5,300 feet; Panoche group, Diablo Range, 14,700 feet; Moreno group, Diablo Range, 5,000 feet.

F. M. Anderson, 1938, (abs.) Geol. Soc. America Bull., v. 49, no. 12, pt. 2, p. 1863; 1940, 6th Pacific Sci. Cong. Proc., v. 1, p. 394–398. Marine Upper Cretaceous detrital deposits in California and Oregon constitute Chico series. It is well represented in Great Valley of California where it has aggregate thickness of 26,700 feet. Representative exposures lie along west border of valley, generally in monclinal attitude, for about 400 miles. Divided into three major groups: Pioneer (new), Panoche, and Orestimba (new).

J. A. Taff, G. D. Hanna, and C. M. Cross, 1940, Geol. Soc. America Bull., v. 51, no. 9, p. 1311–1328. Results of study show that Chico Creek must be considered type locality of Chico formation (group). Cretaceous rocks exposed in Chico Creek comprise series of clastics 2,000 feet in thickness, resting unconformably on older Sierra Nevada metamorphics and covered by Tertiary volcanics. Fauna is abundant, but only meager evidence exists to correlate it with other Cretaceous localities in central valley of California.

J. M. Kirby, 1942, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 26, no. 5, p. 899. Chico series includes following formations (ascending): Golden Gate, Mills, Sites, Funks, Guinda, and Forbes (all new). Discussion of area on west side of Sacramento Valley south of Willows, Glenn County.

N. L. Taliaferro, 1943, California Div. Mines Bull. 118, pt. 1, p. 130–134 [preprint 1941]. For many years, Upper Cretaceous was known practically everywhere in Coast Ranges as the Chico although it was frequently recognized that the various occurrences were not always equivalent to Chico Creek section in Butte County. 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 for all Upper Cretaceous and the Panoche as upper group of this series. This usage makes the Chico include beds separated by disconformity which locally becomes pronounced unconformity. Terms Pacheco and Asuncion groups are proposed for the Upper Cretaceous of central Coast Ranges. The groups are separated by event termed Santa Lucian orogeny.

F. M. Anderson, 1943, California Div. Mines Bull. 118, pt. 1, p. 183–186 [preprint 1941]. Chico series divided into Pioneer (lowest), Panoche, and Moreno groups. Groups are subdivided into stages based on distribution of faunas. Depositional hiatus separates Chico from underlying Shasta series.

J. M. Kirby, 1943, California Div. Mines Bull. 118, pt. 3, p. 601–605; 606–608. Term Chico group used in these reports [Rumsey Hills and Sites anticline areas] to include formations named in reference by Kirby (1942) cited above. Overlies Horsetown formation of Shasta group. Upper Cretaceous.

J. M. Kirby 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 3, p. 279–305. Discussion of stratigraphy of Chico series on west side of Sacramento Valley. Scope of term Chico series as herein applied conforms to that established by F. M. Anderson in that it includes all Upper Cretaceous sediments exposed along west side of Sacramento Valley and elsewhere in California. Seems certain that both Pioneer and Panoche groups of Anderson (Pacheco and lower Asuncion groups of Taliaferro) are represented along west side of Sacramento Valley. Moreno group (and its equivalent, the upper Asuncion group) has not been found in area under discussion, nor at any locality elsewhere in Sacramento Valley. Formational units of series are (descending) Forbes, Guinda, Funks, Sites, Yolo (replaces preoccupied name Mills), and Venado (replaces preoccupied name Golden Gate). 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, in Santa Lucia Range and elsewhere in Central Coast Ranges, is meager in area of this report. Maximum age range of series appears to be from Albian to lower Campanian.

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 18 (table 3), 39–46, pls. Most typically developed exposures of Chico formation in area of this report [Coast Ranges immediately north of San Francisco Bay region] are on eastern slopes of Vaca Mountains. Thickness 9,000 to 12,000 feet. Chico strata exposed in Martinez syncline east and west of Martinez belong to upper part of sequence and are overlain with slight unconformity by Martinez formation.

M. D. Crittenden, Jr., 1951, California Div. Mines Bull. 157, p. 31. Term Chico has been so broadly applied that it no longer has resonable stratigraphic significance. Hence, in this report [San Jose-Mount Hamilton area], term Oakland conglomerate is used instead of conglomerate member of Chico as was used by Lawson (1914, U.S. Geol. Survey Geol. Atlas, Folio 193), and overlying Cretaceous rocks are named Berryessa formation.

G. D. Robinson, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–88. Most extensive formation mapped in Haywood quadrangle; it is monotonous succession of biotitic arkosic sandstone and clay shale with minor siltstone and a few lenses of conglomerate overlying Oakland conglomerate. These rocks are designated Chico formation of Lawson (1914, U.S. Geol. Survey Geol. Atlas, Folio 193) although name is not entirely satisfactory. Thickness at least 2,000 feet; may be as much as 6,000; appears to thicken southeastward. In most places, overlain by Sobrante sandstone. If Chico is time-rock term, it should be properly applied only to Upper Cretaceous part of post-Oakland, pre-Tertiary section near Hayward and another name should be given to any Lower Cretaceous beds present. Lower(?) and Upper Cretaceous.

D. L. Peck, R. M. Imlay, and W. P. Popenoe, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 8, p. 1968–1984. Upper Cretaceous rocks in Siskiyou County, Calif., and in adjoining Jackson County, Oreg., are herein defined as Hornbrook formation. A new name to differentiate them from Chico formation in California is justified by their remote position and by their complete lack of faunas in common with Chico at its type section. Chico should be abandoned as group or series name because it has been used with many different meanings. It may be retained as formational name for rocks at and near type locality on Chico Creek. Thus restricted, the name is applied to rocks of late Coniacian to early Campanian age exposed in small area including Chico Creek, Butte Creek, Mill Creek, Deer Creek, Pence (or Pentz) ranch, and Tuscan Springs.

C. A. Hall, Jr., 1958, California Univ. Pubs. Geol. Sci., v. 34, no. 1, p. 8. Discussion of geology of Pleasanton area, Alameda and Contra Costa Counties. Rocks previously referred to as "Chico formation" are recognized as constituting two distinct formations, Niles Canyon and Del Valle (both new).

C. A. Hall, Jr., D. L. Jones, and S. A. Brooks, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2855, 2859. Sedimentary rocks of Cretaceous age exposed along Pacific Coast south of Pescadero Point, Calif., were originally assigned to Chico formation by Branner, Arnold, and Newsom (1909, U.S. Geol. Survey Geol. Atlas, Folio 163). Application of this term to beds lithologically different, located nearly 200 miles from type locality of Chico formation, is unwarrented in absence of established continuity between the two sections. Name Pigeon Point formation is herein proposed for the beds exposed south of Pescadero Point, San Mateo County.

Type locality (Taff, Hanna, and Cross): In canyon of Chico Creek, 8 to 16 miles northeast of Chico, Butte County. Chico Creek has cut gorge 1,000 to 1,500 feet deep through late Tertiary lava flows and tuff beds of Tuscan formation, exposing the Chico.

Chico Phonolites

Quaternary: Northeastern New Mexico.

Helen Stobbe, 1948, (abs) Geol. Soc. America Bull., v. 59, no. 12, pt. 2, p. 1355. Occur as flows chiefly. Incidental mention only.

R. F. Collins, 1949, Geol. Soc. America Bull., v. 60, no. 6, p. 1021 (table 2), 1023, 1034–1036, pl. 1; H. R. Stobbe, 1949, Geol. Soc. America Bull., v. 60, no. 6, p. 1073–1077. Green, fine-grained, porphyritic, soda-rich extrusives and intrusives with large feldspar phenocrysts. Some pyroxene needles. Heavily jointed. Quaternary age. Derivation of name and geographic distribution given.

Named after excellent exposures in township of Chico. Occur abundantly in triangular area between Laughlin Peak, Temples Peak, and Turkey Mountain in eastern Colfax County.

Chico Creek Beds (in Panoche Group)

Upper Cretaceous (Chico Series): Northern California.

F. M. Anderson, 1937, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 21, no. 12, p. 1612. Incidental mention.

Occurs in Diablo Range.

Chicoma Volcanic Formation

Tertiary, middle: 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. 939–940. Consists mainly of andesite and latite flows; maximum thickness several thousand feet. Probably oldest of the four Tertiary formations named in area; succeeded by Ortega formation (new). Tertiary formations overlie pre-Tertiary rocks with angular unconformity. Rocks represent much eroded and partly buried remnants of volcanic field which dominated ancestral Valles Mountains.

Occurs in Abiquiu quadrangle, Rio Arriba County. Forms Abiquiu and Chicoma Peaks.

Chico Martinez Chert Member (of Monterey Formation)

Miocene (Mohnian-Delmontian): Southern California.

L. B. McMichael, chm., 1959, San Joaquin Geol. Soc. Guidebook Field Trip, May 9, Road log, topog. profile, columnar section, map. Overlies Antelope shale member; underlies Chico Martinez (Belridge) diatomite. Thickness about 700 feet. McDonald shale, Antelope shale, and Chico Martinez chert members are equivalent to McLure shale member of Monterey.

Occurs along Chico Martinez Creek, Kern County.

Chicopee Formation

Pre-Carboniferous(?): Southern California.

R. B. Guillou, 1953, California Div. Mines Spec. Rept. 31, p. 5, 7–10, pl. 1. Lime silicate-bearing quartzites and cross-laminated quartzites which crop out beneath the Saragossa thrust in Chicopee Canyon. These quartzites were included in Saragossa quartzite by Vaughan (1922). Thickness about 1,000 feet. In fault contact with older Baldwin gneiss (new) except in two localities where the quartzite overlies gneiss by what may be depositional contact. Stratigraphically underlies Furnace limestone. Locally intruded by Cactus quartz monzonite.

J. F. Richmond, 1955, Dissert. Abs., v. 15, no. 3, p. 394; 1960, California Div. Mines Spec. Rept. 65, p. 11. Replaced by term Chicopee Canyon; name Chicopee preempted.

Type locality: Chicopee Canyon, near Baldwin Lake, San Bernardino Mountains, San Bernardino County.

Chicopee Shale[1]

Upper Triassic: Central Massachusetts and central Connecticut.

Original reference: B. K. Emerson, 1891, Geol. Soc. America Bull., v. 2, p. 451–456.

M. E. Willard, 1951, Bedrock geology of the Mount Toby quadrangle, Massachusetts: U.S. Geol. Survey Geol. Quad. Map [GQ–8]. Name replaced by Turners Falls sandstone (new) in Greenfield and northern part of Mount Toby quadrangles. Unit can not be traced into this area from its type area.

Best exposed along railroad cut near Holyoke Dam, Mass. Extends southward through Chicopee, Mass.

Chicopee Canyon Formation

Pre-Carboniferous: Southern California.

J. F. Richmond, 1955, Dissert. Abs., v. 15, no. 3, p. 394; 1960, California Div. Mines Spec. Rept. 65, p. 11–15, pl. 1. Name Chicopee formation proposed by Guillou (1953) for series of metamorphosed quartzites beneath gray marble of Furnace formation in Johnston Grade area about 7 miles northeast of Delamar Mountain. Name Chicopee is preempted and it is here proposed that name be amended to Chicopee Canyon. Rocks similar to those described by Guillou are poorly exposed in same stratigraphic position over area of a square mile on eastern and southeastern flanks of Delamar Mountain; upper part of Chicopee Canyon crops out north of Bertha Peak. Two members recognized. Lower, minimum thickness 1,000 feet, consists of crossbedded quartzite, thin-bedded quartzite, and micaceous quartzites; intruded at base by tonalite porphyry. Upper, consists of two distinctive units, 370 feet of massive quartzite overlain by 75 feet of andalusite-bearing rock. Conformably underlies Furnace formation. No fossils found in formation. Tops of beds established by truncated crossbedding indicate that strata are right side up across measured sections. As lower part of Furnace formation is Mississippian, Chicopee Canyon is early Mississippian or pre-Mississippian.

Exposed in San Bernardino Mountains, north of Big Bear Lake, San Bernardino County. Name derived from Chicopee Canyon. Quartzites exposed principally in faulted eroded anticline overturned to northwest.

Chico Ridge Limestone (in Graford Formation)[1]

Pennsylvanian: Central northern Texas.

Original reference: G. Scott and J. M. Armstrong, 1932, Texas Univ. Bull. 3224, p. 31.

Forms extensive upland known as Chico Ridge, south of Chico and north of Lake Bridgeport Dam, Wise County.

Chico Shunie Quartz Monzonite

Mesozoic(?): Southwestern Arizona.

James Gilluly, 1937, Arizona Bur. Mines Bull. 141, Geol. Ser. 9, p. 15 (table 1), 23–27, pl. 1; 1946, U.S. Geol. Survey Prof. Paper 209, p. 17–20, pl. 3 [1947]. The typical quartz monzonite is slightly foliated to massive and coarsely porphyritic. Light pinkish gray on fresh fracture and weathers to light brown. Conspicuous crystals of pink feldspar an inch or less in length occur in coarse groundmass. Other intrusive rocks of comparable structure mapped with this formation but may include rocks of several ages. Intrusive into Cardigan gneiss (new); intruded by border facies of Cornelia quartz monzonite (new). Underlies Daniels conglomerate (new).

Named from representative exposures in the Chico Shunie Hills, and is exposed over wide area in the southwestern part of the Ajo quadrangle, Pima County.

†Chico-Tejon series[1]

Upper Cretaceous and Eocene: California.

Original reference: C. A. White, 1889, U.S. Geol. Survey Bull. 51, p. 11–14.

Chief Consolidated Limestone[1]

Ordovician: Central northern Utah.

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

Probably named for Chief Consolidated mine.

Chignik Formation[1]

Upper Cretaceous: Southwestern Alaska.

Original reference: W. W. Atwood, 1911, U.S. Geol. Survey Bull. 467, p. 24, 41–48, 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.

Type section: In Whalers Creek, one-half mile from shore of Chignik Lagoon; Alaska Peninsula.

Chikaskia Sandstone Member (of Harper Sandstone)

Permian (Leonard Series): Southern Kansas and northern Oklahoma.

G. H. Norton, 1937, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 21, no. 12, p. 1557. Member, 100 to 125 feet thick, is marked by benches of red sandstone separated by red and gray shales; contains numerous geoidal sugary-dolomite concretionary lentils. Overlies Stone Corral member; underlies Kingman sandstone member (new).

G. H. Norton, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 12, p. 1782–1785. Basal member of Harper sandstone (restricted). Has three-fold character: (1) highly variable sand and shale section at base; (2) a series of bench-forming well-cemented even-bedded red sandstones; and (3) white sandstones, dolomite lentils and concretions in red shale. Type locality designated.

Type locality: In sec. 10, T. 31 S., R. 6 W., Harper County, Kans. Named for exposures along Chickaskia River.

Childress Dolomite Member (of Marlow Formation)

Childress Dolomite Member (of Dog Creek Shale)[1]

Permian (Guadalupe Series): Northern and central northern Texas.

Original reference: A. M. Lloyd and W. C. Thompson, 1929, Am. Assoc. Petroleum Geologists Bull., v. 13, p. 952, pl. 10.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, pl. 2. Assigned to Marlow formation at base of Whitehorse group. Guadalupe series.

Named for outcrops in and around Childress, Childress County.

Childs Latite

Pliocene(?): Southwestern Arizona.

James Gilluly, 1937, Arizona Bur. Mines Bull. 141, Geol. Ser. 9, p. 15 (table 1), 47–48, pl. 1. Augite, latite, coarsely porphyritic, in thick flows, from 30 to 80 feet thick, of aa and block lava. Rocks are light gray to reddish and weather dark brown, with conspicuous mottling. Maximum exposed thickness about 700 feet. Appears to rest on Black Mountain andesite (new) at north end of Childs Mountain. Elsewhere the Black Mountain rests on the latite. It is possible that apparent occurrence of the Black Mountain beneath it is due to faulting. Also underlies Daniels conglomerate (new) in Childs Mountain.

James Gilluly, 1946, U.S. Geol. Survey Prof. Paper 209, p. 44–45, pl. 3 [1947]. In two northern localities, the latite is overlain by Batamote andesite flows. In the canyon 6½ miles west of Batamote well, on north side of Childs Mountain, the latite appears to rest on the Batamote andesite, suggesting that the latite is merely an intercalation in the Batamote series. This apparent anomaly may be due to faulting.

Flows are widespread in Ajo region from Crater Mountains north of Ajo quadrangle to Puerto Blanco Hills south of it. In Ajo quadrangle, Pima County, the largest exposures are along west slope of Childs Mountain, from which formation is named.

†Chilhowee Conglomerate[1]

Lower Cambrian: Southeastern Tennessee.

Original reference: A. Keith, 1895, Philos. Soc. Washington Bull., v. 12, p. 75, pl. 1.

Chilhowee Group[1]

Lower Cambrian and Lower Cambrian(?): Eastern Tennessee, Maryland, western North Carolina, and Virginia.

Original reference: J. M. Safford, 1856, Geol. Reconn. Tennessee 1st Rept., p. 149, 152–153.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 26–40. Name extended into Virginia although the group there may not be exactly equivalent to group in Chilhowee Mountain, Tenn. Two sets of formation names have been given individual members of group in Virginia. Names used north of Roanoke are: Loudoun formation, Weverton sandstone, Harpers shale, and Antietam sandstone; names south of Roanoke: Unicoi formation, Hampton shale, and Erwin quartzite. The Unicoi is equivalent to the Loudoun and Weverton. Basal Cambrian. Underlies Shady-Tomstown dolomite.

G. W. Stose and A. J. Stose, 1947. Am. Jour. Sci., v. 245, no. 10, p. 626. In Hot Springs area, North Carolina, group comprises (ascending) Vann quartzite (new), Sandsuck shale, Cochran quartzite, Nebo quartzite, Murray shale, Hesse quartzite, Shady dolomite, and Rome formation. Unconformable above early Precambrian granite gneiss. Lower Cambrian.

P. B. King, 1950, U.S. Geol. Survey Prof. Paper 230, p. 14–23, pl. 1. Described in Elkton area, Virginia, where it comprises (ascending) Loudoun, Weverton, and Harper formations and Antietam quartzite. Overlies Catoctin greenstone; underlies Tomstown dolomite. Base of group considered base of Cambrian.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, pls. Group mapped in eastern Tennessee. Overlies Ocoee series and Mount Rogers volcanic complex or, where they are absent, the crystalline complex. Southwestern sequence comprises (ascending) Cochran conglomerate, Nichols shale, Nebo sandstone, Murray shale, and Hesse sandstone with Helenmode member at top. Northeastern sequence comprises (ascending) Unicoi, Hampton, and Erwin formations; Erwin formation has Helenmode member at top. Underlies Shady dolomite. Lower Cambrian.

P. B. King and others, 1958, Geol. Soc. America Bull., v. 69, no. 8, p. 955 (table 1), 964. Group has for many years been classed by U.S. Geological Survey as Cambrian on basis of occurrence of trilobites, brachiopods, and other fossils in its upper part, the occurrence of *Scolithus* in upper and middle parts, the sedimentary homogeneity of the group, and presence in many places of well-marked unconformity at base. Relations are confused, however, because in places the Chilhowee lies on earlier sedimentary and volcanic rocks with only minor unconformity, or even conformably, and many geologists have termed these earlier rocks Cambrian also; the underlying Ocoee was thus placed in the Cambrian by Keith. Paleontological data to fix as Cambrian the age of the Chilhowee group itself are decisive only for its upper part. U.S. Geological Survey now restricts beds classed as Cambrian to those for which paleontological data are available. Helenmode formation at top of Chilhowee group is classed as Cambrian, and remaining unfossiliferous formations are termed Precambrian(?); group as a whole is classed as Cambrian and Precambrian(?).

P. B. King and H. W. Ferguson, 1960, U. S. Geol. Survey Prof. Paper 311, p. 28, 32–45, pl. 1. In area of this report [Carter and Johnson Counties, Tenn.], group comprises (ascending) Unicoi, Hampton, and Erwin formations. Overlies Mount Rogers volcanic group; underlies Shady dolomite. Lower Cambrian.

R. B. Neuman and R. L. Wilson, 1960, U.S. Geol. Survey Geol. Quad. Map GQ–131. In Blockhouse quadrangle, Tennessee, includes (ascending) Cochran formation, Nichols shale, Nebo quartzite, Murray shale, Hesse quartzite, and Helenmode formation. Overlies Wilhite formation of Walden Creek group; sequence broken by faulting. Underlies Maryvale limestone of Conasauga group; sequence broken by faulting. Most of Chilhowee group is now questionably assigned to Early Cambrian because recoverable fossils of Early Cambrian age are confined to Helenmode formation. Lower Cambrian and Lower Cambrian(?). An age determination of 584±30 million years was made from rubidium-strontium ratio in glauconite from sample of Murray shale.

Named for Chilhowee Mountain, Sevier and Blount Counties, Tenn.

Chilibrillo Limestone Member (of Caimito Formation)

Chilibrillo [Limestone or Formation]

Miocene, lower: Panamá.

A. A. Olsson, 1942, 8th Am. Sci. Cong. Proc., v. 4, p. 234 (correlation chart). Name Chilibrillo used on correlation chart.

W. P. Woodring and T. F. Thompson, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 2, p. 235, 246 (fig. 12); W. P. Woodring, 1957, U.S. Geol. Survey Prof. Paper 306–A, p. 32, pl. 1. Chilibrillo limestone member is the Emperador limestone of Reeves and Ross (1930, U.S. Geol. Survey Bull. 821) and Chilibrillo formation of Kellogg (1931, Final report on field investigations of the Madden Dam and Reservoir site at Alhajuela, Panama Canal Zone: Panama Canal Rept.). Maximum thickness 100 feet; pinches out on either side of Madden basin. Overlies unnamed pyroclastics clay member; underlies unnamed calcareous siltstone member. Fossil evidence favors Miocene age, presumably early Miocene. Type region noted.

Type region: East side of Madden basin, between Madden Lake and Río Chilibrillo, C.Z.

Chillicothe till[1]

Pleistocene: Ohio to Minnesota and northern Wisconsin.

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

Chilliwack Granodiorite[1] and Quartz Diorite

Lower Cretaceous and younger: Southern British Columbia, Canada, and central northern Washington.

Original reference: R. A. Daly, 1913, Canada Dept. Int. Rept. Chief Astronomer 1910, v. 2.

H. A. Coombs, 1939, Geol. Soc. America Bull., v. 50, no. 10, p. 1948. Daly concluded Chilliwack granodiorite might have been intruded as late as Miocene; equally probable is a Jurassic age which corresponds with numerous other batholiths in Cascade Range.

Peter Misch, 1952, The Mountaineer, v. 45, no. 13, p. 4 (geol. map), 14–16. Discussion of geology of northern Cascades of Washington. Chilliwack granodiorite and quartz diorite are at least in part later than Lower Cretaceous. Younger than Skagit gneisses.

First described from occurrence at Chilliwack Lake, British Columbia.

Chilliwack Group

Carboniferous: Southern British Columbia, Canada, and northern Washington.

C. E. Cairnes, 1944, Hope [quadrangle], Yale and Westminster districts, British Columbia (1:253,440): Canada Geol. Survey Map 737-A. Described in Yale and New Westminster districts, British Columbia. Series is predominantly sedimentary and has provided collections of marine forms regarded as most probably Upper Carboniferous though they may be Permian. Extent of group beyond its type area has not been determined. It is part of a belt of strata which, particularly north and west of Fraser River, is so greatly deformed and altered that it could not be subdivided in spite of the fact that poorly preserved fossil remains indicate presence of younger beds. A large body of volcanic rocks is apparently interbedded with Chilliwack strata at international boundary.

W. R. Danner, 1958, Dissert. Abs., v. 18, no. 1, p. 195. Chilliwack group in northwestern Whatcom County, Wash., is in part divisible into a lower formation of clastics, volcanics, and limestones containing fusulinids, endothyroids, algae, corals, brachiopods, and large crinoid stems of probable early Pennsylvanian or late Mississippian age and an upper formation composed mostly of clastics and limestones containing fusulinids and bryozoa of early Permian (Wolfcampian) age.

It is not clear what relationship the Chilliwack group bears to units described as Chilliwack series and Chilliwack volcanic formation.

Chilliwack Series[1]

Carboniferous and older(?): Southern British Columbia, Canada, and central northern Washington.

R. A. Daly, 1912, Canada Geol. Survey Dept. Mines Mem. 38, p. 507-516, maps 15, 16, 17. From Skagit River to gravel plain traversed by lower Fraser River, the Boundary belt crosses a number of formations which range in age from Miocene to Carboniferous, if not to Precambrian. Oldest fossiliferous sediments so far discovered date from Upper Carboniferous; these belong to thick group of rocks here named Chilliwack series, most of which are believed to be Carboniferous. A thick andesitic group forms upper part of Chilliwack series as exposed near Tamihy Creek and is named Chilliwack volcanic formation. Certain phases of Chilliwack series are probably contemporaneous with Hozomeen series. The Slesse diorite and the Chilliwack granodiorite are both in batholithic intrusive relation to Chilliwack series. Map 16 shows Chilliwack series extending south of international boundary.

H. A. Coombs, 1939, Geol. Soc. America Bull., v. 50, no. 10, p. 1497. Carbonaceous phyllites crop out at widely scattered localities in vicinity of Mount Baker. Daly's (1912) Chilliwack series (not to be confused with Chilliwack volcanic formation), only 5 miles north of phyllites under Mount Baker, is composed of slates, phyllites, and limestones. It is probable that phyllites surrounding Mount Baker belong in this same general sequence.

Named for exposures along Chilliwack River, Skagit Mountain Range, British Columbia.

Chilliwack Volcanic Formation[1]

Upper Carboniferous: Southern British Columbia, Canada, and central northern Washington.

R. A. Daly, 1912, Canada Geol. Survey Dept. Mines Mem. 38, p. 507, 521–522, map 16. A thick andesitic group forms upper part of Chilliwack series as exposed near Tamihy Creek and is here named Chilliwack volcanic formation. Consists mainly of thick, massive flows, which are so welded and altered as to make individual flows difficult to distinguish. Lavas are commonly amygdaloidal, with calcite filling pores; many andesites have been altered to typical greenstones and green schists; augite has relations and abundance observed in olivine-free basalts. Estimated thickness at least 2,000 feet. Map 16 shows formations extending south of international boundary.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 16–17. List shows Carboniferous sequence in northern Washington (ascending) Hozomeen series, Chilliwack volcanic formation, and Vedder greenstone. Text states that "associated with Chilliwack series are altered gabbro masses termed Vedder formation." [Use of term Chilliwack is not clear here.]

H. A. Coombs, 1939, Geol. Soc. America Bull., v. 50, no. 10, p. 1496–1497. Older rocks project above surface of Mount Baker lavas in vicinity of Herman Mountain. This older rock is part of a series containing greenstone, sandstone, and graywacke. Greenstone may correspond to Daly's (1912) Chilliwack volcanic formation, type area of which is only 6 miles north of Herman Mountain; it is also possible that the greenstone may correspond to Daly's (1912) Vedder greenstone located 18 miles to northwest.

Named for exposures along Chilliwack River, British Columbia.

Chilton Sandstones (in Kanawha Formation[1] or Group)

Pennsylvanian: Western West Virginia.

Original reference: I. C. White, 1908, West Virginia Geol. Survey, v. 2–A, p. 271.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 81, 104. Massive sandstones in Kanawha group.

Probably named for occurrence at Chilton, Kanawha County.

Chimneyhill Limestone[1] (in Hunton Group)

Silurian: Central southern Oklahoma.

Original reference: C. A. Reeds, 1911, Am. Jour. Sci., 4th, v. 32, p. 256–268.

R. A. Maxwell, 1936, Northwestern Univ. Summ. of Doctoral Dissert., v. 4, p. 132–134. Subdivided into (ascending) Hawkins, Keel, Cochrane, and Dillard members (all new). Underlies Henryhouse formation; unconformably overlies Sylvan shale. Alexandrian-Niagaran.

T. W. Amsden, 1957, Oklahoma Geol. Survey Circ. 44, p. 6 (fig. 3), 7–25; 1960, Oklahoma Geol. Survey Bull. 84, pt. 6, p. 27–66. Formation is complicated stratigraphic sequence which includes several members separated from one another by unconformities. Considering these complications, it might be advisable to drop name and elevate each member to rank of formation. However, Chimneyhill is retained here because it makes convenient stratigraphic unit. All members are similar in lithology, being fairly pure limestones with low silt and clay content.

Comprises (ascending) Ideal Quarry (replaces Maxwell's preoccupied Hawkins limestone), Keel, Cochrane, and Clarita (replaces Maxwell's preoccupied Dillard) members. Thickness 60 feet at type locality with all members present; 70 feet at old Hunton townsite, all members present; 70 feet southwest of Wapanucka, Clarita member absent. Overlies Sylvan formation; underlies Henryhouse, Haragan, or Bois d'Arc formation. Chimneyhill includes strata which represent a rather long time span, probably including representatives of both the Lower and Middle Silurian. Reeds stated type locality was at confluence of three small creeks, sec. 4, T. 2 N., R. 6 E., but this section number is in error; only Chimneyhill present in section 4 is in southwest corner and this outcrop is not on the creek. There are exposures of formation along Chimneyhill Creek in SE¼ sec. 5, T. 2 N., R. 6 E., and this is probably locality referred to by Reeds and is here designated type section.

Type locality: SE¼ sec. 5, T. 2 N., R. 6 E., Pontotoc County. Named for Chimneyhill Creek which crosses formation in northeastern corner of Arbuckle Mountains.

Chimney Rock Tongue (of Rock Springs Formation)

Upper Cretaceous: Southwestern Wyoming.

L. A. Hale, 1950, Wyoming Geol. Soc. Guidebook 5th Ann. Field Conf., p. 52, fig. 1. Sandstone tongue of the Rock Springs; extends into Mancos shale; underlies Black Butte tongue (new).

L. A. Hale, 1955, Wyoming Geol. Soc. Guidebook 10th Ann. Field Conf., p. 90 (fig. 1), 91 (fig. 2), 92, 93 (fig. 3). Name applied to prominent littoral and epineritic sandstones which project eastward from main body of Rock Springs into marine shales. Composed of three prominent cliff-forming reddish-brown sandstones; each successive sandstone projects farther into enclosing shale before losing its identity. Contact with overlying Black Butte tongue sharp.

Named for Chimney Rock, sec. 6, T. 16 N., R. 102 W., Sweetwater County. Forms prominent hogback in Linwood-Spring Gap area.

China Mountain Formation

Lower and 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]; 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]. Conglomerate, sandstone, shale, and yellowish, impure dolomite. At base, fanglomerate and conglomerate up to 100 feet thick, containing chert and quartzite fragments up to 2 feet in diameter. May include at top the thinned equivalent of Favret formation. Thickness about 500 feet. Overlies Koipato and Havallah formations with angular unconformity.

Type locality: West slope of China Mountain, Golconda quadrangle.

China Ranch Beds

Quaternary: Southeastern California.

J. F. Mason, 1948, Geol. Soc. America Bull., v. 59, no. 4, p. 336 (table 1), pl. 2. Light-colored saline clays with bedded gypsum; lacustrine origin. Thickness about 1,200 feet. Unconformably overlain by Quaternary gravel beds; uncomformable below unnamed lake beds.

Occurs in Tecopa area, in southeasternmost corner of Inyo County.

Chinati Series[1]

Permian: Southwestern Texas.

Original reference: J. A. Udden, 1904, Texas Univ. Mineral Survey Bull. 8, p. 10–25.

J. W. Skinner, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 180–188. Udden recognized three formational divisions in Chinati series (ascending): Cieneguita, Alta, and Cibolo. He assigned entire series to Permian. Present report is a study of section selected by Udden as type of all three of his formations. Concluded that Udden's original age assignment was very nearly correct, much more so than later correlations based on fossils collected from exposures other than type locality.

Described in Shafter district, Chinati Mountains, Presidio County.

Chinati Mountain Volcanic Series or Group

Tertiary: Western Texas.

C. C. Rix, 1952, Geologic map of Chinati Peak quadrangle, Presidio County, Texas (1:48,000): Texas Univ. Bur. Econ. Geology, Prelim, ed. As shown on map legend, Chinati Mountain volcanic series occurs above Buck Hill volcanic series. Oligocene and younger.

W. N. McAnulty, 1955, Geol. Soc. America Bull., v. 66, no. 5, p. 558. Chinati Mountain series in Chinati Mountains may be same age as Rawls basalt.

D. L. Amsbury, 1957, Dissert, Abs., v. 17, no. 9, p. 1981. Chinati Mountain group (emended) overlies Petan trachyte (new).

D. L. Amsbury, 1958, Texas Bur. Econ. Geology Quad. Map 22. Chinati Mountain group, composed of more than 3,500 feet of plagioclase trachyte, rhyolite, and tuff, crops out south of Shely fault to form Chinati Mountains. Group is here expanded to include 1,500 feet of plagioclase trachyte, tuff, and local basal conglomerate which are probably older than lowest unit at type locality as designated by Rix (1953, unpub. thesis). Where base is exposed, group overlies Comanche strata; in fault contact with older Shely group (new). Older than Allen intrusive complex.

First mapped in Chinati Peak quadrangle, Presidio County.

Chinitna Shale,[1] **Siltstone,** or **Formation**

Chinitna Shale Member (of Shelikof Formation)

Upper Jurassic: Central southern Alaska.

Original reference: G. C. Martin and F. K. Katz, 1912, U.S. Geol. Survey Bull. 485, p. 65, table opposite p. 30, map.

L. B. Kellum, 1945, New York Acad. Sci. Trans., ser. 2, v. 7, no. 8, p. 202 (table 1), 207. Member of Shelikof formation. Gray shale with stringers of fine and coarse sandstone and buff-weathering limestone. Thin porphyry sill intrudes section at Wide Bay. Thickness 400 to 1,300 feet. Overlies Tuxedni sandstone on Iniskin-Chinitna Peninsula. Underlies unnamed gray sandy shale unit of Shelikof.

C. E. Kirschner and D. L. Minard, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 95 [1949]. Chinitna siltstone consists of approximately 2,000 feet of arenaceous siltstone which lies conformably between Tuxedni and Naknek formations in area between Chinitna and Iniskin Bays.

R. W. Imlay, 1953, U.S. Geol. Survey Prof. Paper 249–B, p. 49–51, table 5 facing p. 60. Tonnie member, which previously was assigned to Tuxedni formation, forms roughly lower third of Chinitna formation. Formation underlies Naknek formation in Cook Inlet region and as mapped at Matanuska Valley may include beds older than typical Chinitna.

Well exposed on west side of Chisik Island, on both shores of Chinitna and Oil Bays, and on east shore of Iniskin Bay. Occurs in area extending from Iniskin Bay to Tuxedni Bay, Cook Inlet region.

Chinle Formation[1] (in Dockum Group)

Upper Triassic: Northern Arizona, southwestern Colorado, southeastern Nevada, northern New Mexico, and Utah.

Original reference: H. E. Gregory, 1915, Am. Jour. Sci., 4th, v. 40, p. 102.

H. R. Stagner, 1941, *in* L. H. Daugherty, Carnegie Inst. Washington Pub. 526, p. 10, 11–12. In Blue Forest locality, Arizona, three units are recognized in Chinle formation: lower bentonitic shale zone; Newspaper Rock sandstone (new) leaf shale unit; and upper bentonitic shale zone.

H. E. Thomas and G. H. Taylor, 1946, U.S. Geol. Survey Water-Supply Paper 993, p. 20, 22–23. Described in Cedar City and Parowan Valleys, Utah, where it is 1,950 feet thick, overlies Shinarump conglomerate and underlies Navajo sandstone. Section in Coal Creek Canyon described in detail (beds numbered 15 through 30). No perceptible stratigraphic break noted between Chinle and Navajo. Between shaly sandstones and sandy shales that are typical of Chinle and massive beds that are clearly identifiable as Navajo, there is transition zone several hundred feet thick which might doubtfully be included in either formation. This transition zone, represented in Coal Creek section by beds 26 to 30 is here assigned to Chinle, although beds 26 and most of 27 are quite similar to typical Navajo.

J. M. Gorman and R. C. Robeck, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 44. Assigned to Dockum group.

V. C. Kelley and G. H. Wood, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 47. In Lucero uplift comprises two members: red shale below and sandstone member here named Correo. Overlies Shinarump conglomerate; underlies Wingate sandstone.

G. H. Wood and S. A. Northrop, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 57. Described in Sandoval and Rio Arriba Counties, N. Mex., where it unconformably overlies Cutler, Yeso, and San Andres formations and underlies Wingate(?) sandstone. Lower part of formation divided into (ascending) Agua Zarca sandstone member, Salitral shale tongue, and Poleo sandstone lentil (all new).

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 two members: lower, unnamed; upper, herein named Redonda. Overlies Santa Rosa sandstone; underlies Wingate(?) sandstone.

H. E. Gregory and N. C. Williams, 1947, Geol. Soc. America Bull., v. 58, no. 3, p. 227–228. Described in Zion National Monument where it is subdivided into four members: lower unnamed sandstone, 20 to 60 feet; Petrified Forest member (new), 300 to 400 feet; Springdale sandstone member (new) 40 to 180 feet; and upper sandstones, 500 to 800 feet. Overlies Shinarump conglomerate; underlies Navajo sandstone.

C. R. Longwell, 1952, Utah Geol. Soc. Guidebook 7, p. 34, 35. In Muddy Mountains, Nev., the Chinle formation with Shinarump member at base is 1,500 to 2,500 feet or more thick. Underlies Aztec sandstone; overlies Moenkopi formation. In Frenchman Mountain area, underlies Thumb formation (new) with angular unconformity.

P. D. Procter, 1953, Utah Geol. and Mineralog. Survey Bull. 44, p. 18–38, pl. 2. In Silver Reef area, Utah, Chinle formation consists of about 1,100 feet of alternating sandstones and shales with exception of two small beds of cherty limestone. On basis of color and lithology, formation is subdivided into a lower member consisting predominantly of dark-red shales and minor interbedded red sandstones 265 feet thick overlying Shinarump formation, a prominent 5- to 15-foot bed of white arkosic sandstone, 10 to 15 feet of purplish- to bluish-gray bentonitic shales with included banded chert, 310 feet of deep-red to brick-red sandstone and shales with an included 1-foot bed of white silicified limestone, 65 feet of buff weathering to white sandstone overlain by 35 feet of lavender to purple sandstone together known as Silver Reef sandstone (Reeside and Bassler, 1922, U.S. Geol. Survey Prof. Paper 129) and an upper Chinle which consists of more than 400 feet of red shales and sandstones with some white, friable sandstone beds locally more than 10 feet thick. Lower Chinle subdivided into (ascending) Hartley shales and sandstones, Fire Clay Hill bentonitic shales, and Trail Hill sandstone members (all new). These members do not have wide areal extent. Upper Chinle subdivided into (ascending) Silver Reef sandstone, and Duffin sandstone and shale (new) members.

G. O. Bachman, 1953, U.S. Geol. Survey Oil and Gas Inv. Map OM–137. In northwestern Mora County, N. Mex., conformably overlies Santa Rosa sandstone; underlies Naranjo formation (new). Thickness 640 feet.

J. H. Stewart and J. F. Smith, Jr., 1954, Intermountain Assoc. Petroleum Geologists [Guidebook] 5th Ann. Field Conf., p. 29–33. Chinle in southeastern Utah has been divided into six units (ascending) : claystone and sandstone unit, a sandstone commonly called "Moss Back," variegated claystone unit, reddish-orange unit, limy unit, and reddish siltstone unit. Four of these units appear to be correlative with the four divisions of Chinle recognized by Gregory (1917, U.S. Geol. Survey Prof. Paper 93) in Navajo Indian Reservation of Arizona. Claystone and sandstone unit is equivalent to "D" division, the variegated claystone unit equivalent to "C" division, the limy unit equivalent to "B" division, and reddish siltstone unit equivalent to "A" division. Overlies Moenkopi; underlies Wingate.

Paul Averitt and others, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 12, p. 2518–2519, 2520, 2522. As restricted herein, includes beds between top of Shinarump conglomerate and disconformity at base of Moenave formation (Dinosaur Canyon member). At Kanab, and elsewhere in southwestern Utah, restricted Chinle includes only lower part of Chinle as mapped by Gregory (1950, U.S. Geol. Survey Prof. Paper 220). Units 26 and 27 of Coal Creek Canyon section of Chinle (Thomas and Taylor, 1946) are here designated Shurtz sandstone tongue of Navajo sandstone; units 28, 29, and 30 of Thomas and Taylor's section are here designated Cedar City tongue of Kayenta formation.

R. C. Robeck, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 10, p. 2499, 2502 (fig. 2). In Temple Mountain area, Utah, comprises (ascending) Temple Mountain (new), Moss Back, and Church Rock members. Overlies Moenkopi formation; underlies Wingate sandstone.

J. W. Harshbarger, C. A. Repenning, and J. H. Irwin, 1957, U.S. Geol. Survey Prof. Paper 291, p. 3 (table), 5–7. Contact between Chinle formation and Glen Canyon group in Navajo country lies between Gregory's "A" and "B" (1917, U.S. Geol. Survey Prof. Paper 93) divisions of the

Chinle. Rocks long assigned to Chinle formation are therefore included in Glen Canyon group. The "A" division has been reassigned to Wingate sandstone and is herein named Rock Point member of Wingate. This reassignment of the Chinle "A" was based upon intertonguing between the Wingate sandstone and the Chinle "A" in several areas.

J. H. Stewart, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 3, p. 441–462. Discussion of proposed nomenclautre of part of Upper Triassic strata in southeastern Utah. Chinle is subdivided into (ascending) Temple Mountain, Shinarump, Monitor Butte, Moss Back, Petrified Forest, Owl Rock, and Church Rock members. Overlies Moenkopi formation; underlies Wingate sandstone.

J. A. Momper, 1957, Four Corners Geol. Soc. [Guidebook] 2d Field Conf., p. 86 (chart), 91, 92. Agua Zarca and Salitral members removed from Chinle and assigned to Moenkopi formation.

J. P. Akers, M. E. Cooley, and C. A. Repenning, 1958, New Mexico Geol. Soc. Guidebook 9th Field Conf., p. 91. Chart shows that Chinle in St. Johns area, Black Mesa basin, comprises (ascending) Shinarump, Mesa Redondo, and Petrified Forest members.

E. M. Shoemaker and W. L. Newman, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 1838, 1841, 1845. In salt anticline region, overlies Pariott member (new) of Moenkopi.

R. L. Griggs and C. B. Read, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 2004–2005. Stratigraphic nomenclature revised in Tucumcari-Sabinoso area, New Mexico. Chinle stratigraphically restricted above to exclude Redonda member which is herein given formation rank.

Named for Chinle Valley, northeastern Arizona.

Chinook Pass Diorite Porphyry

See Keechelus Andesitic Series.

Chino Quarry Limestone[1]

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, 354–355. Probably Upper Paleozoic.

Well exposed in Chino Quarry at Crestmore, Riverside County.

Chino Quarry Quartzite[1]

Paleozoic(?): Southern California.

Original reference: J. W. Daly, 1935, Am. Min., v. 20, no. 9, p. 638–647, map.

Named for quarry at Crestmore.

Chipman Formation

Chipman Group

Lower Ordovician: West-central Vermont.

Marshall Kay and W. M. Cady, 1947, Science, v. 105, no. 2736, p. 601. Group named to include the Burchards (new) and succeeding Beldens limestone and dolomites. Underlies Middlebury limestone. Chazyan series.

W. M. Cady and E-an Zen, 1960, Am. Jour. Sci. v. 258, no. 10, p. 728–739. Chipman formation of west-central Vermont is rock unit in uppermost part of Lower Ordovician, of Beekmantown age, between underlying Bascom formation and overlying rocks of Middle Ordovician (Chazy) age. Structural setting is Middlebury synclinorium and adjacent areas to west. Characterized by four principal rock types: buff to brown, sharply defined, and laterally persistent beds of massive dolomite; white to blue-gray limestone; gray limestone with thin interbeds of sandy limestone; and blue-gray limestone with irregular spots of dolomite. These lithofacies are interbedded in type section. Formation was first referred to as group (Kay and Cady, 1947) but is herein reduced to formation rank. Beldens formation and Weybridge member of Beldens (Cady, 1945), the Burchards limestone (Kay and Cady, 1947), and Bridport dolomite (Cady, 1945) are redefined as members of Chipman. Weybridge and Burchards have not been mapped north of Middlebury synclinorium, whereas Beldens and Bridport are considered formations in northwestern Vermont (Kay, 1958) that correlate in time with all or part of Chipman formation. All units of Chipman overlie Bascom formation and underlie Middlebury limestone. In Cornwall area, the Chipman is exposed in belt of discontinuous outcrops of rock of Beekmantown age that extends from about 1 mile south of village of Cornwall through The Ledges into town of Weybridge. Chipman is in section that, at latitude of The Ledges, includes three Cambrian formations—Winooski dolomite, Danby formation, and Clarendon Springs dolomite—as well as Ordovician formations of Beekmantown, Chazy, Black River, and Trenton age. Distribution and relationships of units are about as described and mapped by Cady (1945), though their terminology is partly changed. Shelburne is referred to as a formation; the "Crown Point limestone" becomes Burchards member of Chipman formation; and Orwell limestone is now assumed to be Black River age rather than Trenton. Cutting and Bascom formations and Bridport dolomite member are as mapped by Cady (1945) at Bascoms Ledge, but Middlebury limestone is expanded westward and downward stratigraphically to top of Bridport and includes rocks that had been interpreted as "Crown Point limestone" and "Beldens formation." Orwell limestone on summit of De Long Hill was misidentified as Beldens during previous mapping. The first and apparently the correct, interpretation of stratigraphic relationships of Beldens and Burchards members to Bridport member was given by Augustus Wing (*in* Dana, 1877, Am. Jour. Sci., 3d, v. 13, no. 77; no. 78). One of the purposes of present paper is to call attention to Wing's conclusions in further support of the inclusion of the Bridport as a member of Chipman and the time-stratigraphic unity of the various lithofacies of the Chipman. Wing referred to both the Bridport and the Beldens as unit 6, the "*Rhynchonella* beds" and left no doubt that the two are to be correlated. Beneath the Beldens in section near and north of Cornwall village is Burchards, a limestone that Wing referred to as unit 5c. He mentioned the local occurrence of this unit in The Ledges north of Cornwall. Recent mapping shows that the Burchards is a lithofacies extensive enough to be mapped as member of the Chipman north and south of village of Cornwall. Also in section near and north of Cornwall is Weybridge member (Cady, 1945), which was referred to by Wing as the "striped stratum" in the "*Rhynchonella* beds." Wing also mentioned the "striped stratum" in the "*Rhynchonella* beds" at Bascoms Ledge. There the "*Rhynchonella* beds" are now known as Bridport member of Chipman. Brainerd (1891, Geol. Soc. America Bull., v. 2, p. 293–300) assigned a Chazy age to Zone 4 of Bascom formation ("Calciferous D4") and to whole sequence now known as Burchards and Beldens members of Chipman in The Ledges north of Cornwall village. This incorrectly made these units younger than Bascom Zone 4 and Bridport (Beekmantown) of section at Bascoms Ledge. Cady (1945) recognized Zone 4 of the Bascom in The Ledges in Cornwall but followed Brainerd in correlating Wing's unit 5c (the Burchards) with Crown Point limestone of middle Chazy age. The Beldens was mistakenly extrapolated into section east of and stratigraphically above the Bridport southwest of De Long Hill (Cady, 1945). The rock above the Bridport here is actually Middlebury limestone, which is of Chazy age. Kay and Cady (1947) proposed that the "Crown Point" formation east of Champlain thrust in west-central Vermont be designated Burchards limestone with type locality in belt of outcrop between Cornwall village and The Ledges. This seemed advisable because of structural separation from typical Crown Point limestone. Kay (1950; 1958) recognized fauna in the Weybridge supporting a late Beekmantown age as well as stratigraphic correlation of the Weybridge and the Beldens with Bridport. Rock of Chazy age in vicinity of Shoreham village is structurally isolated from Middlebury limestone and lithically and faunally like the typical Crown Point limestone; it is here continued as the Crown Point.

Named from Chipman Hill in outcrop belt north of Middlebury village, Addison County.

Chipola Formation (in Alum Bluff Group)[1]

Chipola facies (of Alum Bluff Stage)

Miocene, lower: Northwestern Florida and southeastern Alabama.

Original reference: Julia Gardner, 1926, U.S. Geol. Survey Prof. Paper 142, p. 1–2.

C. W. Cooke, 1945, Florida Geol. Survey Bull. 29, p. 161–167. Typical part of formation is fine blue-gray to yellow sand crowded with shells. This facies appears to be confined to vicinity of Chipola and Apalachicola Rivers, where it lies at base of formation and is about 10 feet thick. Beds above it are less fossiliferous, and the sand is more or less cemented by calcium carbonate. Farther west are two principal facies—sandy limestone, which for most part is buried beneath younger deposits, and a coarse light-colored sandy facies including lenses of light-colored or variegated clay; this latter facies may be littoral equivalent of the limestone. Thickness at least 20 feet; as much as 56 feet has been reported. Seems to merge laterally into Hawthorn formation. Underlies Shoal River formation; directly and unconformably overlain by Duplin marl from Washington County eastward.

H. S. Puri, 1953, Florida Geol. Survey Bull. 36, p. 22–24. A facies in Alum Bluff stage. At type locality, facies is blue-gray to yellowish-brown highly fossiliferous marl studded with molluscan shells; thickness about 28 feet. This marly facies is restricted to vicinity of Chipola and Apalachicola Rivers. Farther west Cooke (1945) recognized two facies: sandy limestone which for the most part is buried and light-colored coarse sandy facies with lenses of clay. Lower Miocene.

C. W. Cooke, 1959, U.S. Geol. Survey Prof. Paper 321, p. 2 (table 2). Table shows Chipola as middle Miocene.

Type locality: McClelland's Farm, near Bailey's ferry, northern Calhoun County, Fla. Named for exposures on Chipola River, Jackson County. Type locality of facies: Tenmile Creek, from bridge to one-half mile below bridge on Marianna-Clarksville Road, 2,376 feet south of NW cor. sec. 12, T. 1, N., R. 10 W., 22 miles south of Marianna, Calhoun County.

†Chipola Marl Member (of Chipola Formation)[1]

Miocene, lower: Northern Florida and southeastern Alabama.

Original reference: W. H. Dall, 1892, U.S. Geol. Survey Bull. 84, p. 112–113, 120, 122, 157, 324.

Named for exposures on Chipola River, especially at McClelland Farm, south of Tenmile Creek, Jackson County, Fla.

†Chippewa Felsite (in Ashbed Group)[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: W. C. Gordon, 1905, Michigan Acad. Sci. 7th Rept., p. 188–195.

Crops out only in Black River and on Chippewa Bluff near Bessemer, Gogebic County.

Chippewa Granite[1]

Precambrian: Northwestern New York.

Original reference: A. F. Buddington, 1934, New York State Mus. Bull. 296, p. 86.

Exposed in valley of Chippewa Creek, Hammond quadrangle. Derivation of name not stated.

†Chippewa Porphyry (in Ashbed Group)[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: F. E. Wright and A. C. Lane, 1909, Michigan Geol. Survey Rept. State Board 1908, pl. 1.

Porcupine Mountains.

Chippewa Quartzite[1]

Precambrian (upper? Huronian): Central northern Wisconsin.

Original reference: E. T. Sweet, 1876, Wisconsin Acad. Sci. Trans., v. 3, p. 40–55.

Named for exposures on Chippewa River, Chippewa County.

†Chiquito sandstone

Precambrian (Chuaran series): Northern Arizona.

Charles Keyes, 1938, Pan-Am. Geologist, v. 70, no. 2, p. 107 (chart), 112. Lowermost beds are shallow-water deposits with abundant ripple marked bedding planes. Massive sandstones follow; then shaly sandstones. Thickness 300 to 400 feet. Underlies Gunther dolomite (new); overlies Cardenas lava series (new).

[C. R.] Keyes, 1939, Pan-Am. Geologist, v. 71, no. 1, p. 69. Name previously used for another unit and is abandoned in favor of the new name Aguja sandstone.

Name derived from the Rio Colorado Chiquito or Little Colorado River, opposite the mouth of which the strata are well exposed.

Chiquito sandstones[1]

Permian (Aubreyan series): Northern Arizona.

Original reference: C. R. Keyes, 1922, Pan-Am. Geologist, v. 38, p. 251, 336.

Named for exposures in lower valley of Rio Chiquito Colorado in Grand Canyon region.

Chiricahua Limestone[1] (in Naco Group)

Permian: Southeastern Arizona and southwestern New Mexico.

Original reference: A. A. Stoyanow, 1936, Geol. Soc. America Bull., v. 47, no. 4, p. 532, 536.

F. F. Sabins, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 3, pt. 1, p. 498. Concha limestone is undoubtedly same unit which Stoyanow (1926, Am. Jour. Sci., 5th, v. 12; 1936) mentioned from the Chiricahua Mountains and correlated with the Kaibab. He proposed Chiricahua limestone for these beds, but no type section was ever designated or described, and term has seldom been used by later writers. Suggested that terms Chiricahua limestone and Snyder Hill formation be suppressed and that term Concha limestone be used for the light-colored cherty limestones of southeast Arizona that contain Kaibab fauna and overlie Scherrer formation.

Elliot Gillerman, 1958, New Mexico Bur. Mines Mineral Resources Bull. 57, p. 11 (table 2), 41–43, pl. 1. Included in Naco group. In Peloncillo Mountains, term Chiricahua limestone is used for cherty limestone overlying Scherrer quartzite. Belived that Chiricahua limestone and Concha limestone are same stratigraphic unit and that the terms are synonymous; because of priority, term Chiricahua limestone should be retained. In Peloncillo Mountains, consists principally of thick-bedded light-gray medium-grained limestone containing irregularly shaped grayish-pink chert nodules. Estimated thickness 800 feet. Underlies McGhee Peak formation (new) of Bisbee group; intruded by Cienega Peak granite (new).

Exposed in Chiricahua Mountains near New Mexico border.

Chiricahuan series[1]

Upper Cambrian: Arizona and New Mexico.

Original reference: C. R. Keyes, 1915, Conspectus of geologic formations of New Mexico: Des Moines, Robert Henderson, State printer, p. 4, 6.

Chisholm Shale[1]

Chisholm Formation

Chisholm Shale (in Bright Angel Group)

Middle Cambrian: Eastern Nevada, northwestern Arizona, southeastern California, and western Utah.

Original reference: C. D. Walcott, 1916, Smithsonian Misc. Colln., v. 64, no. 5, Pub. 2420, p. 409–410.

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1158 (fig. 6), 1160. Thickness emended [type section] 137 feet. Overlies Lyndon limestone; underlies Highland Peak limestone.

H. E. Wheeler, 1940, Nevada Univ. Bull., Geology and Mining Ser., no. 34, p. 12 (fig. 2), 14–15. Underlies Peasley limestone (new); Highland Peak limestone restricted to exclude Peasley.

H. E. Wheeler, 1943, Geol. Soc. America Bull., v. 54, no. 12, pt. 1, p. 1794, 1816–1817, pl. 1. Geographically extended into western Grand Canyon area, Arizona, where it is about 99 feet thick. Underlies Peasley limestone and overlies Lyndon shale.

H. E. Wheeler, 1948, Nevada Univ. Bull., Geology and Mining Ser., no. 47, p. 32, 35. Geographically extended into Wah Wah Range, Utah, where it is 56 feet thick. Not distinguished from Peasley and Lyndon limestones in House Range, and here the undifferentiated unit is named Millard limestone. Through discovery of Lyndon limestone in southeastern California, the Chisholm could be differentiated there. In Nopah-Johnnie region, Chisholm shale includes members 5F and 5G of Hazzard's (1937, California Jour. Mines and Geology, v. 33, no. 4) Cadiz formation.

H. E. Wheeler and V. S. Mallory, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 10, p. 2413 (fig. 2), 2414. Generalized discussion of designation of stratigraphic units. Chisholm shale is included in Bright Angel group in one area, and classed as member of Bright Angel shale in another area.

M. S. Johnson and D. E. Hibbard, 1957, U.S. Geol. Survey Bull. 1021–K, p. 339, pls. 32, 33. In Nye and Clark Counties, Nev., underlies Jangle limestone (new); conformably overlies Lyndon limestone.

R. A. Robison, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 48 (fig. 3), 49–50. Proposed here that name Chisholm formation be applied to unit in House Range that Wheeler (1948) designated as Burnt Canyon limestone. Wheeler assigned only a 35–foot shale unit to the Chisholm in the Wah Wah Range. A second 10-foot shale bed with a *Glossopleura* fauna occurs about 150 feet above Chisholm shale of Wheeler. Proposed here that the entire 195-foot shale and limestone sequence be assignd to Chisholm formation. Elsewhere in eastern Great Basin, Chisholm shale occurs in middle of Millard limestone of Cohenour (1959) in Sheeprock Range and of Rigby (1958) in Stansbury Mountains. Further east, the Chisholm merges into lower part of Ophir shale and in Tintic and Ophir districts; to the west, the shales finger out. As defined in this paper, the Chisholm underlies the Dome and overlies the Howell in the House and Wah Wah Ranges and underlies the Peasley and overlies the Lyndon in Pioche district.

Type locality: Vicinity Chisholm mine and Half Moon Gulch, 2 to 3 miles northwest of Pioche, Nev.

Chisholm Creek Shale Member (of Wellington Formation)

Permian: Central Kansas.

W. A. Ver Wiebe, 1937, Wichita Municipal Univ. Bull., v. 12, no. 5, p. 5, 11–12. Soft blocky drab claylike shales which weather greenish. Locally, thin zones of red clay. Thickness approximately 40 feet. Underlies Carlton limestone member; overlies Annelly gypsum member (new).

Type locality: Along east branch of Chisholm Creek, beginning in SW sec. 35, T. 26 S., R. 1 E., Kechi Township.

Chisik Conglomerate Member (of Naknek Formation)[1]

Chisik Member (of Naknek Formation)

Upper Jurassic: Central southern Alaska.

Original reference: G. C. Martin and F. J. Katz, 1912, U.S. Geol. Survey Bull. 485, p. 68–69.

C. E. Kirschner and D. L. Minard, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 95 [1949]. Chisik member, 300 to 600 feet thick, consists of a sandstone and a conglomerate facies. On south shore of Chinitna Bay and on Oil Bay, member almost entirely of sandstone. On east shore of Iniskin Bay, member consists of conglomerate which extends as a tongue into the sandstone. Conglomerate facies traced eastward to within 2 miles of Iniskin Bay, where it gradually interfingers with sandstone. Underlies unnamed siltstone member.

A. S. Keller amd H. N. Reiser, 1959, U.S. Geol. Survey Bull. 1058–G, p. 269–270, 287, pls. 29, 30. Martin and Katz (1912) originally applied name Chisik to a conglomerate at base of Naknek formation and treated it as a unit of formational rank overlying Chinitna shale and underlying Naknek formation. Martin (1926, U.S. Geol. Survey Bull. 776) treated the Chisik conglomerate as basal member of Naknek formation, and this is its present usage. The Chisik consists of irregularly banded marine conglomerate which, north of area of this report [Katmai region], may be as much as 1,000 feet thick. Underlies unnamed member of Naknek.

Type locality on Chisik Island, Cook Inlet region.

Chisna Formation[1]

Carboniferous: Southeastern Alaska.

Original reference: W. C. Mendenhall, 1905, U.S. Geol. Survey Prof. Paper 41, p. 33, map.

Crops out at head of Chisna River and in hills east and west of the Chisna, central Copper River region.

Chisos Volcanics

Chisos Beds[1]

Upper Cretaceous and Tertiary: Western Texas.

Original reference: J. A. Udden, 1907, Texas Univ. Bull. 93, p. 17, 60–67.

R. G. Yates and G. A. Thompson, 1959, U.S. Geol. Survey Prof. Paper 312, p. 16–17, pl. 1. Volcanics described in Terlingua district where they consist of lava flows, tuffs, and interbedded sedimentary rocks. Principal occurrence is at Fresno mine, where they unconformably overlap Boquillas flags. South of mapped area volcanics overlie Tornillo rocks in apparent conformity. Thickness not determined. Age cannot be closely estimated; probably ranges through uppermost Cretaceous well into Tertiary.

Named for Chisos Mountains, Brewster County.

Chispa Andesite[1]

Tertiary: Southwestern Nevada.

Original reference: F. L. Ransome, 1909, U.S. Geol. Survey Prof. Paper 66, p. 28, 64.

Chispa Hills, Goldfield district.

Chispa Summit Formation[1]

Upper Cretaceous (Gulf Series): Southwestern Texas.

Original reference: W. S. Adkins, 1933, Texas Univ. Bull. 3232, p. 239, 271, 426, 431.

P. C. Twiss, 1959, Texas Univ. Bur. Econ. Geology, Geol. Quad. Map 23. Described in Van Horn Mountains. Formation is a marine sequence of flaggy limestone and calcareous shale that crops out in narrow band along western margin of mountains and in northwest-trending belt in central Van Horns south of Willoughby Windgap. Thickness at Chispa Summit 840 feet; section incomplete. Lower 150 feet composed predominantly of pale yellowish-brown flaggy fossiliferous microcrystalline limestone with interbeds of calcareous, illitic shale; above lower 150 feet limestone content decreases and rocks are mostly grayish-orange, gypsiferous, calcareous illitic shale. Lies disconformably on Buda limestone; contact sharp. Underlies Tertiary Colmena formation.

First described in Chispa Summit region, western Jeff Davis County.

Chita Sand Member (of Catahoula Formation)[1]

Miocene: Eastern Texas.

Original reference: F. B. Plummer, 1933, Texas Univ. Bull. 3232, p. 530, 715, 717.

F. E. Smith, 1958, Soc. Econ. Paleontologists Mineralogists and Houston Geol. Soc. Guidebook Ann. Field Trip, p. 9 (columnar section), 13–14. Basal member of Catahoula. Underlies Onalaska clay member. Thickness 10 to 80 feet. Age of Catahoula, as used in Texas and Louisiana, is still in question. Columnar section of field trip area [Brazos River valley] shows Oakville-Catahoula as Miocene.

Type locality: Exposures along north facing escarpment near Chita, Trinity County.

Chitistone Limestone[1]

Upper Triassic: Eastern Alaska.

Original reference: O Rohn, 1900, U.S. Geol. Survey 21st Ann. Rept., pt. 2, p. 426.

F.H. Moffit, 1938, U.S. Geol. Survey Bull. 894, p. 44–52, pl. 2. Bluish-gray limestone, prevailingly in thicker beds and with fewer and thinner shale partings than the overlying Nizina limestone. Black chert bodies of irregular form numerous in places. Thickness 1,900 feet in Nizina district.

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 at junction of Nizina and Chitistone Rivers, hence the name. Nizina-Tanana region.

Chitka Point Formation

Tertiary or Quaternary: Alaska.

H. A. Powers, R. R. Coats, and W. H. Nelson, 1960, U.S. Geol. Survey Bull. 1028–P, p. 539–541. pl. 69. Lava flows and flow breccia of porphyritic andesite, interbedded with marine conglomerate; conglomerate confined to lower part of formation; lava flows and breccia emplaced above water form upper part; at type section, contains carbonized broken fragments of woody material. No complete section compiled but thickness probably exceeds 1,000 feet. Overlies Amchitka formation (new) with angular unconformity, and dikes of porphyritic rock similar to lava of Chitka Point cut Banjo Point formation (new) and Amchitka formation; south of Chitka Point, underlies gravel deposit of hornblende andesite. Age estimated as middle to late Tertiary; no evidence to rule out possibility that formation might be early Quaternary.

Type locality: At Chitka Point, Amchitka Island (Aleutian Islands). Underlies most of mountainous west half of island.

Chittenango Member (of Marcellus Shale)[1]

Middle Devonian: Central New York.

Original reference: G. A. Cooper, 1930, Am. Jour. Sci., 5th, v. 19, p. 131, 219.

G. A. Cooper, 1941, Washington Acad. Sci. Jour., v. 31, no. 5, p. 180. Identification of Stony Hollow member (new) as sandstone equivalent of Cherry Valley limestone helps clarify section along Catskill Front. Beds hitherto classified as "Marcellus" shale (Bakoven of Chadwick) immediately underlie the Stony Hollow member and are now proved to be equivalent of Union Springs member. The Stony Hollow underlies Mount Marion formation of Grabau at its type section; consequently the Mount Marion is interpreted as sandy facies of Chittenango black shale member overlying the Cherry Valley to the west.

G. A. Cooper, 1943, *in* Winifred Goldring, New York State Mus. Bull. 332, p. 249 [1946]. Name Berne member was designated to cover the gray sandy equivalents of the Union Springs, Cherry Valley, and Chittenango members. Now that the Cherry Valley equivalent has been definitely recognized, the name Berne must be restricted wholly to the Chittenango sandy shale equivalent about 100 to 150 feet thick.

R. E. Stevenson, 1948, New York State Sci. Service Rept. Inv. 1, p. 2 (chart). Chart shows Chittenango member overlies Cherry Valley and underlies Bridgewater member.

Type section: In small gully 0.7 mile north of village of Chittenango Falls, Madison County.

Chiulos Shale Member (of Great Blue Formation)

Upper Mississippian: Western Utah.

R. E. Cohenour, 1959, Utah Geol. and Mineralog. Survey Bull. 63, p. 12 (table 1), 90–93, 170, 172, 174–175, pls. 1, 21. Primarily black fissile shale with many interbedded ribs of quartzite near center. Thickness about 1,818 feet. Overlies a lower limestone member about 911 feet thick; in fault contact with upper limestone member that is about 1,410 feet thick.

Described in Sheeprock Mountains, Tooele and Juab Counties.

Chiva Chiva Andesite

Oligocene or Miocene: Panamá.

[T. F. Thompson] 1943, Panama Canal, Spec. Eng Div., 3d Lock Proj., pt. 2, chap. 3, p. 26. Light-gray andesite porphyry. In intrusive contact with an agglomerate of basement complex. Occurs as thick dike or elongated plug. Pre-Pliocene.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 331–332. Type locality stated. Oligocene or Miocene.

Type locality: Quarry 6.5 kilometers northeast of Pedro Miguel, C.Z. Chiva Chiva is name of group of houses about 3 kilometers northeast of Pedro Miguel. Road that runs by quarry is called Chiva Chiva Road.

Chiwapa Sandstone Member (of Ripley Formation)

Upper Cretaceous: Northeastern Mississippi.

F. F. Mellen, 1958, Mississippi Geol. Survey Bull. 85, p. 49–54. Proposed for a sand or sandstone member at top of Ripley formation throughout outcrop belt of the unit in Clay, Chickasaw, Union, and Tippah Counties. Characteristically a "bored" or "horseshoe" limestone or calcareous sandstone; irregularly indurated. Thickness approximately 80 feet. Overlies Ripley marlstone; coarseness of Chiwapa sands suggests possibility of unconformity; separated from overlying Prairie Bluff-Owl Creek by sharp contact that may represent an unconformity or diastem.

Type locality: On branch of Chiwapa Creek at old CWA rock quarry 1½ miles south of Pontotoc in NW¼NW¼ sec. 16, T. 10 S., R. 3 E., Pontotoc County.

Chiwaukum Schist

Pre-Ordovician: Central Washington.

B. M. Page, 1940, Stanford Univ. Abs. Dissert., v. 15, p. 118. Mainly quartz feldspar, biotite, and graphite. Younger than Swakane gneiss.

R. M. Pratt, 1959, Dissert. Abs., v. 19, no. 12, p. 3278. Oldest rock units in Mount Stuart area are Chiwaukum schist and Peshastin slate. The Chiwaukum is a banded staurolite-kyanite-garnet-bearing quartz-biotite schist characterized by much carbonaceous matter and numerous quartz lenses.

First described in area northwest of Wenatchee, Chelan County. Mount Stuart area includes parts of Chelan, Kittitas, and King Counties.

Chloride Formation[1]

Devonian or Mississippian(?): Southwestern New Mexico.

Original reference: C. R. Keyes, 1904, Am. Jour Sci., 4th, v. 18, p. 360–362.

Probably named for town in northwestern part of Sierra County.

Chloride Granite

Precambrian(?): Northwestern Arizona.

M. G. Dings, 1951, U.S. Geol. Survey Bull, 978–E, p. 129–130, pl. 18. Light-gray medium-grained gneissoid granite. Gneissic structure, which is general conforms to schistosity of older folded rocks, in many places grades into a schist as borders of older rocks are approached. Locally granite shows considerable variation in texture, ranging from fine to moderately coarse. Weathers yellowish brown. Has intruded amphibolite and older granite gneisses. Formerly a part of Ithaca Peak porphyry.

Exposed north and northwest of Chloride, in Wallapai mining district, Mohave County.

Chloridian series[1]

Upper Cambrian: Arizona and New Mexico.

Original reference: C. R. Keyes, 1915, Conspectus of geologic formations of New Mexico: Des Moines, Robert Henderson, State printer, p. 4, 6.

Chloropagus Formation

Miocene, upper, to Pliocene, lower: Western Nevada.

D. I. Axelrod, 1956, California Univ. Pubs. Geol. Sci., v. 33, p. 95–97, 138–139, figs. 5, 6, 8. Section exposed in Green Hill area is (ascending) basalt more than 500 feet; breccia and agglomerate, 500 feet; basalt, 200 feet; tuff and breccia grading to siliceous shale, 50 feet; basalt, 450 feet; siliceous shale, 5 feet; tuffaceous sandstone and shale, 15 feet; basalt, 200 feet. Aggregate thickness over 1,920 feet. Base not exposed in Hot Springs Range but supposedly rests on basement rock. Conformably underlies Desert Peak formation (new). Southwest of Fallon, conformably overlies Old Gregory formation (new). Rocks show several important facies changes as they are traced away from Chloropagus.

Type area in middle foothills of Hot Springs (Kawsoh) Mountains 1 to 2 miles north of Desert Peak, in vicinity of Green Hill *(chloropagus)*, Desert Peak quadrangle. Identified over wide area in western Trinity

Range to north, and also crops out 30 miles north of Desert Peak, and adjacent hills to northeast and southwest.

†Choccolocco Shale[1]

Lower Cambrian: Alabama.

Original reference: E. A. Smith, 1890, Alabama Geol. Survey Rept. on Cahaba coal field, p. 148, map.

Named for Choccolocco, Calhoun County.

Chocolay Group

Precambrian (Animikie Series): Northern Michigan.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 30 (table 1), 35. Oldest of the four groups in the series. As defined here, equivalent to the Lower Huronian of earlier reports. Comprises (ascending) Fern Creek formation, Sturgeon quartzite, and Randville dolomite and their stratigraphic equivalents. In parts of Iron and Dickinson Counties, only unit of group is Randville dolomite (in southern Iron County, its partial correlative, the Saunders formation); Mesnard quartzite and Kona dolomite, exposed at Mount Chocolay and adjacent area to the west, are accepted as direct correlatives of Sturgeon quartizite and Randville dolomite. Group unconformably overlies post-Dickinson granitic rocks; underlies Menominee group.

Named for Mount Chocolay and for Chocolay Junction on the Duluth, South Shore, and Atlantic Railroad, about 3 miles southeast of Marquette, Marquette County.

Chocorua Granite[1]

Upper Devonian or Upper Carboniferous: Northern New Hampshire.

Original reference: C. H. Hitchcock, 1874, Geology of New Hampshire, pt. 1, p. 508–545.

Well exposed on Mount Chocorua, Carroll County.

†Choctaw Buhrstone (in Claiborne Group)[1]

Eocene, middle: Southern Alabama and Mississippi.

Original reference: W. J. McGee, 1890, Am. Jour. Sci., 3d, v. 40, p. 27, 30, 32.

Name probably derived from the broad belt of the formation across Choctaw County, Ala.

†Choctaw Limestone[1]

Lower Cretaceous (Comanche Series): Northeastern Texas.

Original reference: F. W. Cragin, 1894, Colorado Coll. Studies, v. 5, p. 41.

Named for Choctaw Creek, Grayson County.

†Choctawhatchee Formation[1]

Choctawhatchee Stage

Miocene, middle and upper. Western and northeastern Florida.

Original reference: G. C. Matson and F. G. Clapp, 1909, Florida Geol. Survey 2d Ann. Rept., p. 114–122, table.

R. H. Smith, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 2, p. 264, 269–272. Term Permenters Farm beds proposed for beds that lie above *Arca* zone in Choctawhatchee formation. Beds have been assigned to overlying *Ecphora* zone by earlier workers. Formation includes (ascending) *Yoldia* zone, *Arca* zone, Permenters Farm beds, *Ecphora* zone, and *Cancellaria* zone.

C. W. Cooke, 1945, Florida Geol. Survey Bull. 29, p. 168. Name Choctawhatchee formation abandoned. *Yoldia* and *Arca* zones transferred to Shoal River formation; *Ecphora* and *Cancellaria* zones classified as Duplin marl.

H. S. Puri, 1953, Florida Geol. Survey Bull. 36, p. 16 (table), 18 (fig. 2), 27–36, fig. 3. Choctawhatchee stage includes 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. These biofacies considered faunizones within Choctawhatchee formation. Type exposure of formation designated as type exposure of stage. Term Permenters Farm beds dropped.

Named for exposure on Choctawhatchee River, Walton County.

Chokecherry Dolomite[1]

Chokecherry Dolostone

Upper Cambrian and Ordovician(?): Western Utah.

Original reference: T. B. Nolan, 1930, Washington Acad. Sci. Jour., v. 20, no. 17, p. 421–432.

C. B. Bentley, 1958, Brigham Young Univ. Research Studies, Geology Ser., v. 5, no. 6, p. 24. Chokecherry dolomite is equivalent to both Notch Peak limestone (Upper Cambrian) and Pogonip group of Lower Ordovician age. Proposed that Cambrian part of Chokecherry dolomite be renamed Notch Peak and Ordovician part be renamed Pogonip formation.

K. F. Bick, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 5, p. 1067–1068. Cambro-Ordovician boundary lies within the Chokecherry dolostone; approximately lower third of formation is Late Cambrian and remainder Early Ordovician, the boundary being at change from thick-bedded to thin-bedded rocks. Overlies Hicks formation. Discussion of Deep Creek Mountains area.

L. F. Hintze, 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 50. Recommended that terms Chokecherry dolomite and Opohonga limestone be abandoned in Gold Hill and Tintic mining districts.

A. R. Palmer, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B290. In Deep Creek Range, Utah, Chokecherry dolomite overlies Corset Spring shale, geographically extended into this area.

U.S. Geological Survey currently designates the age of the Chokecherry Dolomite as Upper Cambrian and Ordovician(?) on the basis of faunal studies.

Named for exposures in Chokecherry Canyon just south of Gold Hill quadrangle.

Cholla Member (of Lowell Formation)

Lower Cretaceous: Southeastern Arizona.

A. A. Stoyanow, 1949, Geol. Soc. America Mem. 38, p. 10, 16, pl. 27. Consists of following divisions (ascending): white shaly sandstone with numerous fragments of silicified wood, buff-streaked sandstone, platy thin-bedded shale, crossbedded and streaked sandstone, light-buff limestone, crumbly yellow shale, gray limestone, friable light-yellow sandstone, crossbedded pinkish sandstone, platy light-colored sandstone, and massive crossbedded sandstone. Thickness 68 feet. Underlies unnamed shale and sandstone division; overlies unnamed limestone 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.

Cholla 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. Described as small tongue of Cliff House sandstone in Menefee formation. As a result of this tonguing, approximately 60 feet of beds at top of Menefee formation are replaced northeastward by Cliff House sandstone. Contacts are sharp.

Exposed within southeasterly trending band about one-half mile wide and about 3 miles southwest of edge of Barker Dome tongue. These exposures are along southwestern flanks of Barker and Southern Ute Domes and are especially well developed at the head of Cholla Canyon, in secs. 9, 10, and 15, T. 31 N., R. 14 W., San Juan County.

Chopaka Basic Intrusives[1]

Carboniferous(?): Central northern Washington, and southern British Columbia, Canada.

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

Caps Chopaka Mountain, Wash.

Chopaka Schist[1]

Carboniferous(?): Central northern Washington.

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

Caps Chopaka Mountain.

Choptank Formation[1] (in Chesapeake Group)

Miocene, middle: Eastern Maryland and Virginia.

Original reference: G. B. Shattuck, 1902, Science, new ser., v. 15, p. 906.

W. B. Spangler and J. J. Peterson, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 1, p. 77–78. Consists of fine yellow quartz sand, bluish-green sandy clay, slate-colored clay, and, locally, ledges of indurated material. Two well-defined fossil zones. Thickness variable; 50 feet at Nomini Cliffs, Va., where entire formation is exposed between St. Mary's formation above and Calvert formation below.

L. W. Stephenson and F. S. MacNeil, 1954, Geol. Soc. America Bull., v. 65, no. 8, p. 733–738. Yorktown formation geographically extended into Maryland where it transgresses both the St. Marys and Choptank formations.

Named for exposures on Choptank River, Md., a short distance below Dover Bridge, Talbot County.

Choptankian 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 Choptank formation, type exposure of which is considered exemplary of the substage. In sequence, the Choptankian succeeds Calvertian substage and is followed by St. Marysan substage.

Chorrera Basalt

Oligocene or Miocene: Panamá.

S. M. Jones, 1950, Geol. Soc. America Bull., v. 61, no. 9, p. 898 (table 2). Listed on correlation chart together with Cerro Gigante basalt and Bruja dolerite. Units are unconformable below Gatún formation and above upper Caimito members. Lower Miocene. "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. 332. Oligocene or Miocene.

Occurs in Gatún Lake area.

Chota Formation

Middle Ordovician: Eastern Tennessee.

R. B. Neuman, 1955, U.S. Geol. Survey Prof. Paper 274–F, p. 141, 145 (chart), 157–160, pls, 27, 28. Name applied to a unit which is formed dominantly of gray quartzose calcarenite, 550 to 900 feet thick, and which is underlain by Tellico formation and overlain by Sevier formation. Formation is thinnest in northeast part of homocline; thickens to northeast to 650 feet 3 miles southwest of its truncation by Guess Creek fault; at type locality 900 feet. This is same unit as "sandstone lentil of the Sevier formation" of Keith (1895, 1896) and Holston formation of Rodgers (1953) as mapped in this area.

Type locality: Near Chota School, on Tennessee Highway 72, Vonore quadrangle, Monroe County.

†Chouteau Group[1]

Mississippian: Missouri.

Original reference: G. C. Broadhead, 1874, Missouri Geol. Survey, v. 1, p. 26–65.

Chouteau Limestone[1]

Chouteau Group

Chouteau Limestone (in Easley Group or Sulphur Springs Group)

Lower Mississippian: Central and eastern Missouri and southwestern Illinois.

Original reference: G. C. Swallow, 1855, Missouri Geol. Survey 2d Ann. Rept., pt. 1, p. 101, sections opposite p. 98, 103.

E. B. Branson, 1944, Missouri Univ. Studies, v. 19, no. 3. p. 189–202. Formation in southwestern part of State includes (ascending) Compton, Northview, Pierson, and Reeds Spring members; in southeastern part of State, includes Fern Glen member; in central part of State, includes

Sedalia member; in northeastern part of State, undifferentiated. Underlies Burlington limestone; overlies Hannibal shale or Bushberg sandstone.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5. Chouteau limestone included in Easley group (new). In standard Mississippian section, occurs above Maple Mill shale and below Gilmore City limestone.

A. G. Unklesbay, 1952, Missouri Geol. Survey and Water Resources, 2d ser., v. 33, p. 46–56. Formation described in Boone County, where it is as much as 68 feet thick. In this report, name Chouteau is used in unrestricted sense of Swallow. Term is applied to the limestone between the Bushberg sandstone and Burlington limestone. In Sulphur Springs group. Weller placed the Chouteau in Easley group, but this term has not been generally accepted in Missouri. Kinderhookian.

E. L. Clark and T. R. Beveridge, 1952, Missouri Geol. Survey and Water Resources Rept. Inv. 13, p. 71–75. [Reprinted from Kansas Geol. Soc. Guidebook 16th Regional Field Conf.] Redefined as group to include (ascending) Compton, Sedalia, and Northview formations. This usage follows Broadhead (1874) by using Chouteau in unrestricted sense and ranking it as a group. At the time that Moore (1928) restricted the Chouteau, he believed the Kinderhookian-Osagean line to be between the Chouteau (restricted) or Compton and Sedalia. The Kinderhookian-Osagean line is now believed to be at the top of the Northview. Overlies Sylamore formation; underlies Pierson formation.

L. E. Workman and Tracey [Tracy] Gillette, 1956, Illinois Geol. Survey Rept. Inv. 189, p. 8 (fig. 1), 31–35. Chouteau is used in this report for the limestone that in western and central Illinois rests conformably on Maple Mill formation and in eastern and southern Illinois on New Albany formation. Uppermost limestone of Kinderhook series in these areas and is unconformably overlain by Osage group of Valmeyer series.

T. J. Laswell, 1957, Missouri Geol. Survey and Water Resources Rept. Inv. 22, p. 9 (fig. 2), 39–42. Formation described in Bowling Green quadrangle where it is as much as 25 feet thick. Overlies Hannibal formation; underlies Burlington formation. The Reeds Spring and Pierson formations are not of Chouteau age, as Branson (1944) believed, but are younger than the Chouteau.

Charles Collinson and A. J. Scott, 1958, Illinois Geol. Survey Circ. 254, p. 3, 5–6. In southern Illinois, Chouteau limestone underlies State Pond member (new) of Springville formation and is uppermost unit in Kinderhook series. Thin and discontinuous; thickness not more than 2 or 3 feet.

Charles Collinson and D. H. Swann, 1958, Geol. Soc. America Guidebook Field Trip St. Louis Mtg., p. 24 (fig. 3), 46 (fig. 8), 49–51. Described in western Illinois where it is as much as 70 feet thick. Overlies Hannibal shale; underlies Sedalia formation. Beds to which name Chouteau is applied in Illinois probably correlate with Compton limestone of Chouteau group in type area.

Named for Chouteau Springs, Cooper County, Mo.

†Chowan Formation (in Columbia Group)[1]

Pleistocene: Eastern North Carolina, eastern Maryland, and eastern Virginia.

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

Named for Chowan River, N.C.

Choza Formation[1] (in Clear Fork Group)

Lower Permian (Leonard Series): Central and central northern Texas.

Original reference: J. W. Beede and V. V. Waite, 1918, Texas Univ. Bull. 1816, p. 49, map.

M. G. Cheney, 1940, Am Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Assigned to Clear Fork group. Underlies San Angelo sandstone of El Reno group; overlies Vale formation. Includes Merkel dolomite member. Leonard series.

E. C. Olson, 1951, Jour. Geology, v. 59, no. 2, p. 178–181. Vertebrate fauna discussed.

C. O. Dunbar and others, 1960, Geol. Soc. America Bull., v. 71, no. 12, pt. 1, chart 7. Chart shows Choza formation below San Angelo [sandstone] of Pease River group; El Reno group not used in Texas.

Named for Choza Mountain, near Tennyson, Coke County.

Christine Member (of Yegua Formation)

Eocene (Claiborne): Southern Texas.

H. D. McCallum, 1947, South Texas [Geol. Soc. Guidebook] 14th Ann. Mtg. Field Trip, p. 5. Third member of the Yegua. Contact with underlying Cistern member (new) is within a graben.

Named for town of Christine, Atascosa County.

Christy Creek Siltstone Member (of Brodhead Formation)

Lower Mississippian: Northeastern Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 76, 179, 180–182, pl. 17. Massive siltstone at base of Brodhead formation, Morehead facies (new). Commonly 80 to 90 feet thick; 130 feet thick at type locality. Underlies Frenchburg siltstone member (new).

Typical exposure: Steep valley bluff and hillside slope above north side of Christy Creek valley, immediately north of State Highway 32, just east of Deep Fork Branch, 3¾ miles east of Morehead, Rowan County. Name taken from Christy Creek, a tributary to Triplett Creek. Can be traced northward to Ohio River where it is at horizon of Byer member of Logan formation in Scioto County, Ohio.

Chrysler Limestone

†Chysler Waterlime[1]

Upper Silurian and Lower Devonian: Central New York.

Original reference: G. H. Chadwick, 1930, Geol. Soc. America Bull., v. 41, p. 81.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, p. 534, chart 3. Term Chrysler was proposed by Chadwick for beds here called Rondout. Beds called Rondout in this column include more than those to which name has latterly been confined in type region in east, but agree with those to which name was originally applied there; hence, Chadwick now considers his term Chrysler to be superfluous.

U.S. Geolgical Survey currently designates the age of the Chrysler Limestone as Upper Silurian and Lower Devonian on the basis of a study now in progress.

Named for Chryslers Glen, Syracuse quadrangle.

Chuar Group[1]

Chuar Series

Precambrian (Grand Canyon Series) : Northern Arizona.

Original reference: C. D. Walcott, 1883, Am. Jour. Sci., v. 26, p. 439–442, 484.

J. F. Mason, 1948, Geol. Soc. America Bull., v. 59, no. 4, p. 350. Incidental mention of Chuar series.

C. E. Van Gundy, 1941, Geol. Soc. America Bull., v. 62, no. 8, p. 953, 954, pl. 1. Upper group of Grand Canyon series. Stratigraphically restricted; lower member reassigned to Nankoweap group. Thickness in Basalt Canyon, 5,098 to 5,323 feet. Disconformably overlies Nankoweap group.

Named for Chuar Valley, Grand Canyon region.

Chuarian series[1]

Precambrian: Northern Arizona and New Mexico.

[Original reference]: C. R. Keyes, 1906. Am. Jour. Sci., 4th ser., v. 21, p. 298.

Charles Keyes, 1938, Pan-Am. Geologist, v. 70, no. 2, p. 107, 109, 111. In Grand Canyon of Arizona, Chuaran series includes the following formations: Chiquito, Gunther, Jupiter, Oso, Venus, Marble, and Final. Older than Kwaguntan series (new) ; younger than Cardenas lava series (new).

Grand Canyon region.

Chubb Siltstone Member (of Maroon Formation)[1]

Chubb 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. Plants are not proof of Permian or even late Pennsylvanian age.

J. T. Stark and others, 1949, Geol. Soc. America Mem. 33, p. 43, pls. 1, 8. Described in South Park area where it is 1,827 feet thick at type locality. Underlies Pony Spring siltstone member; overlies Coffman conglomerate here included at top of Weber(?) formation.

K. G. Brill, Jr., 1952, Geol. Soc. America Bull., v. 63, no. 8, p. 820, 836, pls. 1, 8. Chubb siltstone considered member of Minturn formation in this report [Permo-Pennsylvanian zeugogeosyncline, Colorado and New Mexico]. Underlies Pony siltstone member and overlies Coffman conglomerate here considered member of Minturn. Assumed to be Desmoinesian because of position in section.

Type locality (Stark and others) : East side of Chubb Gulch in sec. 16, T. 13 S., R. 77 W., Park and Chaffee Counties.

Chubbuck Marble Member (of Essex Series)

Precambrian: Southern California.

J. C. Hazzard and E. F. Dosch, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 309. A marble, quartzite, and schist unit, 500 to 600 feet thick. Middle member of series; overlies a basal quartz-feldspar-biotite gneiss and underlies an upper 5,000-foot unit of quartz-feldspar-biotite gneiss.

Occurs in the Piute and Old Woman Mountains, San Bernardino County. [Probably named from Chubbuck on the Santa Fe Railroad.]

Chuckanut Formation[1]

Eocene: Northwestern Washington.

Original reference: R. D. McLellan, 1927, Washington Univ. Pub. in Geology, v. 2, p. 93, 136–138.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 75–90. pl. 11. Essentially massive crossbedded to stratified medium- to coarse-grained grayish-brown to brownish-gray sandstone; subordinate amounts of sandy shales, varying in color from gray to light and dark brown; lenses of conglomerate locally as much as 100 feet thick. Two type sections measured: along Chuckanut Drive on east shore of Samish Bay, thickness 11,272 feet, and along west shore of Lake Whatcom, thickness 8,930 feet. Field and drill hole evidence indicates total thickness may be more than 16,000 feet in western Whatcom County. Formation may represent time interval beginning in late Cretaceous and continuing into middle or possible late Eocene. Overlies schists and igneous rocks.

W. P. Popenoe, R. W. Imlay, and M. A. Murphy, 1960, Geol. Soc. America Bull., v. 71, no. 10, chart 10e (column 59). Listed on Cretaceous correlation chart with note that unit may be all Tertiary.

Well exposed along Chuckanut Drive on Pacific Highway, western Whatcom County.

Chuckwalla Complex

Precambrian: Southern California.

W. J. Miller, 1944, California Jour. Mines and Geology, v. 40, no. 1, p. 12, 16–20. Diorite-granite complex, locally including migmatities and banded gneiss and some involved metasediments. In Maria Mountains, unconformably underlies Paleozoic Maria formation (new); in Orocopia Mountains, in fault contact with Orocopia schist (new), considered younger. In Little San Bernardino Mountains, Chuckwalla complex is cut by Fargo Canyon diorite (new).

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 491. Granite of Chuckwalla complex named Berdoo granite.

Named for exposure in Chuckwalla Mountains, Palm Springs-Blythe area, Riverside County.

Chuctanunda Creek Dolomite or 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), 77, 90–92. Name proposed for sequence of medium- to thick-bedded buff-weathering blue-gray medium-grained dolomites. Lower half is dark-blue tó gray variegated noncherty coarse dolomarenite, locally laminated; small amounts of silt and angular sand present. Upper half is a siliceous dolomilutite, fine- to medium-grained, brownish-gray to blue-gray, and markedly cherty with much interstitial silica; chert mainly stringy or hackly. Thickness 40 feet at type locality. Unconformably underlies Cranesville dolomite (new); unconformably overlies Tribes Hill formation (Fonda member, new). Offlaps Tribes Hill formation in a northward direction.

Named for exposure along North Chuctanunda Creek within city of Amsterdam, Montgomery County.

Chuctenunda[1]

Chuctenunda Shale Member (of Canajoharie Shale)

Middle Ordovician: Eastern New York.

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

Rudolf Ruedemann, 1947, Geol. Soc. America Mem. 19, p. 119. Referred to as Chuctenunda shale member of Canajoharie. Overlies Fort Plain shale member; underlies Gansevoort shale member.

Type locality and derivation of name not given but may have been named from Chuctenunda Creek near Amsterdam, Montgomery County.

Chucunaque Formation

Miocene or Pliocene: Panamá.

Karl Sapper, 1937, Mittelamerika, Handbuch der regionalen Geologie. Heidelberg, v. 8, Abt. 4a, no. 29, p. 133, 134 (correlation chart). Underlies Piliguilla conglomerate; overlies Pucro sandstone. Upper Miocene.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 332. Undefined name; also used by Terry (1956, California Acad. Sci. Occasional Paper 23) without definition. Miocene or Pliocene.

In Darién area.

Chugwater Formation[1]

Chugwater Group

Permian and Triassic: Wyoming, Colorado, and central southern Montana.

Original reference: N. H. Darton, 1904, Geol. Soc. America Bull., v. 15, p. 394–401.

J. D. Love, 1939, Geol. Soc. America Spec. Paper 20, p. 12, 41–48, pl. 17. In present discussion [southern margin Absaroka Range], term Chugwater formation is applied to all strata between Dinwoody and Sundance formations. Thickness 1,250 feet. Comprises (ascending) Red Peak (new), Crow Mountain (new), Popo Agie, and Gypsum Spring (new) members. Triassic.

G. E. Condra, E. C. Reed, and O. J. Scherer, 1940, Nebraska Geol. Survey Bull. 13, p. 2; 1950, Nebraska Geol. Survey Bull. 13–A, p. 2 (fig. 2), 3. Chugwater as now used in Wyoming is synonymous with Spearfish (redefined). Freezeout tongue of Chugwater is here designated as a member or formation in Phosphoria group.

E. B. Branson and C. C. Branson, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 133–136. Rank raised to group. Compromises (ascending) Dinwoody formation, Red Peak formation, Alcova dolomite, Crow Mountain formation, Popo Agie formation, Wyopo formation (new), and Gypsum Spring formation. Overlies Phosphoria; underlies Sundance. Triassic.

J. D. Love and others, 1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 17. Name, Chugwater, has been used as both a group and a formation name by various investigators. Some authors have included the Dinwoody formation in the Chugwater along with four younger

Triassic units—the Red Peak, Alcova. Crow Mountain and Popo Agie—and two Jurassic formations—the Nugget ("Wyopo") and Gypsum Spring. Chugwater as used in present report [central Wyoming] is considered to be a formation 1,000 to 1,250 feet thick, overlying Dinwoody formation and underlying the Nugget, Gypsum Spring, and younger Jurassic formations. Comprises (ascending) Red Peak, Alcova, and Popo Agie members. Triassic.

R. K. Hose, 1955, U.S. Geol. Survey Bull. 1027-B, p. 51–52, pl. 6. Formation described in Crazy Woman Creek area, Johnson County, Wyo., where it overlies Permian red shale and gypsum sequence and is unconformably overlain by Gypsum Spring formation. Thickness 750 to more than 800 feet. In most places, divisible into three units (ascending): Red Peak, Alcova, and Crow Mountain members. Threefold division feasible only where Alcova member is present. Triassic.

C. A. Burk and H. D. Thomas, 1956, Wyoming Geol. Survey Rept. Inv. 6, p. 5, 6 (fig. 1). Overlies Goose Egg formation (new) at type section of Goose Egg formation.

N. C. Privrasky and others, 1958, Wyoming Geol. Assoc. Guidebook 13th Ann. Field Conf., p. 52–54. Chugwater, as redefined by Darton (1908) for Laramie basin, included sediments between Jurassic Sundance formation and Permian Forelle limestone. Chugwater of present report is restricted to sediments beneath the Sundance and above Goose Egg formation which includes, in part, Forelle limestone member, lower unnamed shale member, Ervay limestone member, and upper unnamed shale member. Formation comprises (ascending) Red Peak shale, Alcova limestone, Crow Mountain sandstone, and Popo Agie shale.

W. P. Mapel, 1959, U.S. Geol. Survey Bull. 1078, p. 26–28, pls. Formation, in Buffalo-Lake De Smet area, Wyoming, consists chiefly of dark-red siltstone, sandstone, and shale. Forms conspicuous band of red outcrops adjacent to east flank of Bighorn Mountains in southwestern, west-central, and northwestern parts of area. Thickness 810 feet. Three members recognized: lower, similar to Red Peak member in central Wyoming; middle, tentatively correlated with Alcova member; and upper, similar to Crow Mountain member in central Wyoming. Unconformably underlies Gypsum Spring formation; overlies unnamed sequence of red shale, siltstone, and gypsum, about 180 feet thick, which unconformably overlies Tensleep sandstone. Triassic.

T. A. Steven, 1960, U.S. Geol. Survey Bull. 1082-F, p. 338–339, pl. 12. Described in Northgate district, Jackson County, Colo., where it is about 690 feet thick on northern flank of Sentinal Mountain. Nonmarine strata chiefly impure red shales and sandstones. Underlies Sundance formation; overlies Forelle(?) limestone. Permian and Triassic.

Named for Chugwater Creek near Iron Mountain, Wyo.

Chumway Rhyolite

Oligocene: Central Colorado.

J. E. Bever, 1954, Dissert. Abs., v. 14, no. 7, p. 1088. Oligocene extrusive rocks are here named Guffey volcanics with the upper section correlated with Thirty-nine Mile andesite series, and the lower section here designated the Chumway rhyolite. They covered most of area with flows and tuffs thousands of feet thick.

Guffey area [Park County].

†Chupadera Formation[1]

Permian: New Mexico.

Original reference: E. H. Wells, 1919 [1920], New Mexico State School Mines Bull. 3, p. 10–11, 17–18.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 668 (footnote). Term abandoned.

Christina Lochman-Balk, 1959, New Mexico Geol. Soc. Guidebook 10th Field Conf., p. 100. Recent mapping has recognized the Yeso, Glorieta, and San Andres formations; term Chupadera has lapsed from usage and should be abandoned.

Named for Chupadera Mesa, eastern Socorro County.

Church Limestone Member (of Howard Limestone)[1]

Pennsylvanian (Virgil Series): Southeastern Nebraska, Iowa, southern Kansas, and northwestern Missouri.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull., 2d ser., v. 1, p. 42, 54.

R. C. Moore, 1949, Kansas Geol. Survey Bull. 83, p. 170 (fig. 34), 173–174. Most persistent and important limestone member of Howard formation. Commonly a single massive bed of dark-blue to blue-gray limestone. Thickness ranges from about 1½ to 6 feet, the average a little more than 2 feet. Underlies Winzeler shale member; overlies Aarde shale member. Where Bachelor Creek limestone is absent and Aarde shale cannot be differentiated, Church limestone is considered as forming basal unit of the Howard, resting on Severy-Aarde shale.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 19. Mentioned as occurring in Iowa and Missouri.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 19–20. Church, Winzeler, and Utopia members of Howard limestone are readily distinguishable in Missouri as the two thin limestones with intervening shale described as units of the Howard by McQueen and Greene (1938, Missouri Geol. Survey and Water Resources, 2d ser., v. 25, pl. 5).

Named for Church Farm, on Turner Creek, southeast of Du Bois, Nebr.

Church Creek Beds

Eocene to Oligocene: Southern California.

Parry Reiche, 1937, California Univ. Pubs., Dept. Geol. Sci. Bull., v. 24, no. 7, p. 144–146, geol. map. Sandstones and siltstones; lower part buff heavy-bedded well-cemented feldspathic sandstone; upper part interbedded buff and gray finer less well indurated sandstones and siltstones, with minor dark gray mudstones. Thickness about 600 feet. Bounded above by Church Creek fault and below by depositional contact with crystalline basement.

Area of study is Santa Lucia quadrangle, southwestern Monterey County.

Church Rock Member (of Chinle Formation)

Upper Triassic: Northeastern Arizona, southwestern Colorado, and southeastern Utah.

J. H. Stewart, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 3, p. 448 (fig. 4), 459–460, 461 (fig. 8). Described in southeastern Utah where it is composed of pale-reddish-brown and light-brown very fine grained sandy siltstone; siltstone may be structureless, horizontally laminated to very thick bedded, or, in places, ripple laminated. Sandstone more common in northern part of southeastern Utah where it includes unit termed Bowknot bed. Thickness ranges from wedge-edge to 400 feet in Utah. Conformably overlies Owl Rock member in most of southeastern Utah. Conformably overlies Moss Back member in San Rafael Swell, and unconformably overlies Moenkopi formation in Moab area. Disconformably underlies Wingate sandstone. Member thickens abruptly north of Elk Ridge area, probably by incorporating strata which are equivalent to Owl Rock farther south. Extends into Monument Valley, Ariz. Rock Point member of Wingate sandstone, which is largely, or entirely, the same unit as Church Rock member, is present in large part of Arizona and locally extends into west-central New Mexico. Name Church Rock is used in southeastern Utah and in areas in Arizona north of Laguna Creek, and name Rock Point member of Wingate is used in New Mexico and in areas of Arizona south of Laguna Creek. Church Rock member corresponds to A division of Chinle formation described by Gregory (1917 U.S. Geol. Survey Prof. Paper 93). Name credited to Witkind and Thaden.

J. H. Stewart and others, 1959, U.S. Geol. Survey Bull. 1046–Q, p. 517–520. In San Juan County, Utah, includes Hite bed (new).

Named for exposures in Monument Valley area, Arizona. In west-central Colorado, constitutes entire Chinle formation.

Church Run Conglomerate[1]

Pennsylvanian: Pennsylvania.

Original reference: J. F. Carll, 1875, Pennsylvania 2d Geol. Survey Rept. I, p. 38–40.

In hilltops at Church Run, Warren County.

Churn Creek Member[1] (of Cuyahoga Formation)

Churn Creek Shale Member (of New Providence Formation)

Churn Creek Siltstone and Shale Member (of Logan Formation)

Lower Mississippian: Southern Ohio and northeastern Kentucky.

Original reference: J. E. Hyde, 1915, Jour. Geology, v. 23, p. 656, 657, 763.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 77, 134, pl. 6. In upper part of New Providence column in Lewis County, Ky., siltstone beds become fewer as well as thinner, with argillaceous to silty shale becoming prevalent; no sharp break occurs between these two divisions. This upper zone, 75 to 100 feet thick, is interpreted as the "Churn Creek" of Hyde (1915) and termed Churn Creek shale member. Occurs above Vanceburg siltstone member in Vanceburg facies 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), 63–64. Churn Creek siltstone and shale member included in Vanceburg facies of Logan formation in Ohio. Underlies Vinton sandstone member; overlies Vanceburg siltstone member, but no dependable horizon separates the two, distinction being made on basis of 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 Vanceburg facies. Editor's note states Hyde (1921, Ohio Geol. Survey Bull. 23) correlated Buena Vista sandstone with Berne and lower portion 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.

Named for Churn Creek, southeastern Adams County, Ohio.

Chusa Tuff Member (of Catahoula Tuff)[1]

Oligocene or Miocene, lower: Southwestern Texas.

Original reference: T. L. Bailey, 1926, Texas Univ. Bull. 2645, p. 65, 89–105, 178–179.

Named for exposures on slopes of La Chusa Mesa, in southeastern McMullen County.

Chuska Sandstone[1]

Pliocene(?): Northwestern New Mexico and northeastern Arizona.

Original reference: H. E. Gregory, 1916, U.S. Geol. Survey Water-Supply Paper 380.

J. T. Hack, 1942, Geol. Soc. America Bull., v. 53, no. 2, p. 350. Tentatively correlated with Bidahochi formation.

J. E. Allen, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 11, p. 2569–2571. Overlies Tohatchi formation with angular unconformity. Thickness about 1,100 feet. Pliocene(?).

J. E. Allen and Robert Balk, 1954, New Mexico Bur. Mines Mineral Resources Bull. 36, p. 97–99. Massive crossbedded silica-cemented sandstone about 1,000 feet thick. Overlies, commonly with marked angular unconformity, formations ranging from Summerville upwards to Tohatchi formation of Mesaverde group. The Chuska is penetrated and overlain by volcanic rocks in vicinity of Washington Pass, 6 miles north of area [Tohatchi quadrangle]. Similar Tertiary beds occur between Gallup and Zuni 40 miles to south. Widespread similar sediments interbedded with volcanic debris near White Cone, Ariz., contain fossils indicative of an upper or middle Pliocene age. Chuska believed to be of upper Tertiary and probably Pliocene age.

C. A. Repenning and J. H. Irwin, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 8, p. 1821–1826. Because Bidahochi and Chuska formations are associated with apparently contemporaneous volcanic rocks and are lithologically similar, and because of the apparent comparison of the surfaces upon which the Bidahochi formation, the Chuska sandstone, and the Tertiary rocks of the Zuni Plateau were deposited, it is believed that the Chuska should tentatively be considered equivalent to lower member of Bidahochi.

H. E. Wright, Jr., 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 8, p. 1829 (fig. 2), 1830, 1831. Gradationally overlies Deza formation (new).

H. E. Wright, Jr., 1956, Geol. Soc. America Bull., v. 67, no. 4, p. 413–434. As restricted herein, forms cap rock of Chuska Mountains, which extend 60 miles along Arizona-New Mexico State line north of Gallup, N. Mex. Maximum thickness about 1,750 feet. Unfossiliferous; crossbedded throughout; contains no shale or conglomerate interbeds; several thin ash beds. Restricted Chuska and underlying Deza formation, together forming Gregory's Chuska sandstone, truncate Mesaverde group (Upper Cretaceous) and are unconformably overlain by middle or upper Pliocene volcanics. Suggested Miocene(?) age based on physiographic data. Discussion of origin of Chuska sandstone. Theory of correlation of Chuska and Bidahochi considered unacceptable.

C. A. Repenning, J. F. Lance, and J. H. Irwin, 1958, New Mexico Geol. Soc. Guidebook 9th Field Conf., p. 123–129. Hack (1942) tentatively correlated the Chuska with the Bidahochi. Repenning and Irwin (1954) accepted and elaborated these correlations to the extent of tentatively correlating the Chuska with lower member of Bidahochi. Although this correlation seems within reason in light of present information, the reasoning used to defend it is, in some respect, in error. Formation currently assigned a Pliocene(?) age until more convincing evidence becomes available.

Named for Chuska Peak, McKinley County, N. Mex.

Cialitos Limestone

Upper Cretaceous: Puerto Rico.

R. C. Mitchell, 1954, Puerto Rico Univ. Agr. Expt. Sta. Tech. Paper 13, p. 47, 48 (table 4). A distinctive creamy-white, coarsely crystalline limestone.

Occurs in Barrio Cialtos, Arecibo district.

Cibao Formation in Río Guatemala Group)

Cibao Limestone[1] or Marl

Oligocene and Miocene: Puerto Rico.

Original reference: B. Hubbard, 1920, Science, new ser., v. 51, p. 396.

A. D. Zapp, H. R. Bergquist, and C. R. Thomas. 1948, U.S. Geol. Survey Oil and Gas. Inv. Prelim. Map 85. Cibao marl included in Río Guatemala group (new). Consists of soft argillaceous marls, chalky limestones, and local thin beds of sand and clay. Best developed in inter-bioherm area and in western and eastern clastic basins. Maximum thickness approximately 230 meters midway between the Río Manatí and Río Indio in inter-bioherm area. Westward, entirely replaced by Lares limestone of western bioherm area. Upper 50 meters of Cibao continues in outcrop across eastern bioherm into eastern clastic basin. The Cibao becomes increasingly impure toward eastern extremity of outcrop area. Near eastern extremity, overlaps San Sebastián formation and rests on uneven surface of Cretaceous rocks. Transitional into upper Lares limestone. In western clastic area, contains sequence of predominantly clastic sediments herein named Guajataco member. Cibao marl is absent in vicinity of town of Florida, where western bioherm persisted until deposition of Aguada limestone (new) began. Some beds of the Cibao intervene between eastern bioherm and Aguada limestone. Middle Oligocene-lower Miocene, top uncertain.

Type locality: In barrio Cibao, north of Lares.

Cibola limestone[1]

Silurian(?): Southwestern New Mexico.

Original references: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 257–259; 1915, Conspectus of geologic formations of New Mexico: Des Moines, Robert Henderson, State printer, p. 3, 6.

Crops out at Cibola mill, at Silver City, Grant County.

Cibolo Formation[1]

Permian: Southwestern Texas.

Original reference: J. A. Udden, 1904, Texas Univ. Min. Survey Bull. 8, p. 10–25.

J. W. Skinner, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 180–188. Contact with underlying Alta transitional. All except uppermost part of Cibolo of Udden is regarded as upper Wolfcamp in age. At type section, upper member of Cibolo is overthrust on limestones of upper Permian (Capitan) age.

C. C. Rix, 1952, Geologic map of Chinati Peak quadrangle, Presidio County, Texas: Texas Univ. Bur. Econ. Geology, Prelim. ed. Stratigraphically below Ross Mine formation (new). Leonard series.

Named for Cibolo Creek and Cibolo Ranch, Presidio County.

Cienda Limestone (in Pacheta Member of Lowell Formation)

Lower Cretaceous: Southeastern Arizona.

A. A. Stoyanow, 1949, Geol. Soc. America Mem. 38, p. 12. Minutely clastic argillaceous limestone with glauconite in matrix and numerous larger inclusions of broken shell and chert. Weathers into round-edged slabs. Very rich in silicified ammonites. Thickness 4 feet. Underlies Black Knob dolomite (new); overlies Tusonimo limestone (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.

Cienega Peak Granite

Cretaceous or Tertiary: Southwestern New Mexico.

Elliot Gillerman, 1958, New Mexico Bur. Mines Mineral Resources Bull. 57, p. 12–13, table 1, pl. 1. Holocrystalline equigranular fine-grained light-pink rock with hypidiomorphic texture. Intrudes Chiricahua limestone and basal conglomerate and sandstone of McGhee Peak formation (new). Probably intrusive into Granite Gap granite (new) in area south of Preacher Mountain fault. Lenses out north of Cienega Peak.

Forms an almost vertical sill or laccolith which makes up Cienega Peak, a prominent landmark on western side of Peloncillo Mountains just north of Granite Gap, Hidalgo County.

Cieneguilla Formation

Pennsylvanian (Des Moines): Northern New Mexico.

J. A. Young, Jr., 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1247. Arkose, arkosic sandstone, arenaceous, carbonaceous, and calcareous shale, and thin beds of limestone. Thickness more than 2,200 feet. Upper beds interfinger with lower beds of a thick sequence of red arenaceous shale.

Exposed in valley of Coyote Creek, north of Black Lake, northern Sangre de Cristo Mountains.

Cieneguilla Limburgite.

Tertiary: North-central New Mexico.

C. E. Stearns, 1953, Am. Jour. Sci., v. 251, no. 6, p. 424 (fig. 3), 445–451. Proposed for series of flows and ejectamenta, with associated waterlaid beds, exposed in vicinity of La Cienega. Thickness at type locality 590 feet. At Cieneguilla, overlain with angular unconformity by Pleistocene alluvium of Santa Fe Plateau, Pleistocene basalt of the Mesa Negra, and by younger alluvium in Santa Fe Creek. Base of section not exposed; maximum stratigraphic interval concealed estimated to be 50 feet. Underlain by Espinaso volcanics (new) and separated from them by time interval during which a small body of augite quartz latite was intruded, solidified, and exposed by subsequent erosion. Appears to be Oligocene or earliest Miocene.

Type locality: Canyon of Santa Fe Creek between settlements of Canyon and Cieneguilla, Cerrillos Hills, Galisteo-Tonque area.

Cieneguita Formation

Cieneguita Beds[1]

Middle and Upper Pennsylvanian: Southwestern Texas.

Original reference: J. A. Udden, 1904, Texas Univ. Min. Survey Bull. 8, p. 10–25.

C. C. Rix, 1952, Geologic map of Chinati Peak quadrangle, Presidio County, Texas (1:48,000): Texas Univ. Bur. Econ. Geology, Prelim. ed. Formation consists of quartz-pebble conglomerate, coarse sandstone, sandy shale, and reef limestone. Underlies Alta formation. Strawn-Canyon (?), Cisco series.

Named for Cieneguita Ranch, Presidio County.

Cierbo Sandstone (in San Pablo Group)[1]

Cierbo Stage or Substage

Miocene, upper: Western California.

Original reference: B. L. Clark, 1921, Jour. Geology, v. 29, p. 586–614.

J. E. Eaton, U. S. Grant, and H. B. Allen, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 2, p. 199–200. The Monterey comprises three substages (ascending): Briones, Cierbo, and Neroly. Substages can be recognized strandward by distinctive echinoderm faunas and by a number of more or less distinctive mollusks.

A. S. Huey, 1948, California Div. Mines Bull. 140, p. 16 (fig. 2), 40–42, pls. Formation described in Tesla quadrangle. Unit herein called Cierbo was described as undifferentiated Miocene by Anderson and Pack (1915, U.S. Geol. Survey Bull. 603). A transgressive formation structurally involved in the regional folding and faulting. Rests with angular unconformity on Panoche; overlain conformably to unconformably by Neroly formation. Estimated maximum thickness about 500 feet. San Pablo group.

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 17 (table 3), 78–80, pls. 11–13. Exposed in southern parts of Carquinez and Mare Island quadrangles and rests with erosional unconformity on Briones sandstone. In San Pablo area, approximately 900 feet thick; consists of basal unit composed of alternating layers of fine- and coarse-grained brownish-gray sandstone; upper 160 feet is yellowish- and brownish-gray concretionary medium-grained sandstone; crossbedded pebbly and conglomeratic sandstone rests on the concretionary sandstones, and the contact is regarded as top of Cierbo. Underlies Neroly sandstone. In Los Medanos Hills, unconformably overlies Markley sandstone.

J. W. Durham, 1954, California Div. Mines Bull. 170, chap. 3, p. 24 (fig. 2), 26 (fig. 4). Listed as megafaunal stage. Follows Briones and precedes Neroly.

C. A. Hall, Jr., 1958, California Univ. Pub. Geol. Sci., v. 34, no. 1, p. 26–27, fig. 2, geol. map. In Pleasanton area, the Cierbo is 750 to 2,000 feet thick. Overlies Briones formation; underlies Neroly sandstone. In some areas, underlies Livermore gravels with angular discordance. Upper Miocene. Term San Pablo group not used in this report. Considered advisable to redefine term San Pablo formation and designate Cierbo and Neroly as members.

Type section: South side of Canada del Cierbo near Carquinez Straits, Carquinez quadrangle, San Francisco Bay region.

Ciervian Stage

Late Cretaceous: California.

P. P. Goudkoff, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 7, p. 960 (table 1), 982–985, 1005. Uppermost 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). Stage corresponds to Moreno shale at its type locality. Lower part of stage is represented by three facies, one composed of shales and the others of silty shales and silts. Includes interval between Paleocene Cheneyan stage (new) and Upper Cretaceous Ingramian stage (new).

Occurs in Great Valley in both surface and subsurface. Named after Ciervo Hills [Fresno County], in vicinity of which wells furnished typical material. Stage is well represented in upper 2,100 feet of Cretaceous strata exposed in Moreno Gulch, Fresno County.

Ciervo 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). Green shale and brownish-green sandstone. Thickness 3,470 feet. Includes Ortigalita sandstone member (new). Overlies Benito sandstone (new); underlies Marlife shale (new). Name credited to D. W. Sutton (unpub. thesis).

Type locality: Papanatas Canyon. Name derived from Ciervo Mountain in south-central sec. 5, T. 17 S., R. 13 E., Fresno County.

Cima Sandstone Lentil (in Dos Palos Shale Member of Moreno Formation)

Upper Cretaceous or Paleocene(?): Southern California.

M. B. Payne, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1953; 1951, California Div. Mines Spec. Rept. 9, p. 6 (fig. 2), 8 (fig. 4), 9, 22–23, pls. 2, 3, 4, 5. A 60-foot lens lying 185 feet below top of Dos Palos shale member (new). On the 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. Cima is Spanish word for peak given to hill 1,800 feet south and 50 feet west of NE cor. sec. 7.

Cimarron Anhydrite (in Hennessey Formation)

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 as occurring near the base of the formation.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 106. Rejected by Oklahoma Geological Survey. Name preoccupied; used by Cragin (1896) for a Permian group in Kansas and by Keyes (1904) for the Permian of New Mexico.

Occurs in Woods County.

†Cimarron Formation[1]

Permian: New Mexico.

Original reference. C. R. Keyes, 1904, Am. Jour. Sci., 4th, v. 18, p. 360–362.

†Cimarron Group[1]

Cimarron Series

Permian: Central southern Kansas.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 3, 18–48.

J. E. Adams and others, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 11, p. 1677, 1678. Cimarron series of northern Midcontinent region should be abandoned and its constituent strata reclassified as belonging to Leonard series and Guadalupe series.

G. H. Norton, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 12, p. 1764 (fig. 3), 1766–1814. Succeeding Milan limestone, top member of Wellington formation, without a break, are red shales and sandstones and higher evaporite beds of Kansas which constitute Cimarron series, which includes all succeeding Permian redbeds of the state, divided by Cragin (1896) into Salt Fork and Kiger divisions. Series comprises (ascending) Ninnescah shale, Stone Corral dolomite, Nippewalla group (new, which includes Harper sandstone redefined, Salt Plain formation, Cedar Hills sandstone, and Flowerpot shale), Blaine formation, Whitehorse formation, Day Creek dolomite, and Big Basin formation. Overlies Big Blue series.

G. E. Condra and E. C. Reed, 1959, Nebraska Geol. Survey Bull. 14A, p. 24–30. Formations of Cimarron series are well developed in northern Oklahoma and southern Kansas from which some of them extend subsurface to southern and western Nebraska and grade into Permian redbed section of Rocky Mountain, Laramie Range, Hartville, and Black Hills regions. Correlations discussed.

Named for Cimarron River.

Cimarron Creek Latite[1]

Miocene or Pliocene: Southwestern Colorado.

Original reference: W. Cross and E. Howe, 1907, U.S. Geol. Survey Geol. Atlas, Folio 153.

Exposed in drainage of Cimarron Creek in Ouray and Lake City quadrangles.

Cimarronian series[1]

Carboniferous: Texas.

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

Rio Grande Valley.

†Cincinnati Beds (proper)[1]

Middle and Upper Ordovician: Southwestern Ohio and north-central Kentucky.

Original reference: E. Orton, 1873, Ohio Geological Survey, v. 1, p. 370–387.

Named for exposures at Cincinnati, Ohio.

Cincinnati Group[1]

Upper Ordovician: Cincinnati arch region (surface and subsurface).

Original reference: F. B. Meek and A. H. Worthen, 1865, Philadelphia Acad. Nat. Sci. Proc., v. 17, p. 155.

A. M. Gutstadt, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 3, p. 513–547. Term Cincinnati group revived for body of rocks continuous with Cincinnatian series in Cincinnati arch region. In subsurface, group is composed of (descending) Maysville-Richmond formation and Eden shale. Exact relationships of Cincinnati group to underlying Trenton group not precisely known. Correlated with Maquoketa group.

Type locality: Region about Cincinnati, Ohio.

†Cincinnati Limestone[1]

Upper Ordovician: Southwestern Ohio.

Original reference: W. W. Mather, 1859, Rept. State House Artesian Well at Columbus, Ohio, p. 6.

Cincinnatian Series[1]

Cincinnatian Epoch[1]

Upper Ordovician: North America.

Original references: F. B. Meek and A. H. Worthen, 1865, Philadelphia Acad. Nat. Sci. Proc., v. 17, p. 155; J. M. Clarke and C. Schuchert, 1899, Science, new ser., v. 10, p. 876, 877.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 90–93. Cincinnatian series as developed in Minnesota is essentially Maquoketa formation, which is often considered a group or series.

R. H. Flower, 1946, Bulls. Am. Paleontology, v. 29, no. 116, p. 107–120. Cincinnatian series comprises Covington subseries with Eden and Maysville groups, and Richmond subseries with Arnheim, Waynesville, Liberty, Whitewater, and Elkhorn formations. Systematic description of cephalopods.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 2, chart 2. As shown on correlation chart, Cincinnatian series comprises Edenian, Maysvillian, Richmondian, and Gamachian (in Canada) stages.

A. M. Gutstadt, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 3, p. 513–547. Name Cincinnatian series, a time-stratigraphic term, is restricted to rocks of Late Ordovician age, wherever they occur. Most of "formations" assigned to Cincinnatian series are actually biostratigraphic zones. Name Cincinnati group revived for body of rocks continuous with type Cincinnatian series in Cincinnati arch region.

W. C. Sweet and others, 1959, Jour. Paleontology, v. 33, no. 6, p. 1029–1068. There is general agreement as to how local section in Cincinnati region should be subdivided into formational units, but there are differences of opinion as to how these formations should be named and grouped into larger units. If reference section of Cincinnatian in Cincinnati region is considered to include all strata between Point Pleasant (Cynthiana) beds and the Brassfield and their lateral equivalents, eight reasonably distinct formational units can be recognized in sequence. In ascending order, these are Eden, Fairview, McMillan, Arnheim, Waynesville, Liberty, Whitewater, and Elkhorn formations. Eden formation may be considered reference standard for an early Cincinnatian Eden stage; Fairview and McMillan formations constitute standard for medial Cincinnatian Maysville stage; the Arnheim, Waynesville, Liberty, Whitewater, and Elkhorn formations define Richmond stage of Cincinnatian. Eden, Fairview, and McMillan rocks constitute Covington group, which contains standard section of both Eden and Maysville stages.

M. P. Weiss and C. E. Norman, 1960, Ohio Geol. Survey Inf. Circ. 26, p. 1–14, chart 1. Report traces development of stratigraphic classification of Ordovician rocks in Cincinnati region.

Marshall Kay, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 7, p. 28–33. Cincinnatian series comprises Edenian, Maysvillian, and Richmondian stages. 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 series. With respect to base of Cincinnatian or "Upper Ordovician," using New York stages as applied herein, the boundary has ranged from the base to the top of the Pictonian. In present report, the lower series boundary is placed above all the Utica; the Pictonian is placed at top of Trentonian.

Type locality: Region about Cincinnati, Ohio.

Cincinnatus Sandstone[1]

Upper Devonian: Central New York.

Original reference: J. M. Clarke, 1903, New York State Mus. Handb. 19, p. 24, chart.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Shown as shale and sandstone. Underlies Kattel shale.

Typical exposures along Otselic River. Named from Cincinnatus Township, Cortland County.

Cinder Cone Basalts, Lavas, Tuffs

Recent: Northern California.

Howel Williams, 1932, California Univ. Pub., Bull. Dept. Geol. Sci. v. 21, no. 8, p. 225, 374, 375. Names applied to basalts at Cinder Cone. Latest activity at Chaos Crags and Cinder Cone belongs to last few centuries.

J. A. S. Adams, 1955, Geochim. et Cosmochim. Acta, v. 8, p. 82. Mentioned in report on uranium geochemistry of Lassen volcanic rocks.

Cinder Cone is in Lassen Volcanic National Park.

Cinnamon Ridge Member (of Flat Ridge Formation)

Precambrian: Southwestern Virginia.

A. J. Stose and G. W. Stose, 1957, Virginia Div. Mineral Resources Bull. 72, p. 48, 49, 51–52, pls. 1, 60. Blue dense basalt, with veins of epidote and red jasper, a green amygdaloidal basalt with epidote-filled vesicles, and a tuff. These are underlain by an agglomerate and flow breccia containing angular blocks of purplish-blue flow-banded vesicular basalt, of red rhyolite, of red jasper, and of granite, in epidotic groundmass. Thickness about 190 feet. Beds thin out east of Wolfpen Branch. Lies near base of formation.

Named from Cinnamon Ridge, 1 mile west of Gossan Lead district. Occurs west of Comers Rock-Blue Spring Gap Road and northwest of Comers Rock village, Gossan Lead district. Section measured on Cinnamon Ridge, Mouth of Wilson quadrangle, Grayson County.

Cintura Formation[1] (in Bisbee Group)

Lower Cretaceous (Comanche Series): Southeastern Arizona.

Original reference: F. L. Ransome, 1904, U.S. Geol. Survey Prof. Paper 21, p. 56, 68.

James Gilluly, 1956, U.S. Geol. Survey Prof. Paper 281, p. 8 (table), 76, pl. 1. Top of Bisbee group. Occupies less than 2 square miles of area of this report [central Cochise County]; forms eastern slopes of Mule Mountains. Consists of sandstone, mudstone, and a few thin limestone beds. As much as 1,800 feet thick in Bisbee quadrangle but only a few hundred feet of basal part represented in area of this survey. Overlies Mural limestone, contact transitional, first thick sandstone in transitional series selected as base of Cintura; underlies Quaternary.

Named for Cintura Hill near northern edge of Bisbee quadrangle.

Cinturan series[1]

Lower Cretaceous: Arizona.

Original reference: C. R. Keyes, 1935, Pan-Am. Geologist, v. 64, no. 2, p. 125–140.

Circle Volcanics[1]

Lower Mississippian: Northeastern Alaska.

Original reference: J. B. Mertie, Jr., 1930, U.S. Geol. Survey Bull. 816, p. 85.

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 east bank of Yukon River for about 15 miles upstream from Circle, Eagle-Circle district.

Cisco Group[1]

Cisco Formation[1]

Cisco Series

Upper Pennsylvanian: Central northern and central Texas.

Original reference: E. T. Dumble, 1890 Texas Geol. Survey 1st Ann. Rept., p. lvii, pl. 3.

Wallace Lee and C. O. Nickell, 1938, Texas Univ. Bur. Econ. Geol. Pub. 3801, p. 12–90, 118–134. Group, in Brazos River valley and Colorado River valley, includes (ascending) Graham, Thrifty, Harpersville, and Pueblo formations. Moran and Putnam formations formerly included in the Pennsylvanian are now placed in the Permian, thus restricting definition of Cisco group.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 90–92. Cisco series includes Pennsylvanian sediments above widespread disconformity which followed deposition of Home Creek limestone of Caddo Creek group, Canyon series. The Cisco is intended to be approximate Texas equivalent of Virgil series of northern midcontinent region. Upper boundary for series and Pennsylvanian system is placed at disconformity in Harpersville formation about Waldrip-Newcastle coal zone and below *Schwagerina*-bearing "Waldrip limestone No. 3" and Saddle Creek limestone. As thus defined, Permian-Pennsylvanian boundary is 40 to 150 feet below Saddle Creek limestone. "Harpersville" beds below boundary are assigned to Obregon (new) and Chaffin formations of Thrifty group; those above systemic boundary are assigned to Saddle Creek formation of expanded Pueblo group. Series comprises Graham and Thrifty groups.

R. C. Moore and M. L. Thompson, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 3, p. 288 (fig. 1), 299. Rocks of Kawvian series (new) are widespread in North America. In north-central Texas, series includes the Canyon and Cisco groups.

R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80. In Colorado River area, Texas, base of rocks classed as Permian lies about 50 feet below Saddle Creek limestone member of Pueblo formation. Beds between Saddle Creek units and boundary at base of Permian are assigned to Waldrip shale member of Pueblo. First limestone above disconformity is a 1-foot fusuline-bearing limestone called Waldrip No. 3 limestone by Drake (1893). Disconformity marks top of Cisco group. In accordance with Cheney's (1940) classification, term Harpersville is suppressed.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 58 (table 1), 68–74, pl. 27. Drake (1893, Texas Geol. Survey 4th Ann. Rept., pt. 1) referred lower part of what is now considered Cisco group, including his Bluff Creek and Campophyllum beds, to Cummins' (1891) Canyon division. To Cummins' Cisco division he referred the rocks from base of his Trickham bed up to base of his Coleman Junction bed (Coleman Junction limestone of Putnam formation, Wichita group, Moore, 1949). Plummer and Moore (1921, Texas Univ. Bull 2132) reclassified Drake's beds as members and considered his Bluff Creek bed to be a member of their Graham formation. Gunsight limestone (Plummer, 1919) and the newly named Wayland shale were also included in Graham formation which they placed in Cisco group. Plummer and Moore (1921) placed upper boundary of Cisco at top of their Coleman Junction limestone. Thus they considered Cisco group to consist of all beds from their Home Creek limestone to top of their Coleman Junction limestone. They placed in Thrifty formation all beds between their Wayland shale and top of Breckenridge limestone (Drake's Chaffin bed). Their Harpersville formation consisted of Drake's Waldrip and Saddle Creek beds. They also included the Pueblo, Moran, and Putnam formations in this Cisco group. Sellards (1933, Texas Univ. Bull. 3232) considered top of Home Creek as base of Cisco group, but lowered top of Cisco to top of Plummer and Moore's (1921) Camp Colorado limestone of Pueblo formation. Bullard and Cuyler (1935, Texas Univ. Bull. 3501) retained these boundaries but raised Graham-Thrifty boundary to top of Speck Mountain limestone member. Present report [Brown and Coleman Counties] places top of Thrifty formation of Cisco group at top of Chaffin limestone member, the most persistent mappable unit in that part of stratigraphic sequence, and uppermost unit in which distinctive Pennsylvanian fusulinids have been found. Because boundary between Permian and Pennsylvanian is obscure and probably gradational, no definite upper boundary between the two systems has been drawn. Formations and members of Cisco group as recommended in this report are (ascending) Graham formation with Bluff Creek shale, Gunsight limestone, Wayland shale, and Ivan limestone members; and Thrifty formation with Speck Mountain limestone, Breckenridge limestone, Parks Mountain sandstone, and Chaffin limestone members. Overlies Caddo Creek formation of Canyon group; underlies Pueblo formation of Wichita group. Thickness about 400 feet.

Named for Cisco, Eastland County.

Cisco Branch facies[1] (of Floyds Knob Formation)

Lower Mississippian: Southern Indiana.

Original reference: P. B. Stockdale, 1931, Indiana Dept. Conserv., Div. Geology Pub. 98, p. 76, 210–219.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 127–128, pl. 1. Facies nomenclature discussed. Correlation chart lists Cisco Branch facies of Floyds Knob formation.

Name derived from Cisco Branch, a tributary to Salt Creek which flows mainly across secs. 9, 17, and 18, T. 7 N., R. 1 E., Monroe County.

Cisco Lake Sandstone

Pennsylvanian: North-central Texas.

F. B. Plummer, 1947, Jour. Geology, v. 55, no. 3, pt. 2. p. 194 (table 1). Name appears on table of Pennsylvanian formations.

F. B. Plummer, H. B. Bradley, and F. K. Pence, 1949, Texas Univ. Bur. Econ. Geology Pub. 4915, p. 8, pls. 2, 6. In Eastland County, the Cisco Lake sandstone directly overlies the lower Crystal Falls limestone; in Brown County overlies Curry clay.

First mentioned as cropping out at Cisco Lake spillway, Eastland County.

Cisneros Basalt (in Hinsdale Series)

Pliocene: Central northern New Mexico.

Fred Barker, 1958, New Mexico Bur. Mines Mineral Resources Bull. 45, p. 3, 38, 51–53, pl. 1. Dark-gray slightly vesicular porphyritic olivine basalt. Thickness 10 to 30 feet. Overlies Cordito member (new) of Los Pinos formation with slight angular unconformity. Not overlain by younger rocks and original upper surfaces have been destroyed. Name credited to Butler (unpub. dissert.).

Named for Cisneros Park, in NW¼ T. 29 N., R. 8 E. Found in Las Tablas quadrangle, west and north of Canon del Agua, and in extreme NE cor. secs. 16 and 17, T. 29 N., R. 9 E.

Cistern Member (of Yegua Formation)

Eocene (Claiborne): Southern Texas.

H. D. McCallum, 1947, South Texas [Geol. Soc. Guidebook] 14th Ann. Mtg. Field Trip, p. 4, 5. Black to gray sandy clay. Member is downthrown on the Imogene fault and overlies the so-called Dime Box member.

Derivation of name not stated. Dime Box member occurs in Lee County.

†Citico Conglomerate[1]

Citico Conglomerate Member (of Sandsuck Shale)

Lower Cambrian: Eastern Tennessee and western North Carolina.

Original reference. A. Keith, 1895, U.S. Geol. Survey Geol. Atlas, Folio 16, p. 2.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, p. 29. In eastern Tennessee, Citico conglomerate may be used as a member name for conglomerate beds and lenses within Sandsuck shale, especially south of Miller Cove fault.

P. B. King and others, 1958, Geol. Soc. America Bull., v. 69, no. 8, p. 954. Citico, as used by Keith, is abandoned.

Named for Citico Creek, Monroe County, Tenn.

Citronelle Formation[1]

Pliocene: Gulf Coastal Plain from eastern Texas to Virginia, inclusive.

Original reference: G. C. Matson and E. W. Berry, 1916, U.S. Geol. Survey Prof. Paper 98–L, p. 167–208.

C. J. Roy, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 10, p. 1553–1559. Type locality of Citronelle, as designated by Matson and Berry (1916), is significant mainly because of exposure of plant-bearing clays near Lamberts Station about 5 miles south of Citronelle, Ala. Flora from these clays was correlated with Pliocene by Berry. Recent studies have shown that these clays are faulted and overlain unconformably by sand of the so-called Citronelle formation. Structural evidence indicates that the clays are older than the sands, hence, flora of the clays can not be used to correlate the sands. Suggested that term Citronelle, as formation name, be dropped.

G. F. Brown and others, 1944, Mississippi Geol. Survey Bull. 60, p. 45, 46, 54–59. Graham Ferry formation (new) of Pliocene and Pleistocene age disconformably underlies Citronelle formation.

F. S. MacNeil, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 29. Citronelle formation of Mississippi and Alabama and the unnamed fluvial (?) sands of Georgia may be of early Pleistocene age. Citronelle and unnamed sands shown on chart as Pliocene.

C. W. Carlston, 1950, Geol. Soc. America Bull., v. 61, no. 10, p. 1119–1121, pl. 1. Late Pliocene or early Pleistocene.

R. O. Vernon, 1952, *in* A summary of the geology of Florida and a guidebook to the Cenozoic exposures of a portion of the State: Florida Geol. Survey, p. 59. Prior to 1942, Pliocene series in Florida was composed of Citronelle formation, Tamiami limestone, Buckingham marl, Bone Valley gravel, Alachua formation. Charlton formation, and Caloosahatchie marl. Vernon (1942) dated a part of Citronelle formation as possibly early Nebraskan and the remainder as Pleistocene alluvium. This fieldwork cast some doubt on dating of "Pliocene" beds in south peninsula. Cooke (1945, Florida Geol. Survey Bull. 29) continued to recognize these units as Pliocene.

J. A. Doering, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 8, p. 1882. Citronelle, of south Mississippi and Alabama, which was considered to be, in part, a residual formation (Doering, 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 5), is now recognized to be equivalent of Willis formation of Texas and Louisiana. Name Citronelle has priority, and it is herein used for combined Citronelle-Willis. Formation was originally correlated as Pliocene in age by Matson and Berry (1916) on evidence of single fossiliferous outcrop located a few miles south of Citronelle. Doering (1935) pointed out that the fossil bed appeared to be a part of the underlying formation. This opinion was concurred with by later investigators. Citronelle is now believed to be Pleistocene.

V. T. Stringfield and P. E. LaMoreaux, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 4, p. 742–757. Age discussion. Red Bluff locality on Perdido Bay, Baldwin County, Ala., described by Matson and Berry (1916), restudied. Here, as much as 45 feet of Citronelle exposed. Exposures show that bed containing fossil plants is underlain by orange-colored sand and clay typical of Citronelle. Flora considered to be Pliocene in age. In addition to fossil evidence, oldest marine terrace of Pleistocene age in Florida is underlain by Citronelle formation, indicating that formation is older than oldest Pleistocene.

J. A. Doering, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 4, p. 764–786. Age problem discussed. Fossil evidence supports no more than a pre-Nebraskan determination, thus making an early Pleistocene correlation as plausible as one of late Pliocene.

K. B. Ketner and L. J. McGreevy, 1959, U.S. Geol. Survey Bull. 1074–C. p. 71–72. Cooke and Mossom (1929, Florida Geol. Survey 20th Ann. Rept.), assigned certain clayey, micaceous sands of peninsular Florida to the Citronelle. However, Citronelle formation of Pliocene or later age, apparently does not extend into peninsular Florida. Clayey, micaceous sand, which has been considered an equivalent of Citronelle, is late middle Miocene or early late Miocene in age.

J. A. Doering, 1960, Jour. Geology, v. 60, no. 2, p. 182–201. Citronelle formation of eastern Gulf Coast region extends northward across coastal plains of Georgia, South Carolina, North Carolina, and Virginia, as gravelly sand formation 100 feet thick, covering 30,000 square miles of upland area. These deposits were shown on early geological maps as the Lafayette or Altamaha formation, of late Pliocene or early Pleistocene age. In more recent geological reports, the deposits have been ignored or included in underlying Tertiary or Cretaceous formations; miscorrelations at State boundaries are involved in these later interpretations. Determinations made on basis of plant fossils indicate early Pleistocene (preglacial) age.

Type locality: Exposures around Citronelle, Mobile County, Ala., especially along Mobile and Ohio Railroad for a distance of 3 or 4 miles.

City Bluffs Shale (in Shawnee Formation)[1]

Pennsylvanian: Northwestern Missouri and southwestern Iowa.

Original reference: G. L. Smith, 1909, Iowa Geol. Survey, v. 19, p. 613, 615, 617, 622, 631.

Named for City Bluffs, now known as Burlington Junction, Nodaway County, Mo.

City Creek Limestone

Upper Devonian: Central northern Utah.

A. E. Granger and others, 1952, Utah Geol. Soc. Guidebook 8, p. 8, pls. 1, 2. Fossiliferous gray shaly limestone. Medium to thick bedded, and commonly shows an incipient large-scale-pencil fracture at right angles to the bedding. Weathers to mottled olive tan. Thickness 160 feet. Overlies Swan Peak(?) quartzite with apparent conformity. Underlies Madison limestone.

J. E. Brooks, 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 55. In areas of Becks Spur and City Creek

Canyon, Edvalson (1947, unpub. thesis) described section of Upper Devonian rocks to which he applied name Becks formation. The Becks underlies the Madison and rests on quartzose sandstones and quartzites which were provisionally referred to Swan Peak quartzite. Granger and Sharp (1952) applied name City Creek to these same rocks. Granger (1953) abandoned name City Creek and applied name Pinyon Peak.

Granger (1953), U.S. Geol. Survey Circ. 296 did not use term City Creek. It may be inferred from this report that he abandoned term City Creek in favor of Pinyon Peak.

On the Salt Lake Salient and in City Creek Canyon in Wasatch Mountains east of Salt Lake City.

City Creek Series

Precambrian: Central Arizona.

E. D. Wilson, 1939, Geol. Soc. America Bull., v. 50, no. 7, p. 1118 (table), 1126–1127. Series of shale beds with some interbedded quartzite. At northern base of Mazatzal Mountains, series comprises (ascending) well-stratified grayish-black to purplish siliceous shale member at least 800 feet thick; 15-foot member of alternating shale and novaculitic quartzite; thin-bedded friable maroon shale member about 50 feet thick; 10-foot member of alternating novaculitic quartzite and shale; and thin-bedded maroon to purple shale member with some interbedded quartzite, apparent thickness at least 1,000 feet. Farther northwest, in bluffs fronting East Verde River, series consist of very thin bedded friable grayish-green shale; thickness of this member not determined. Total thickness about 2,000 feet. Relation of series to other Precambrian rocks unknown. Unconformably underlies Tapeats sandstone; appears only in fault contact with Yaeger greenstone.

At northern base of Mazatzal Mountains on western side of City Creek (long 111°30′W.).

Clackamas Gravels

Pleistocene: Northwestern Oregon.

R. C. Treasher, 1940, (abs.) Geol. Soc. America Bull., v. 51, no. 12, pt. 2, p. 2034. Name applied to gravels deposited from eroded Troutdale formation in Clackamas Valley.

R. C. Treasher, 1942, Geologic map of the Portland area, Oregon (1:96,000): Oregon Dept. Geology and Mineral Resources. Described as poorly indurated, rudely bedded conglomerate; this lack of structure is principal feature distinguishing Clackamas from the Troutdale. Thickness as much as 100 feet.

Forms cover on terraces east of Carver; west of Carver, forms cover on terraces to Clackamas; northwest of Clackamas forms valley fill.

Claflin Ranch Formation

Tertiary: Southeastern Arizona.

Kenyon Richard and J. H. Courtright, 1960, Arizona Geol. Soc. Digest, v. 3, p. 1, 6. A thick series of clastic beds unconformably underlying Silver Bell formation. Enclosed within these thin- to thick-bedded clastics are angular blocks of andesite-schist conglomerate over 50 feet in length and 25 feet in thickness. Resembles Tucson Mountain chaos as it is exposed one-half mile south of Gates Pass.

Present in Silver Bell area and in South Tucson Mountains.

Claggett Formation[1] **or Shale** (in Montana Group)

Claggett Shale Member (of Cody Shale)

Upper Cretaceous: Central Montana and northern Wyoming.

Original reference: J. B. Hatcher and T. W. Stanton, 1903, Science, new ser., v. 18, p. 211–215.

P. W. Richards and C. P. Rogers, Jr., 1951, U.S. Geol. Survey Oil and Gas Inv. Map OM–111. In Hardin area, Big Horn and Yellowstone Counties, Wyo., considered upper member of Cody shale. Thickness 367 feet. Overlies shale member equivalent to Eagle sandstone; underlies Parkman sandstone.

J. D. Love, J. L. Weitz, and R. K. Hose, 1955, Geologic map of Wyoming (1:500,000): U.S. Geol. Survey. Claggett shale mapped in northwestern Wyoming.

W. J. McMannis, 1955, Geol. Soc. America Bull., v. 66, no. 11, pl. 7. Plate 7 shows Livingston formation intertongues with Claggett, Judith River, Bearpaw, Lennep, Hell Creek, Tullock, and Lebo formations.

W. A. Cobban, 1955, Billings Geol. Soc. Guidebook 6th Ann. Field Conf., p. 108 (fig. 1), 115. Claggett shale described on northwest flank of Sweetgrass arch, northwestern Montana. Commonly medium gray, soft, and silty. Thickness 420 feet on Goosebill Butte; 90 feet in western part of Sweetgrass Hills. Overlies Eagle sandstone; underlies Judith River formation.

Named for old Fort Claggett (now called Judith), at mouth of Judith River, Mont.

Claiborne Group[1]

Eocene, middle: Gulf Coastal Plain from Georgia to southern Texas.

Original reference: T. A. Conrad, 1847, Philadelphia Acad. Nat. Sci. Proc., v. 3, p. 280–282.

H. B. Stenzel, 1938, Texas Univ. Bur. Econ. Geology Pub. 3818, p. 20 (table), 58–160. Group comprises (ascending) Carrizo sand; Reklaw formation with Newby glauconitic sand and Marquez shale members (both new); Queen City sand with Omen glauconitic sand member; Weches glauconite marl with Tyus marl, Viesca glauconitic marl and Therrill clay members (all new); Sparta sand; Stone City beds (formation); Crockett formation with Wheelock marl, Landrum shale, Spiller sand, and Mount Tabor shale members (all new); and Yegua formation. Overlies Sabinetown shale of Wilcox group; underlies Uvalde(?) formation. Middle Eocene.

C. W. Cooke, 1939, Jour. Paleontology, v. 13, no. 3, p. 337-340. Gosport sand of Alabama, heretofore classified as topmost formation of Claiborne group (Eocene), and only known formation of "upper Claiborne" age, proves to be nearly equivalent to Moodys marl of Mississippi, the basal formation of Jackson group. Recommended that name Gosport be replaced by Moodys and that Claiborne group be restricted to formations heretofore classified as lower Claiborne.

H. A. Tourtelot, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 6. In Quitman fault zone, group includes Tallahatta formation, Zilpha clay, Winona sand, Kosciusko sand, Wautubbee formation, and Cockfield formation.

P. L. Applin and E. R. Applin, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 12, p. 1732–1733. Avon Park limestone, Tallahassee limestone (with nonfossiliferous facies) and Lake City limestone (early middle Eocene) represent Claiborne group in Florida Peninsula, and where all three units are present they appear to make, in most places, a conformable sequence. In J. S. Cosden's Lawson well No. 1, Marion County, beds of lignite occurring at contact of Lake City with nonfossiliferous limestone are believed to indicate local unconformity. Along northeast coast of Florida and in south half of peninsula, nonfossiliferous limestone is not present and the Avon Park rests on Lake City limestone.

L. D. Toulmin, Jr., 1944, Southeastern Geol. Soc. [Guidebook] 1st Field Trip, p. 10–11. Group, in Alabama, comprises (ascending) Tallahatta, Lisbon, and Gosport formations. Overlies Hatchetigbee formation of Wilcox group; underlies Moodys Branch marl of Jackson group.

W. E. Belt and others, 1945, Geologic map of Mississippi (1:500,000): Mississippi Geol. Survey. As mapped, group includes Tallahatta formation, Zilpha clay, Winona sand, Neshoba sand, Sparta sand, Cook Mountain formation, and Cockfield formation.

E. H. Rainwater, chm., 1945, Southeastern Geol. Soc. [Guidebook] 3d Field Trip, p. 47–51. Claiborne group in subsurface in western Florida is subdivided into Lisbon and Tallahatta formations in accordance with usage in Alabama. Overlying Gosport formation also was formerly included in Claiborne, but is now generally considered lower Jackson in age. Overlies Wilcox group not subdivided in subsurface of western Florida.

F. S. MacNeil, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 29. Group, in Alabama and Georgia, comprises (ascending) Tallahatta formation, Lisbon formation, and Gosport sand.

R. O. Vernon, 1951, Florida Geol. Survey Bull. 33, p. 88–111. Rocks assigned to Claiborne group of peninsular Florida differ in faunal content and lithology from those recognized throughout Gulf Coast elsewhere. In general, Claiborne group of northern and peninsular Florida is composed of carbonates and evaporites and that of western Gulf Coast is composed of clastics, largely sands and clays. An occasional fossil common to both sections support stage-age assignments, but these are insufficient to allow extension of Gulf Coast formational nomenclature to carbonate rocks of Florida. Applin and Applin (1944) erected three formations in Claiborne group: Lake City limestone (early middle Eocene), Tallahassee limestone (late middle Eocene), and Avon Park limestone (late middle Eocene). In western Florida, Claiborne group is not present at surface, but two-fold division can be recognized in subsurface, Gosport at top and Lisbon formation at base. Disconformably underlies Moodys Branch formation of Jackson group. Claiborne-Jackson contact discussed [see Jackson group].

G. E. Murray *in* W. C. Holland, L. W. Hough, and G. E. Murray, 1952, Louisiana Dept. Conserv. Geol. Bull. 27, p. 77–78, pls. 11, 12. Current usage of Claiborne group is in time-stratigraphic sense, including within its limits many lithologic types deposited during several advances and retreats of sea. Recommended that Claiborne be utilized strictly as group name for clastic facies in central and western Gulf Coast Plain below Jackson stage and above Wilcox group. So used, it would be partially the arenaceous counterpart of calcareous Lisbon group of eastern Gulf Coast.

James Turner, 1952, Mississippi Geol. Survey Bull. 76, p. 10. In Yalobusha County, Claiborne [group] includes (ascending) Meridian formation, Tallahatta, Winona, Zilpha, and Kosciusko formations.

H. V. Andersen, 1960, Louisiana Dept. Conserv. Geol. Bull. 34, p. 85–94, maps. Group, in Sabine Parish, comprises (ascending) Cane River, Sparta, Cook Mountain (with Dodson member equivalent, Milams and Saline Bayou members), and Cockfield formations. Overlies Wilcox group (rock term); underlies Jackson group.

Named for exposures at Claiborne Bluff and Claiborne Landing, on Alabama River, Monroe County, Ala.

†Claiborne Sand (in Claiborne Group)[1]

Eocene, middle: Southern Alabama and Mississippi.

Original reference: T. A. Conrad, 1847, Philadelphia Acad. Nat. Sci. Proc., v. 3, p. 280–281.

G. D. Harris, 1940, Science, v. 92, no. 2386, p. 257–258. Name Claiborne in geologic literature discussed. Possibly name Claiborne sands should not be abandoned.

Named for exposures at Claiborne Bluff, on Alabama River, in Monroe County, Ala.

Claiborne Stage, Age

Eocene, middle: Gulf Coastal Plain from Georgia to southern Texas.

G. E. Murray, 1953, Mississippi Geol. Soc. [Guidebook] 10th Field Trip, p. 54. In discussing subsurface stratigraphy of Beauregard and Allen Parishes, La., Murray (1952) used Claiborne as a rock-unit term and utilized three unnamed stages between Jackson and Sabine stages. This usage is improper and should not be followed. Instead, Claiborne stage should consist of all deposits in Gulf and Atlantic Coastal Plain province formed during fluctuations of middle Eocene sea, beginning with close of withdrawal of Sabinian sea and ending with first transgression of Jacksonian sea. The Reklaw-Queen City, Cane River-Sparta, and Cook Mountain-Cockfield cycles of deposition, and their demonstrable equivalents should be considered substages. Type exposures of Gosport, Lisbon, and Tallahatta formations in Alabama, exposures at Claiborne Bluff and Claiborne Landing on Alabama River, Monroe County, Ala., and type exposures of Reklaw, Queen City, Winona-Zilpha-Weches-Cane River, Sparta, Cook Mountain, and Yegua-Cockfield formations in Mississippi, Louisiana, and Texas are exemplary of the stage. Claiborne age includes all time covered by deposition of these deposits.

Clallam Formation[1]

Miocene: 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. 118, 173, 175. Recent studies indicate that sandstones and shales occurring along sea-cliffs between Clallam Bay and Pysht are probably correlative, at least in part, with middle Miocene Astoria formation of southwestern Washington and western Oregon. Former broad usage of name Clallam should be restricted to Miocene part of stratigraphic section along northern side of Olympic Peninsula. May become desirable to abandon name

Clallam and use only term Astoria formation. Massive sandstones, conglomerates, shaly and pebbly sandstones, and interstratified clay shales constitute greater part of formation. Appears to be unconformable upon Oligocene shales. Uppermost beds have been largely removed by erosion.

R. D. Brown, Jr., and H. D. Gower, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 10, p. 2492, 2494, 2511. Conformably overlies Twin River (redefined).

H. D. Gower, 1960, U.S. Geol. Survey Geol. Quad. Map GQ–129. Described in Pysht quadrangle. Term used in restricted sense of Weaver (1937). Thick-bedded and crossbedded light-olive-gray fine- to coarse-grained sandstones. Estimated thickness more than 2,500 feet. Overlies Twin River formation. Much of coastal section highly deformed and inland poorly exposed. Miocene.

Well exposed in region between Clallam Bay and Pillar Point, Clallam County.

Clan Alpine Volcanics

Miocene, middle to upper(?): Western Nevada.

D. I. Axelrod, 1956, California Univ. Pubs. Geol. Sci., v. 33, p. 182–183, pls. 10, 11. Include rhyolite, quartz latite and dacite tuffs, breccias, and flows. Rhyolites range in color from pale yellowish brown to dark yellowish brown and pale red. Thickness of individual flows ranges from few feet up to 40 feet, the tuffs from few inches to massive beds of 40 feet or more. Quartz latites range in color from medium light gray to light brownish gray, brownish gray, and pale red purple and may well represent the dominant volcanic. Total thickness in excess of 3,000 feet in southern part of range and increases northward. Oldest rock in area; unconformably underlies Middlegate formation (new).

Named for exposures in southern parts of Clan Alpine Range. Extends well to northward to form important part of that mountain mass. Churchill County.

Clancy Granodiorite

Upper Cretaceous: Southwestern Montana.

Adolph Knopf, 1957, Am. Jour. Sci., v. 255, no. 2, p. 81, 91–92, map facing p. 88. A light-gray coarse-grained rock in which quartz is conspicuous. Represents the second intrusion of the Boulder bathylith. Cuts the older Unionville granodiorite (new).

Named from the Kain quarry on Clancy Creek, Jefferson County.

Claremont 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. 17 (table 3), 69 (table 14), 70, pl. 11. Described in Contra Costa County where it occurs as band about 1,000 feet wide southwest of Pinole and trends northwestward toward shore of San Pablo Bay. Fine-grained light-colored moderately hard slightly bituminous shale locally containing thin layers of grit and fine conglomerate; east of Berkeley, formation is a series of alternating thin layers of siliceous shale or chert and partings of shale. Probable average thickness south of San Pablo Bay 800 feet. Conformably underlies Oursan sandstone; overlies Sobrante sandstone.

G. D. Robinson, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–88. In Hayward quadrangle, Claremont shale ranges in thickness from 150 to 300 feet. Mapped for convenience as Claremont, though quite possibly from a younger formation of Monterey group, is a siliceous mudstone containing ovoid masses that may be diatoms; it crops out between Leona rhyolite and serpentine in hill above Hayward High School, several miles west of main Tertiary outcrops. Conformably overlies Sobrante sandstone; underlies unnamed middle sandstone and shale of Monterey group.

C. A. Hall, Jr., 1958, California Univ. Pubs., Geol. Sci., v. 34, no. 1, p. 16–18, fig. 2, geol. map. Claremont shale, in Pleasanton area, Alameda and Contra Costa Counties, is about 700 feet thick. Overlies Sobrante sandstone; underlies Oursan sandstone. Term Monterey group not considered appropriate in this area.

Named for exposure on Claremont Creek, Concord quadrangle.

†Claremore Formation[1]

Pennsylvanian: Northeastern and central eastern Oklahoma.

Original reference: C. N. Gould, D. W. Ohern, and L. L. Hutchison, 1910, Oklahoma State Univ. Research Bull. 3, p. 6, 7, 10.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 100. A vaguely defined unit including Fort Scott limestone and subjacent strata. Abandoned by Oklahoma Geological Survey.

Named for Claremore, Rogers County.

Clarendon Beds[1]

Pliocene: Texas.

Original reference: J. W. Gidley, 1903, Am. Mus. Nat. History Bull., v. 19, p. 632–635.

Named for Clarendon, Donley County.

Clarendon Dolomite

Cambrian: West-central Vermont.

G. W. Bain, 1938, New England Intercollegiate Geol. Assoc. [Guidebook] 34th Ann. Field Mtg., p. 8. Name applied to massive gray-weathering dolomite which represents most of lower half of Rutland formation in this area. Dolomite contains small percentage of coarse sand grains. Thickness 2,000 to 3,000 feet.

Best exposed in Clarendon and along Tinmouth Channel, Rutland County.

Clarendon Gravel[1]

Pleistocene: Northwestern Pennsylvania.

Original reference: E. H. Williams, Jr., 1920, Am. Philos. Soc. Proc., v. 59, p. 62, 73.

Named for Clarendon, Warren County.

Clarendonian Age

Pliocene: North America.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 12, pl. 1. Provincial time term, based on the Clarendon local fauna (and member?), near Clarendon, Donley County, Texas. Covers the interval between the Barstovian (Miocene) and Hemphillian (Pliocene) ages. Report defines 18 provincial time terms, based on mammal-bearing units, for the North American continental Tertiary. [For sequence see under Puercan.]

D. I. Axelrod, 1957, Am. Jour. Sci., v. 255, no. 10, p. 695 (fig. 1). Table shows Clarendonian as late Miocene and early Pliocene. Determination based on paleoclimatic analyses of sequences of Late Tertiary floras.

Clarendon Springs Dolomite[1] (in Stockbridge Group)

Upper Cambrian: West-cental Vermont and Massachusetts

Original reference: Arthur Keith, 1932, Washington Acad. Sci. Jour., v. 22, p. 360, 397.

W. M. Cady, 1945, Geol. Soc. America Bull., v. 56, no. 5, p. 525, 536–539. Keith included in Clarendon Springs all dolomite beds between uppermost sandy strata of limestones of overlying Shelburne marble. In some localities along western side of area, the dolomite includes horizons both above and below a sandstone. Rogers (1937, Geol. Soc. America Bull., v. 48, no. 11) indicates stratigraphic break above the dark-gray dolomites and suggests that the sandstone is basal to certain of the higher strata. Break was not noted in eastern area. Upper strata of dolomite facies grade laterally into limestones and marbles. Thicknesses: 120 feet at Brandon, 80 feet at Middlebury, 45 feet at New Haven.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, p. 23–24. In Castleton area, unit is 130 to 175 feet thick. Overlies Danby formation; underlies Boardman formation (new).

A. B. Shaw, 1951, Jour. Paleontology, v. 25, no. 1, p. 97. Includes Milton dolomite facies.

P. H. Osberg, 1952, Vermont Geol. Survey Bull. 5, p. 21 (table 1), 42. In this report [vicinity of Rochester and East Middlebury], name Clarendon Springs is used according to definition of Cady (1945). Thickness about 200 feet. Top of section in western sequence. Overlies Danby formation.

Norman Herz, 1958, U.S. Geol. Survey Geol. Quad. Map GQ–108. In Cheshire quadrangle, Massachusetts, included in Stockbridge group. Thickness 0 to 800 feet. Contact with underlying Kitchen Brook dolomite (new) not observed; underlies Shelburne marble.

Type locality: Clarendon Springs, Rutland County, Vt.

Clarion Clay (in Allegheny Formation)[1]

Pennsylvanian: Western Pennsylvania, Ohio, and West Virginia.

Original reference: W. G. Platt, 1880, Pennsylvania 2d Geol. Survey Rept. H_5.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 44, table 1. Clarion clay listed as member of Clarion cyclothem in Perry County. Underlies Clarion (No. 4a) coal; overlies Canary ironstone. Allegheny series.

W. A. Tallon and R. G. Hunter, 1959, West Virginia Geol. Survey Rept. Inv. 17, p. 16. Clarion underclay mentioned in report on high-alumina clays of West Virginia. Samples collected in Randolph County. Basal member of Allegheny series.

Name derived from Clarion, Clarion County, Pa.

†Clarion coal group[1] (in Allegheny Formation)

Pennsylvanian (Allegheny Series): Southeastern Ohio and southwestern and northern West Virginia.

Original reference: H. D. Rogers, 1858, Geology Pennsylvania, v. 2, pt. 1, p. 474–477.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 56–59. Rogers (1858) used Clarion as a group name for beds between the Freeport (Lower?) sandstone above and Tionesta sandstone below. As originally defined, it included beds now assigned to Brookville, Lower, Middle, and Upper Kittanning, Lawrence, and Scrubgrass cyclothems. Clarion cyclothem is restricted to the members lying between Scrubgrass and Winters cyclothems.

Type area: Clarion River valley, western Pennsylvania.

Clarion cyclothem or cyclic group

Pennsylvanian (Allegheny Series): Southeastern Ohio and southwestern Pennsylvania.

N. K. Flint, 1949, Ohio Acad. Sci. [Guidebook] 24th Ann. Field Conf., p. 6. Incidental mention in road log.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 44, table 1, geol. map. Includes Clarion shale and sandstone, 42 feet, Canary ironstone; Clarion clay, 3 feet, and Clarion (no. 4a) coal. Occurs below Scrubgrass cyclothem and above Brookville cyclothem. In area of this report, the Allegheny series is described on a cyclothemic basis; nine cyclothems are named. [For sequence see Brookville cyclothem.]

E. G. Williams, 1957, Dissert. Abs., v. 17, no. 12, p. 2982. Clarion cyclic group recognized in Clearfield Basin, Pennsylvania.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 49 (table 7), 56–59. Rogers (1858, Geology of Pennsylvania, v. 2, pt. 1) used Clarion as a group name for beds between the Freeport (Lower?) sandstone above and Tionesta sandstone below. As originally defined, it included beds now assigned to Brookville, Lower, Middle, and Upper Kittanning, Lawrence, and Scrubgrass cyclothems. Clarion cyclothem is now restricted to four members lying between Scrubgrass and Winters cyclothems. Members (ascending) Clarion shale and (or) sandstone, Canary ironstone, Clarion underclay, and Clarion (No. 4a) coal members. In this report, the Allegheny series is described on a cyclothemic basis; 13 cyclothems are name. [For sequence see Brookville cyclothem.]

First described in Perry County, Ohio.

Clarion Formation[1] (in Allegheny Group)

Pennsylvanian: Pennsylvania.

G. H. Ashley, 1923, Eng. Mining Jour.-Press, v. 115, no. 25, p. 1108; 1926, Pennsylvania Geol. Survey, 4th ser., Topog. and Geol. Atlas 65, p. 29, pl. 4. Clarion formation, Allegheny group, comprises (ascending) Brookville or A coal, Clarion sandstone, Clarion or "A" coal, and Vanport limestone. Overlies Homewood formation which includes Homewood sandstone; underlies Kittanning formation.

C. K. Graeber and R. M. Foose, 1942, Pennsylvania Geol. Survey, 4th ser., Topog. and Geol. Atlas 54, p. 40–45. Lowermost formation in Allegheny group. Includes strata from base of Lower Kittanning clay to base of clay beneath Brookville coal. Comprises (ascending) Brookville coal, Clarion sandstone, Clarion clay, Lower Clarion coal, Upper Clarion coal, Vanport limestone, Lower Kittanning sandstone. Thickness 120 to 145 feet. Underlies Kittanning formation; overlies Homewood sandstone of Pottsville series. Area of report Brookville quadrangle.

E. G. Williams and R. P. Nickelsen, 1958, Pennsylvania State Univ. Mineral Industries Expt. Sta. Bull. 71, p. 36–50. Discussion of correlation of Pottsville and lower Allegheny series in Clearfield and Centre Counties. Clarion formation (Allegheny series) which overlies the Pottsville is 65 to 190 feet thick and consists of cyclic sequences of clay, coal, shale, siltstone, silty shale, and sandstone. Includes (ascending) Brookville coal, Clarion sandstone, Clarion coal, Vanport limestone, and Kittanning sandstone. Underlies Kittanning formation. Reference sections designated. Stratigraphic nomenclature of Clarion formation is more confused and uncertain than that of other formations of the Allegheny. This is due partly to inherent complexity of formation, partly to rather loose definition and description of type sections and partly to questionable correlations between type sections.

R. R. Dutcher and others, 1959, Geol. Soc. America Guidebook for Field Trips, Pittsburgh Mtg., p. 70 (fig. 5), 71. Allegheny group comprises (ascending) Clarion, Kittanning, and Freeport formations. The Clarion overlies Mercer formation of Pottsville group.

E. G. Williams, 1960, Jour. Paleontology, v. 34, no. 5, p. 910 (fig. 2). Formation includes (ascending) Clarion coals, Clarion sandstone, Vanport limestone, and Lower Kittanning sandstone. Overlies Mercer formation, which has Homewood sandstone and shale at top; underlies Kittanning formation, which has Lower Kittanning coal in lower part.

Reference section (31): Northeast rectangle of Glen Richey quadrangle, Clearfield County, in coal strip mines on western end of large hill, one-half mile east of Krebs. Reference section (32): In south-central rectangle of Clearfield quadrangle, Clearfield County, in coal strip mines on a small hill 0.4 mile northeast of mouth of Clearfield Creek. Name derived from Clarion, Clarion County.

Clarion Sandstone Member (of Allegheny Formation)[1]

Clarion Sandstone (in Clarion Formation)

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

Original reference: J. J. Stevenson, 1878, Pennsylvania 2d Geol. Survey Rept. K_3, p. 25, 38.

C. K. Graeber and R. M. Foose, 1942, Pennsylvania Geol. Survey, 4th ser., Topog. and Geol. Atlas 54, p. 50. Sandstone between Clarion coals and Brookville coal in Clarion formation. Thickness 5 to 25 feet thick. Not always present, in which case the horizon is shale or sandy shale. In some areas, cuts out part or all of Brookville coal. Area of report is Brookville quadrangle.

Wilber Stout, Karl Ver Steeg and G. F. Lamb, 1944, Ohio Geol. Survey, 4th ser., Bull. 44, chart facing p. 108. Generalized section of Ohio lists Clarion sandstone below Canary ore and above Winters coal.

R. L. Nace and P. P. Bieber, 1958, West Virginia Geol. Survey Bull. 14, p. 22. Clarion sandstone listed with recognizable members of Allegheny formation in Harrison County. Occurs above Clarion coal and below Vanport limestone.

E. G. Williams, 1960, Jour. Paleontology, v. 34, no. 5, p. 910 (fig. 2). As shown on generalized section of Allegheny group, Clarion formation includes (ascending) Clarion coals, Clarion sandstone, Vanport limestone, and Lower Kittanning sandstone.

Name derived from Clarion, Clarion County, Pa.

Clarion shale and (or) sandstone

See Clarion cyclothem.

Clarita Limestone

Oligocene: Panamá.

Karl Sapper, 1937, Mittelamerika, Handbuch der regionalen Geologie: Heidelberg, v. 8, Abt. 4a, no. 29, p. 133, 134 (correlation chart). Underlies Arusa formation. Middle Oligocene.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 332. Undefined name. Oligocene. Note on derivation of name.

Río Clarita is small stream about 30 kilometers east southeast of El Real de Santa Maria, in Darién area.

Clarita Member (of Chimneyhill Limestone)

Middle(?) Silurian: South-central Oklahoma.

T. W. Amsden, 1957, Oklahoma Geol. Survey Circ. 44, p. 6 (fig. 3), 19–25, fig 4; 1960, Oklahoma Geol. Survey Bull. 84, pt. 6, p. 52–67. Name proposed to replace Maxwell's (1936) preoccupied name Dillard. Fossiliferous limestone ranging from fine calcilutite to coarse calcarenite. Most common facies is calcilutite. Thickness varies; commonly less than 20 feet; maximum thickness 45 feet (on Lawrence uplift). Unconformably overlies Cochrane; base of Clarita marked by a few inches of shale or shaly limestone. Unconformably underlies Hunton marlstone; at some places it is the Henryhouse and at other places the Haragan that overlies the Clarita.

Type locality: About 3 miles west of Clarita, Coal County, in vicinity of old Hunton townsite NW¼ sec. 8, T. 1 S., R. 8 E. This is not same as type locality designated for the Dillard.

Clark Formation[1]

Pennsylvanian: Southern West Virginia and southwestern Virginia.

Original reference: M. R. Campbell, 1896, U.S. Geol. Survey Geol. Atlas, Folio 26, p. 3.

Named for Clark Gap, in Flat Top Mountain, Mercer County, W. Va.

Clark Canyon Lavas

Tertiary, upper, or Pleistocene: Southwestern Montana.

Robert Scholten, K. A. Keenmon, and W. O. Kupsch, 1955, Geol. Soc. America Bull., v. 66, no. 4, p. 377, pl. 1. Name applied to sheet of dense, aphanitic basaltic lava.

Crops out along Clark Canyon, near Armstead, Beaverhead County.

†Clark County littorals[1]

Upper Cretaceous (Gulf Series): Southwestern Arkansas.

Original reference: R. T. Hill, 1888, Arkansas Geol. Survey Ann. Rept. 1888, v. 2, p. 79–83.

Named for exposures in Clark County.

†Clark Fork Beds[1]

Clark Fork Beds or Member (of Polecat Bench Formation)

Paleocene: North-central Wyoming.

Original reference: W. Granger, 1914, Am. Mus. Nat. History Bull., v. 33, p. 204.

G. L. Jepson, 1940, Am. Philos. Soc. Proc., v. 83, no. 2, p. 237–238. Uppermost unit of Polecat Bench formation (new). Occurs 3,000 to 3,500 feet above base of formation. Overlies Silver Coulee beds (or member); underlies Eocene Gray Bull beds. Clark Fork fauna appears in uppermost 500 feet of formation and seems to be increasingly abundant toward top of Clark Fork beds.

F. B. Van Houten, 1944, Geol. Soc. America Bull., v. 55, no. 2, p. 178, pl. 2. Beds underlie Willwood formation (new).

Named for Clark Fork basin.

Clarkforkian 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 the Clark Fork member (and faunal zone) of the Polecat Bench formation, type locality, scarp forming divide between Bighorn and Clark Fork basins and exposures near its base, Park County, Wyoming. Includes the interval between the Tiffanian (Paleocene) and Wasatchian (Eocene) ages. Report defines 18 provincial time terms, based on mammal-bearing units, for the North American continental Tertiary. [For sequence see under Puercan.]

Clark Island Granite

Age not stated: Southern Maine.

F. Chayes, 1952, Jour. Geology, v. 60, no. 3, p. 215–217, 218, 220, 225, 253. Discussion of finer grained calcalkaline granites of New England. Detailed petrographic description given of Clark Island granite.

Specimens collected at Clark Island, Knox County.

Clark Peak Schist[1]

Paleozoic and Triassic(?): Southeastern Alaska.

Original reference: G. C. Martin, 1926, U.S. Geol. Survey Bull. 776, p. 93, 94, 247.

Exposed in Juneau district. Named for Clark Peak, Juneau district.

Clark Reservation Member (of Manlius Limestone)

Clark Reservation Limestone[1] (in Manlius Group)

Lower Devonian: Central New York.

Original reference: Burnett Smith, 1929, New York State Mus. Bull. 281, p. 26, 27, 30–35.

G. H. Davis 3d, 1953, New York State Mus. Circ. 35, p. 10. Termed a member of Manlius limestone.

L. V. Rickard, 1955, New York State Geol. Assoc. Guidebook 27th Ann. Mtg., p. 2 (columnar section), 4–5. Jamesville limestone and Clark Reservation limestone grouped under heading of transitional beds between Manlius group below and Helderberg group above.

Type section: In cliff south of lake which is in Clark Reservation State Park, west of Jamesville, Onondaga County.

Clarksburg Fire Clay Shale (in Conemaugh Formation)[1]

Clarksburg underclay member

Pennsylvanian: Northern West Virginia and eastern Ohio

Original reference: R. V. Hennen, 1912, West Virginia Geol. Survey Rept. Doddridge and Harrison Counties, p. 236.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 94 (table 11), 152. Member of Little Clarksburg cyclothem in report on Athens County. Light- to dark-gray clay or clay shale. Commonly massive and may be calcareous, micaceous, silty, and sandy. Maximum thickness less than 3 feet; average 10 inches. Associated with some development of Little Clarksburg coal, above, and (or) redbed, below. Conemaugh series.

Named for association with Little Clarksburg coal.

Clarksburg Limestone Member (of Conemaugh Formation)[1]

Clarksburg limestone member

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

Original reference: I. C. White, 1891, U.S. Geol. Survey Bull. 65, p. 88.

R. E. Lamborn, 1951, Ohio Geol. Survey, 4th ser., Bull. 49, p. 33; D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 59–60, geol. map. Reports refer to unit as Clarksburg limestone or limestone member of Conemaugh series.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 94 (table 11), 152. Member of Little Clarksburg cyclothem in report on Athens County. Thickness 6 inches to 10 feet; average 4½ feet. Above Clarksburg redbed member and below Clarksburg underclay member. In type area, 20 to 30 feet thick, directly underlies Little Clarksburg coal, and separated from Morgantown sandstone below by 25 to 40 feet of soft shales. Conemaugh series.

Well exposed along bed of Elk and West Fork River, in vicinity of Clarksburg, Harrison County, W. Va.

Clarksburg Red Shale (in Conemaugh Formation)[1]

Clarksburg redbed member

Pennsylvanian: West Virginia and southwestern Pennsylvania.

Original reference: R. V. Hennen, 1912, West Virginia Geol. Survey Rept. Doddridge and Harrison Counties, p. 240.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 94 (table 11), 152. Redbed member of Little Clarksburg cyclothem in report on Athens County. The member is one of the rather thick and conspicuous redbeds that locally more or less unite to fill interval between Ames limestone and Connellsville sandstone and even up to Pittsburgh coal. Thicknesses range from less than 5 feet to more than 32 feet. Below Clarksburg limestone and above Morgantown sandstone and shale member. Conemaugh series.

Named for Clarksburg, Harrison County, W. Va.

Clarksburg Volcanics[1] Member (of Michigamme Slate)

Precambrian (Animikie Series): Northwestern Michigan.

Original reference: C. R. Van Hise and W. S. Bayley, 1895, U.S. Geol. Survey 15th Ann. Rept., p. 604.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 36. Lower part of Michigamme slate in Marquette district, includes Bijiki iron-formation, Clarksburg volcanics, and Greenwood iron-formation members. Included in Animikie series.

Named for exposures east and west from Clarksburg, Marquette County.

Clarks Mill Beds[1]

Lower Devonian: Central Pennsylvania.

Original reference: E. W. Claypole, 1885, Pennsylvania 2d Geol. Survey Rept. F_2, p. 59–62, 181–184.

Exposed at Clark's Mill, Centre Township, Perry County.

Clarks Spring Member (of Secret Canyon Shale)

Middle Cambrian: Central Nevada.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 14–16, pl. 2. Thin-bedded limestone with prominent yellow or red argillaceous partings. The thin limestone bands are commonly one-fourth to one-half inch thick and rarely exceed 2 inches in thickness. Limestone is fined grained, silty, and blue, contrasting markedly with the yellow, or more rarely, red clay partings, which range from one-eighth to one-fourth inch thick. Locally mottled with yellow or red patches. Thickness probably 425 to 450 feet. Contacts between Clarks Spring member and lower shale member below and Hamburg dolomite above are gradational.

Type locality: Especially good exposures of the member provided by roadcuts in upper New York Canyon, just north of Clarks Spring, from which the member takes its name, Eureka mining district, Eureka County.

Clarkston Gravels, deposits

Clarkston Stage

Pleistocene (pre-Wisconsin): Eastern Washington and western Idaho.

R. L. Lupher, 1944, Geol. Soc. America Bull., v. 55, no. 12, p. 1433–1455. Stream and lake deposits older than scabland-Touchet stage [of Snake River Canyon] are well developed in Lewiston-Clarkston region about 100 miles above mouth or Snake River. Immediately southwest of Clarkston, an abandoned course of Snake River is filled with gravel to depth of at least 425 feet. The Clarkston gravels, except near canyon sides and in local tributary canyons, are composed of nearly equal amounts of basalt and pre-Tertiary igneous and metamorphic rocks. Occasional large angular erratics imbedded in stream gravels indicate that Clarkston fill accumulated during a glacial stage. The Clarkston stage is probably pre-Wisconsin.

R. L. Lupher, 1945, Jour. Geology, v. 53, no. 5, p. 337–348. Clarkston stage defined as an episode of proglacial aggradation, especially time during which Clarkston deposits accumulated. Followed earlier Pleistocene deposition, deformation, and dissection but antedated Wisconsin stage. Stream gravels (Clarkston) accumulated to depth of more than 400 feet in Snake River Canyon and in lower parts of most tributary canyons.

Type area: Center of area is at Clarkston, Wash.

Clarksville Member (of Waynesville Formation)

Clarksville division (in Richmond Group)[1]

Upper Ordovician: North-central Kentucky and southwestern Ohio.

Original reference: A. F. Foerste, 1909, Denison Univ. Sci. Lab. Bull. 14, p. 292.

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 Waynesville formation. Underlies Blanchester member; overlies Fort Ancient member.

Named for Clarksville, Clinton County, Ohio.

Clarno Formation[1]

Eocene: Central northern Oregon.

Original references: J. C. Merriam, 1901, Geol. Soc. America Bull., v. 12, p. 496–497; 1901, California Univ. Pub., Bull. Dept. Geol., v. 2, no. 9, p. 285.

W. D. Wilkinson, 1939, Geologic map of the Round Mountain quadrangle, Oregon (1:96,000): Oregon Dept. Geology and Mineral Industries. Underlies John Day formation. Stratigraphic position and presence of fossil leaves indicate Eocene age.

A. C. Waters and others, 1951, U.S. Geol. Survey Bull. 969–E, p. 111–115, pl. 21. Oldest rocks in Horse Heaven district are andesites, tuffs, and tuffaceous sediments that constitute a part of Eocene Clarno formation. Within area the Clarno appears at surface chiefly along a strip about 4 miles long and 1½ to 2 miles wide lying between Cherry Creek and Horse Heaven Mountain. In central and western part of area, it is buried beneath andesite flows and rhyolite volcanoes that make up the higher ridges. In southern part of area, erosion has cut deeply enough to reveal large patches of Clarno rocks. Uptilted beds between southeastern corner and northern edge of area are 5,800 feet thick; base and top not exposed; nearly all measured units vary greatly in thickness along strike. Subdivided into four units. Unit 1, the oldest, consists of andesite flows interbedded with layers of clay; thickness about 600 feet. Unit 2 consists of about 1,350 feet of tuffs and a few andesite flows. Unit 3 about 1,700 feet thick. Unit 4 consists of white coarse-grained tuffs and sandy tuffs that are largely rhyolitic in composition; thickness at least 2,100 feet, top not exposed.

Typically exposed at Clarno's Ferry, on the John Day, east of Antelope near town of Fossil, on Cherry Creek and Burnt Ranch.

Claron Limestone[1] or **Formation**

Eocene(?): Southwestern Utah.

Original reference: C. K. Leith and E. C. Harder, 1908, U.S. Geol. Survey Bull. 338, p. 41.

E. F. Cook, 1952, Utah Geol. Soc. Guidebook 7, p. 96. In Pine Valley Mountains, Washington County, overlies Kaiparowits formation. Forms pink band 460 feet thick, consisting largely of lacustrine limestones with iron-stained basal conglomerate 30 to 80 feet thick. Eastward overlies successively older formations until it rests directly on Navajo sandstone.

J. H. Mackin, 1954, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–14. Claron formation consists of conglomerate, red and gray sandstone and siltstone, and pink and white limestone; aggregate thickness about 1,400 feet in Granite Mountain area. Essentially identical in lithology with, and probably equivalent to, Eocene Wasatch formation at Cedar Breaks (Pink Cliffs) in Colorado Plateau. Overlies Iron Springs formation which replaces Pinto sandstone abandoned in area. Conformably underlies sequence of lava flows and pyroclastic rocks. Eocene(?).

E. F. Cook, 1957, Utah Geol. and Mineralog. Survey Bull. 58, p. 16 (fig. 2a), 37–38. Formation consists of as much as 1,500 feet of fluvial and lacustrine sediments. In Pine Valley Mountains, underlies Quichapa group (new) with disconformity; overlies Kaiparowits formation; in some areas, appears to grade into the Kaiparowits, but in other places an erosion surface is present at base of Claron; where the unconformity is angular, basal Claron cuts sharply across a surface of low relief developed on truncated formations down to Navajo sandstone. Three-fold division: an upper white limestone and calcareous marl; pink calcareous sandstone; and basal pink conglomerate. Thickness 0 to 1,000 feet; average 500 feet. Upper Cretaceous(?).

J. H. Mackin, 1960, Am. Jour. Sci., v. 258, no. 2, p. 90 (table 1), 100–103. Underlies Needles Range formation (new) and in some areas Isom formation (new).

C. M. Tschanz, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B295. Studies indicate that lacustrine limestone near top of Claron is Oligocene or earliest Miocene, instead of Eocene as formerly believed.

E. F. Cook, 1960, Utah Geol. and Mineralog. Survey Bull. 70, p. 18 (fig. 1), 32–36. Although Claron (Wasatch) formation is listed as Cenozoic, the lower part of it may be Late Cretaceous. No evidence by which precise age of Claron in southwest Utah can be determined. The Claron unconformably overlies formations from Kaiparowits down to Navajo sandstone; it is overlain conformably or accordantly by Quichapa formation. lower member of which has zircon age of 28 million years. Age range could be very Late Cretaceous to Oligocene.

Occurs at and around Mount Claron, Iron Springs region, Iron County.

Clarysville Sandstone (in Conemaugh Formation)[1]

Pennsylvanian: Western Maryland and northeastern West Virginia.

Original reference: C. K. Swartz, W. A. Price, and H. Bassler, 1919, Geol. Soc. America Bull., v. 30, p. 573.

Exposed in Hoffman Drainage Tunnel at Clarysville, Allegany County, Md.

Claverack Conglomerate (in Schodack Formation)

Cambrian: Eastern New York.

G. H. Chadwick, 1946, Am. Jour. Sci., v. 244, no. 8, p. 585. Name given to limestone conglomerate in upper part of Schodack formation. Has been mistakenly termed Burden conglomerate.

Type locality: Ham's Mills [Catskill quadrangle].

Clay City Siltstone Member (of New Providence Formation)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 77, 122, 123–124. Thin persistent calcareous siltstone 1½ to 5 feet above base of New Providence formation, Stanton facies (new). Thickness 6 inches to 3 feet. In some areas, overlies Henley shale member.

Well exposed along secondary road, one-half mile northeast of Clay City, Powell County.

Clay Creek Limestone[1] Member (of Kanwaka Shale)

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 about 1 foot 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. Overlies Jackson Park shale member; underlies Stull shale member.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 62 (fig. 23), 67. Dark-blue to bluish-gray limestone, commonly massive and dense; fusulines locally abundant. Thickness as much as 5 feet. Underlies Stull shale member; overlies Jackson Park shale member.

Type locality: Clay Creek, about 1 mile west of Atchison, Atchison County, Kans. Persistent as far southward as Osage County, Kans.

Claymont 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. Pisolitic sandy clay. At type locality, 4 to 6½ feet thick and is about 165 feet above base of formation. Clay is underlain gradationally by coarse-grained pebbly quartz-anauxite mudstone and grades upward into coarse-grained quartzose sandstone also containing some anauxite.

Type locality: On Claymont property of Gladding McBean Co. located near divide between Gypsum Creek and Sierra Canyon, northwestern Santa Ana Mountains, Orange County.

Claypole Hills Sandstone (in McLeansboro Formation)

Pennsylvanian: Southeastern Illinois and southwestern Indiana.

J. A. Culbertson, 1932, The paleontology and stratigraphy of the Pennsylvanian strata between Caseyville, Kentucky, and Vincennes, Indiana: Urbana, Ill., Univ. Illinois, Abs. Thesis, p. 7. Coarse massive sandstone. Overlies St. Wendells limestone; underlies Friendsville coal.

Type locality and derivation of name not stated.

Claypool Formation[1]

Pennsylvanian: Central southern Oklahoma.

Original reference: J. R. Bunn, 1930, Oklahoma Geol. Survey Bull. 40PP, p. 9.

Covers large area to south and east of Claypool, Jefferson County.

Clay Spur Bentonite Bed (in Mowry Shale)[1]

Clay Spur Bed (in Belle Fourche Shale)

Lower Cretaceous: Northeastern Wyoming, southeastern Montana, and western South Dakota.

Original reference: W. W. Rubey, 1930, U.S. Geol. Survey Prof. Paper 165, p. 4.

M. M. Knechtel and S. H. Patterson, 1955, U.S. Geol. Survey Mineral Inv. Field Studies Map MF-36. Clay Spur bentonite bed is one of uppermost strata of Mowry shale. Bed is present at or near surface almost everywhere in vicinity of contact between Mowry and Belle Fourche shales as mapped in this report [northern Black Hills district, Montana, Wyoming, and South Dakota]. Thickness as much as 7 feet, but commonly 2 to 4 feet. Although thickness in a few places is less than 2 inches, no outcrop of uppermost Mowry strata has yet been noted at which this bed is missing. Lower Cretaceous.

86–87. Clay Spur bentonite bed occurs in Belle Fourche-type shale; seems more logical to include it in the Belle Fourche than in the Mowry.

Named for exposures near Clay Spur, sec. 30, T. 47 N., R. 63 W., Weston County, Wyo.

Claysville Limestone Member (of Greene Formation)[1]

Permian: Western Pennsylvania.

Original reference: W. T. Griswold and M. J. Munn, 1907, U.S. Geol. Survey Bull. 318, p. 78.

Named from town in Donegal Township, Washington County.

Clayton Basalts

Quaternary: Northeastern New Mexico.

Helen Stobbe, 1948, (abs.), Geol. Soc. America Bull., v. 59, no. 12, pt. 2, p. 1354. Predominantly olivine basalts but include olivine basalts with quartz inclusions, analcime basanite, nepheline basalts, haüyne basalt, and olivine-free basalts.

R. F. Collins, 1949, Geol. Soc. America Bull., v. 60, no. 6, p. 1021 (table 2), 1023, 1028–1030, pl. 1; H. R. Stobbe, 1949, Geol. Soc. America Bull., v. 60, no. 6, p. 1059. At least 75 percent, by estimate, are medium-gray to black, fine- to medium-grained, slightly vesicular olivine basalts occurring as surface flows and scoria cones. Most vesicular flows weather to a red brown; less vesicular flow rock tends to remain black. Age, 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). Flows range from 10 to 50 feet in thickness and average about 20 feet.

Brewster Baldwin and W. R. Muehlberger, 1959, New Mexico Bur. Mines Mineral Resources Bull. 63, p. 71–72, 75, 77–79, 115–116, 118, 126–127, 133–135, 137. Undifferentiated Clayton basalt caps broad mesas throughout central Union County. Individual sheets were named for ease of discussion although they are petrographically nearly identical: Carrizo, Herringa, Clayton Mesa (original type Clayton basalt of Collins), Apache, Seneca, and Gap flows.

Named after outcrops on large Folsom-Clayton Mesa near town of Clayton, Union County. Also occur in Colfax County.

Clayton Clay[1]

Pleistocene, upper: Connecticut.

Original reference: R. F. Flint, 1933, Geol. Soc. America Bull., v. 44, no. 5, p. 965–987.

Exposed at Clayton, Hartford County.

Clayton Formation (in Midway Group)[1]

Paleocene: Southern Alabama, southwestern Georgia, northeastern Mississippi, southeastern Missouri, and southern Tennessee.

Original reference: D. W. Langdon, 1891, Geol. Soc. America Bull., v. 2, p. 589–605.

J. M. Weller, 1940, Illinois Geol. Survey Rept. Inv. 71, p. 43, 44. Exposed at a few places in southern Illinois but probably generally present at base of Tertiary sediments. Characteristically a more or less marly glauconitic sand generally about 5 to 8 feet thick. Formerly considered

J. D. Haun, 1958, Wyoming Geol. Assoc. Guidebook 13th Ann. Field Conf., p.

member of Porters Creek formation. Overlies McNairy formation; underlies Porters Creek clay.

W. E. Belt and others, 1945, Geologic map of Mississippi (1:500,000): Mississippi Geol. Survey. Age shown as Paleocene.

F. S. MacNeil, 1946, U.S. Geol. Survey Strategic Minerals Inv. Prelim. Rept. 3–195, p. 6–10. East of Butler County, Ala., name Clayton is used for all of Midway beds. In Butler County and westward in Alabama and Mississippi, it is used only for beds below Porters Creek clay. In Butler and Wilcox Counties, includes McBryde limestone member and Pine Barren member (both new). In western Alabama and Mississippi, the Clayton is represented by single unit, Chalybeate limestone member (new). In western Alabama and east-central Mississippi, the Clayton thins to a few feet and may be overlapped by Porters Creek clay in places. From Chickasaw County northward in Mississippi, formation thickens and in northern Mississippi is probably 60 feet thick. At Clayton, Ala., section consists of lower zone of about 35 feet of sand and limestone, grading from noncalcareous, *Halymenites*-bearing sand at base, through coarse sandy limestone to sand-free hard white limestone at top, and an upper zone of about 15 feet of hackly gray clay. Formation thickens eastward to nearly 130 feet in Chattahoochee River, where upper clay is represented by smooth-textured argillaceous limestone. In northern Mississippi, includes a bed of calcareous siltstone formerly regarded by Mississippi Geological Survey as base of Porters Creek. This revision is made to make base of the clay consistently the base of the Porters Creek in Mississippi and also because this siltstone carries the large nautiloid *Hercoglossa ulrichi*, a marker for upper part of Clayton in central Alabama. Underlies Porters Creek clay.

F. S. MacNeil, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 29. Correlation chart shows Clayton in Mississippi, Alabama, and Georgia. In Georgia, undifferentiated; in Alabama, includes Pine Barren member below and McBryde limestone member above; in Mississippi includes Chalybeate limestone member. Underlies and interfingers with Porters Creek clay.

L. W. Stephenson, 1955, U.S. Geol. Survey Prof. Paper 274–E, p. 98, 100, 101. In Stoddard County, Mo., underlies Porters Creek clay and unconformably overlies Owl Creek formation. Thickness 5 to 10 feet. In Pulaski County, Ill., unconformably overlies McNairy sand.

Type locality: Cut on Central Georgia Railroad about 1 mile east of Clayton, Barbour County, Ala.

Clayton Sandstone (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. 298, 383.

Type locality: On waters of Griffith Creek, on road that descends into this valley, 1.2 miles northeast of Clayton, Summers County. Also occurs in Mercer and Monroe Counties ,W. Va., and in Giles County, Va.

Clayton Shale (in Bluefield Formation)[1]

Mississippian: Southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 298, 384.

Type locality: On waters of Griffith Creek, on road that descends into this valley 1.2 miles northeast of Clayton, Summers County. Also occurs in Mercer and Monroe Counties.

Clayton Mesa 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. 1, 12, 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.

Present in eastern Union County.

†Clayton Peak Quartz Diorite[1]

Upper Cretaceous or Tertiary, lower: Northern central Utah.

Original references: S. F. Emmons, 1903, Am. Jour. Sci., 4th, v. 16, p. 141–147; F. F. Hintze, Jr., 1913, New York Acad. Sci. Annals, v. 23, p. 85–143.

In Park City and adjacent districts, Summit County.

Claytonville Dolomite[1] (in Whitehorse Group)

Permian (Guadalupe Series): Central northern Texas.

Original reference: M. G. Cheney, 1929, Texas Univ. Bull. 2913, p. 26, pl. 1.

T. S. Jones, 1953. Stratigraphy of the Permian Basin of west Texas: West Texas Geol. Soc. p. 30 (fig. 9). Shown on chart as occurring near top of Whitehorse group.

Caps escarpment 2 miles west of Sweetwater, Nolan County; also at town of Claytonville, Fisher County.

Claytonville Gypsum (in Double Mountain Group)[1]

Permian: Central northern Texas.

Original reference: H. T. Morley, 1929, Texas Bur. Econ. Geology, geol. map of Fisher County.

Fisher County.

Clear Branch Sandstone[1]

Lower Devonian: Northern central Alabama.

Original references: C. Butts, 1927, Am. Jour. Sci., 5th, v. 14, p. 366, 367; 1927, U.S. Geol. Survey Geol. Atlas, Folio 221.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Shown on correlation chart below Frog Mountain sandstone.

Named for exposures at Clear Branch Gap through Red Mountain in Jefferson County, 5 miles south-southwest of Bessemer, Jefferson County.

Clear Creek Gneiss[1]

Precambrian: Central northern Colorado.

Original references: J. Underhill, 1906, Colorado Univ. Studies, v. 3, no. 4, p. 270; 1906, Colorado Sci. Soc. Proc., v. 8, p. 103–122.

Occurs along Clear Creek, Jefferson and Clear Creek Counties.

Clear Creek Gravels

See **Moncrief Member** (of Wasatch Formation)

Clear Creek Greenstone[1]

Mississippian(?): Northwestern California.

Original reference: O. H. Hershey, 1901, Am. Geologist, v. 27, p. 226, 233, 238.

Probably named for exposures on or near Clear Creek, Shasta County.

Clear Creek Limestone[1] or Chert

Clear Creek Chert (in Ulsterian Group)

Lower or Middle Devonian: Southwestern Illinois and southeastern Missouri.

Original reference: A. H. Worthen, 1866, Illinois Geol. Survey, v. 1, p. 126–129.

J. M. Weller, 1940, *in* J. M. Weller and G. E. Ekblaw, Illinois Geol. Survey Rept. Inv. 70, p. 7, 14–15; J. M. Weller, 1940, Illinois Geol. Survey Rept. Inv. 71, p. 24. Described in Illinois as Clear Creek chert in Ulsterian group; most extensively exposed and probably thickest of Devonian formations. Consists principally of novaculitic chert with variable amounts of fine-grained siliceous limestone. Thickness not accurately measured; not less than 300 feet and may attain maximum considerably in excess of that figure. Unconformably overlies Backbone limestone; underlies Dutch Creek sandstone. Grassy Knob and Clear Creek cherts are so similar they are difficult to differentiate except where intervening Backbone limestone or its cherty equivalent can be identified.

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.

Carey Croneis, 1944, Illinois Geol. Survey Bull. 68, p. 103 (chart), 114–115. Described in southeastern Missouri as Clear Creek chert; outcrops restricted to Perry County; largest exposure is between Wittenberg and mouth of Apple Creek where syncline carries the Bailey below the surface. Consists of white to buff to chrome yellow thin-bedded chert with brown to reddish ferruginous bands and some concretionary limonitic masses; strata range from about 1 inch to 1 foot in thickness and include thin interbedded layers of deeply weathered siliceous limestone and ferruginous clay. Thickness about 300 feet. At most places, superjacent strata have been largely removed either by erosion or through faulting. Thus, contact with Dutch Creek and Grand Tower beds cannot be studied satisfactorily; top of formation can be determined approximately in some areas by position of residual sandstone blocks probably marking the Dutch Creek beds that separate the Clear Creek from overlying Grand Tower formation; some older strata may have been included in Clear Creek and in places it may have been mistaken for Bailey and Grassy Knob strata. Disconformably overlies Bailey formation.

Named from exposures on Clear Creek, Union County, Ill.

†Clear Creek Limestone Member (of Graford Formation)[1]

Pennsylvanian: Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 387, 392.

C. O. Nickell *in* Wallace Lee and others, 1938, Texas Univ. Bur. Econ. Geology Pub. 3801, p. 97, 105. The group of limestones in upper part of Winchell member of Graford includes the Clear Creek limestone of Drake (1893) and Plummer and Moore (1921, Texas Univ. Bull. 2132) plus some higher beds heretofore included in Placid shale member of Plummer and Moore.

Named for Clear Creek, Brown County.

†Clear Creek Sandstone (in Cherokee Shale)[1]

Pennsylvanian: Western Missouri.

Original reference: G. C. Broadhead, 1874, Missouri Geol. Survey, v. 1, p. 57–61, 69, 100.

Named for exposures on Clear Creek, Vernon County.

Clear Creek Series[1]

Mississippian(?): Northwestern California.

Original reference: O. H. Hershey, 1903, Am. Geologist, v. 31, p. 231–245.

Southern part of Klamath Mountains.

Clear Creek Volcanic Series[1]

Triassic(?): Northwestern California.

Original reference: O. H. Hershey, 1904, Am. Geologist, v. 33, p. 248–256, 347–360.

Trinity and Shasta Counties.

†Clear Fork Group[1]

Pennsylvanian: Western Missouri.

Original reference: G. C. Broadhead, 1873, Missouri Geol. Survey Prelim. Rept. on Iron Ores, pt. 2, p. 169, 170.

Named for exposures on Clear Fork, 6 miles southwest of Kansas City.

Clear Fork Group[1]

Clear Fork Formation[1]

Lower Permian (Leonard Series): Central and central northern Texas.

Original reference: E. T. Dumble and W. F. Cummins, 1890, Texas Geol. Survey 1st Ann. Rept., p. 188, pl. 3.

R. I. Dickey, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 42. Term Wichita group (restricted) used for beds of Leonard age between base of Clear Fork group and top of Wolfcamp series. Cheney proposes to abandon term Wichita. Clear Fork group comprises (ascending) Arroyo formation about 250 feet; Vale formation, with Bullwagon dolomite at top and about 360 feet of red shale below; and Choza formation.

L. R. Page and J. R. Adams, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 57. Underlies San Andres group.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 97. Clear Fork group includes (ascending) Arroyo, Vale, and Choza formations. Overlies Lueders group; underlies El Reno (San Andres) group. Leonard.

Robert Roth, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 8, p. 1412; 1945, Geol. Soc. America Bull., v. 56, no. 9, p. 898, 905. Overlies Wichita group; underlies Pease River group.

C. O. Dunbar and others, 1960, Geol. Soc. America Bull., v. 71, no. 12, pt. 1, chart 7 (column 74). Correlation chart shows Clear Fork group in Texas comprises (ascending) Arroyo, Vale, and Choza formations;

underlies Pease River group; overlies Wichita group. Name not used in Oklahoma. Leonardian.

Probably named for Clear Fork of Brazos River, Jones and Shakelford Counties, Tex.

Clear Lake Sediments[1]

Pleistocene: Northern California.

Original reference: W. H. Dall and G. D. Harris, 1892, U.S. Geol. Survey Bull. 84, p. 201–202.

Lake County.

Clear Lake Volcanic series

Quaternary: Northern California.

J. C. Brice, 1953, California Div. Mines Bull. 166, p. 12 (fig. 2), 34–35. Shown on columnar section as comprising (ascending) rhyolite tuff, olivine basalt, Perini Hill flows (new), Boggs Mountain flows (new), Cobb Mountain volcanics (new), pyroxene dacite, obsidian, and Konocti volcanics (new). Age relations of individual units are imperfectly known because some units are isolated and contacts of contiguous flows are commonly obscured by sliding. Rhyolite tuffs and olivine basalt flows are intercalated with uppermost Cache beds; apparently younger than Sonoma volcanics (of middle or upper Pliocene age).

Report covers area of Lower Lake quadrangle, in Coast Ranges, about 70 miles north of San Francisco.

Cleary Coal Member (of Menefee Formation)

Upper Cretaceous: Northwestern New Mexico.

E. C. Beaumont, C. H. Dane, and J. D. Sears, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2149, 2157, fig. 3. Proposed for the beds formerly included in upper part of the Gibson coal member of Mesaverde formation which overlie the Point Lookout sandstone in southern part of San Juan Basin. Coal-bearing sandstone and shale unit, 250 to 300 feet thick.

Named from abandoned Cleary mine in SW¼ sec. 31, T. 19 N., R. 1 W., San Juan Basin; 2 miles west of La Ventana.

Cle Elum Formation

Cretaceous: Central Washington.

R. L. Lupher, 1944, Washington Div. Geology Rept. Inv. 11, p. 7, 12–15, pl. 2. Conglomerate, breccia, mudstone, and shale; arenaceous deposits rare; conglomerates predominate in east and argillaceous materials in west. Commonly less than 15 feet thick. Underlies Swauk formation; overlies a basement composed of peridotite and serpentine.

Occurs as series of restricted exposures that extend from upper Peshastin Creek near Blewett Pass westward to Cle Elum River Canyon, Chelan and Kittitas Counties.

Cleetwood Dacite Flow, Lava

Cleetwood Cove Dacite Flow, Lava

Pleistocene to Recent: Southwestern Oregon.

J. S. Diller and H. B. Patton, 1902, U.S. Geol. Survey Prof. Paper 3, p. 38–39. Cleetwood Cove dacite is one of final flows of Mount Mazama. Lava is a black, yellow, or brown glass and is broken and rough on top. Fills an old valley at head of Cleetwood Cove; has thickness of over

300 feet in middle and tapers to thin edge on both sides. Extends from rim of Crater Lake northeastward for nearly 3 miles where it disappears beneath the plain of pumice and glacial material. Forms crest of rim for nearly a mile, extending upon both sides of Cleetwood Cove, where it makes prominent cliffs. Upper part of sides of Cleetwood Cove is a cliff of dacite, beneath which is a layer of pumice succeeded downward by 350 feet or more of exposed andesitic flows. These subdacite lavas are continuous around head of cove, but are not exposed. At head of cove, they are covered by dacite which flowed down inner slope of rim from caved-in tunnel of Rugged Crest to lake. Some distance above lake, upon both sides, the flow and platy structure of the dacite overlying andesite dip toward central stream, which in places dips toward lake at angle of 35° and lies parallel to present surface. [See Sun Creek Dacite Flow.]

J. E. Allen, 1936, Jour. Geology, v. 44, no. 8, p. 741–744. Diller believed that Cleetwood flow was in process of extrusion at time of collapse of Mount Mazama. The still motile lava poured back down into newly formed caldera, producing structure he labeled "backflow." This feature was used as evidence for theory of collapse of Mount Mazama as opposed to explosion. Suggested herein that the "backflow" is simply filling of the inclined vent of Cleetwood flow, which apparently came up along an east-west fissure dipping steeply southward into prehistoric mountain and which was subsequently exposed in crater wall.

Howel Williams, 1942, Carnegie Inst. Washington Pub. 540, p. 50–52, 62, 63, 120, 138, pl. 1. In sections northwest of the Wineglass, the Wineglass welded tuff overlies Cleetwood lava (flow).

Cleetwood Cove is on northern rim of Crater Lake.

Clem Creek Sandstone Tongue (of Wann Formation)

Clem Creek Sandstone Member (of Ochelata Formation)[1]

Clem Creek Sandstone Member (of Wann Formation)

Pennsylvanian (Missouri Series): Northeastern Oklahoma.

Original reference: W. B. Emery, 1918, U.S. Geol. Survey Bull. 686–B, p. 2, 3.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 14 (table 1), 15 (fig. 3), 17–18. Member of Wann formation in report on Pawnee County. Overlies "Washington Irving" member or in some places separated from it by as much as 38 feet of silty maroon shale. Underlies an unnamed section of gray shale, the topmost unit of the Wann.

Named for exposures along Clem Creek in northwestern part of T. 23 N., R. 11 E., Osage County.

Clement 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 Hely member (new) and overlying Stillman member (new).

Occurs in Dixon-Oregon area.

Clementsville Limestone Member (of Brodhead Formation)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 76, 160–162, pls. 6, 15. Limestone 10 to 15 feet thick. Included in Liberty facies (new) of formation. At type section, Clementsville underlies a 60-foot unnamed silty shale unit and overlies a 25-foot unnamed shale unit. Stratigraphically above Caney Creek member (new).

Type section: At Clementsville, along State Highway 70 (and adjacent slopes) from Woods Creek valley to upland; base of section one-half mile southeast of Clementsville: top of section one-half mile farther along highway. Named from village in western Casey County, 1 mile from Adair County line.

Cleopatra Quartz Porphyry[1]

Precambrian: Central Arizona.

Original references: L. E. Reber, Jr., 1920, Am. Inst. Mining Engrs. Trans.; J. L. Fearing, Jr., 1926, Econ. Geology, v. 21, p. 757–773.

L. E. Reber, Jr., 1938, Arizona Bur. Mines Bull. 145, Geol. Ser. 12, p. 59, 62. May have been early differentiation product of Bradshaw granite.

Jerome district.

Clermont Group (in Allegheny Formation)[1]

Pennsylvanian: Central northern Pennsylvania.

Original reference: C. A. Ashburner, 1882, Am. Philos. Soc. Proc., v. 19, p. 337–348.

Elk County.

Clermont Limestone (in Allegheny Formation)[1]

Pennsylvanian: Central northern Pennsylvania.

Original reference: C. A. Ashburner, 1880, Pennsylvania 2d Geol. Survey Rept. R, p. 46, 128.

In vicinity of Clermont, McKean County.

Clermont Shale (in Maquoketa Group)[1]

Clermont Shale Member (of Maquoketa Formation)

Upper Ordovician: Northeastern Iowa.

Original reference: S. Calvin, 1906, Iowa Geol. Survey, v. 16, p. 60, 98.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2 (column 50). Shown on correlation chart as shale member of Maquoketa formation. Overlies Elgin shaly limestone member; underlies Fort Atkinson limestone member.

Named for exposures at Clermont, Fayette County.

Cleveland magnafacies[1]

Upper Devonian: Northwestern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 28–29.

W. L. Grossman, 1944, Geol. Soc. America Bull., v. 55, no. 1, p. 46. The complete succession of magnafacies as outlined by Caster for southern New York and northwestern Pennsylvania is not represented in the Genesee group. At Cayuga Lake, except for the Geneseo shale, the group is presumably within the Big Bend magnafacies. Westward, the rock changes to black and dark-gray thin-bedded shales which fit the description of the Cleveland magnafacies of Caster. The Geneseo and Middlesex black shale bands correspond to the Cleveland magnafacies; black shales of the Hamilton, notably the Marcellus, are likewise Cleveland type. If the facies are to be given names and more or less specific boundaries, the Geneseo and Middlesex black shales may be considered tongues extending eastward from the main mass of the Cleveland magnafacies. The Rhinestreet black shale, higher in the Devonian of western New York, may also be considered a tongue of the Cleveland magnafacies.

Name derived from Cleveland shale.

Cleveland Member (of Ohio Shale)

Cleveland Shale[1]

Upper Devonian: Northern Ohio.

Original reference: J. S. Newberry, 1870, Ohio Geol. Survey Rept. Prog. 1869, p. 19, 21.

R. E. Lamborn, C. R. Austin, and Downs Schaaf, 1938, Ohio Geol. Survey, 4th ser., Bull. 39, p. 37; Wilber Stout, Karl Ver Steeg, and G. F. Lamb, 1943, Ohio Geol. Survey, 4th ser., Bull. 44, p. 141. Ohio shale has been divided into three parts: Cleveland shale, Chagrin shale, and Huron shale.

Wallace de Witt, Jr., 1951, Geol. Soc. America Bull., v. 62, no. 11, p. 1352–1353. At type locality, Cleveland member consists of about 60 feet of tough bituminous black shale. Thins eastward to featheredge west of Ohio-Pennsylvania line. Overlies Chagrin shale, and in some areas contact is sharply defined and in others there is transition zone; underlies Bedford shale.

J. F. Pepper, Wallace de Witt, Jr., and D. F. Demarest, 1954, U.S. Geol. Survey Prof. Paper 259, p. 15, 16. In outcrops along Rocky River north of Berea, Ohio, Cleveland member is 100 feet thick. Upper part is typically hard dull-grayish-black shale which weathers to thin chips that are commonly stained rusty reddish brown. Lower part of member, which was called Olmsted member by Cushing (Cushing, Leverett, and Van Horn, 1931, U.S. Geol. Survey Bull. 818), contains, in addition to black shale, many beds of bluish-gray or gray clay shale that range in thickness from an inch to several feet; some gray to brown siltstones; many small nodules of pyrite; and several thin siliceous limestones that are characterized by cone-in-cone structure. Conodont fauna found in upper 25 feet of Cushing's Olmsted member is identical with conodont fauna of the Cleveland (Hass, 1947, Jour. Paleontology, v. 21, no. 2). The Cleveland and Huron members are practically identical in lithologic character, and in Erie and Lorain Counties the contact between these two black shales is drawn arbitrarily below lowest cone-in-cone layer and above uppermost zone containing large septarian concretions.

Named for exposures at Cleveland, Cuyahoga County.

Cleveland Sandstone (in Kanawha Formation)[1]

Pennsylvanian: Northern West Virginia.

Original reference: D. B. Reger, 1916, West Virginia Geol. Survey Rept. Lewis and Gilmer Counties, p. 75, 172.

Crops out along north bank of Little Kanawha River at Cleveland, Webster County.

Cleveland County red lands[1]

Eocene: Southeastern Arkansas.

Original reference: R. T. Hill, 1888, Arkansas Geol. Survey Ann. Rept. 1888, v. 2, p. 58–59.

Named for exposures at O. H. Mark's place, Red Land Township, Cleveland County.

Cleveland Gulch Quartzite Member (of Hopewell Series)

Precambrian (Proterozoic): Central northern New Mexico.

Evan Just, 1937, New Mexico School Mines Bull. 13, p. 13 (table 1), 42, pl. 3. A particularly prominent quartzite in the series. Of sedimentary origin. Interspersed with Picuris basalts and Vallecitos rhyolites.

Exposed between Tusas and Kiawa Mountains, Petaca area, Rio Arriba County.

Clews Fanglomerate

Miocene: Southern California.

F. M. Byers, Jr., 1960, U.S. Geol. Survey Bull. 1089–A, p. 15–18, pls. 1, 2. Consists of lower unit of fine-grained tuffaceous sediments, middle unit of ridge-forming reddish-brown fanglomerate, which volumetrically constitutes about 90 percent of formation, and upper unit of sandstone with included tuff beds. Thickness 560 to 660 feet. Unconformably overlies pre-Tertiary plutonic rocks; wedges out westward between plutonic rocks and Alvord Peak basalt (new); where Alvord Peak is missing, Clews is overlain by Spanish Canyon formation (new). Middle Tertiary, possibly early or middle Miocene.

Type locality: Clews Ridge, southeastern part of Alvord Mountains, San Bernardino County.

†Click series[1]

Precambrian (Llano Series): Central Texas.

Original reference: T. B. Comstock and E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept., p. lvii, 274, pl. 3.

Probably named for Click, Llano County.

Cliff House Sandstone (in Mesaverde Group)[1]

Upper Cretaceous: Southwestern Colorado and northwestern New Mexico.

Original reference: A. J. Collier, 1919, U.S. Geol. Bull. 691–K.

P. T. Hayes and A. D. Zapp, 1955, U.S. Geol. Survey Oil and Gas Inv. Map OM–144. In Barker Dome-Fruitland area, New Mexico, includes (ascending) Barker Dome, Cholla Canyon, Beechatuda and Ute Canyon tongues (all new). Overlies and intertongues with Menefee formation; underlies and intertongues with Lewis shale.

E. C. Beaumont, C. H. Dane, and J. D. Sears, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2158–2159. Nomenclature of Mesaverde group in San Juan Basin, N. Mex., revised. Name Cliff House sandstone replaces Chacra sandstone throughout former extent of that unit.

Named for exposures in canyons above the cliff houses of Mesa Verde National Park, Montezuma County, Colo.

Cliffield Formation

Cliffield Group

Middle Ordovician: Southwestern Virginia and northeastern Tennessee.

B. N. Cooper and C. E. Prouty, 1943, Geol. Soc. America Bull., v. 54, no. 6, p. 823–833, 862–868, 884 (fig. 3), pl. 5. In Tazewell County, the strata embraced by the Chazyan and Black River groups of Butts (1940, Virginia Geol. Survey Bull. 52, pt. 1) are subdivided into (ascending) 29 zones. Name Cliffield is proposed for zones 1 through 9, including the succession from the base of basal clastics to top of second zone of calcilutite. Facies variations whereby lithologically distinctive zones grade locally into a thickness of indistinguishable calcilutites prevent succession herein assigned to the Cliffield from being subdidived into mappable formations. Where various zones are distinct, as in most parts of Tazewell County, five members are recognized (ascending) : Blackford, Five Oaks limestone, Lincolnshire limestone, Ward Cove limestone, and Peery limestone (all new). Maximum thickness 1,142 feet south of St. Clair Station; minimum thickness 345 feet, on northwest side of Thompson Valley. Underlies Benbolt limestone (new) ; contact a disconformity; disconformable upon Beekmantown dolomite; top of Beekmantown is an erosion surface with maximum relief of about 200 feet. As here defined, includes beds which Butts has called Murfreesboro, Mosheim, Lenoir, Holston, and Ottosee.

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 54–71. Cliffield group is used to apply to middle Ordovician formations southeast of Clinch Mountain, in Burkes Garden quadrangle. As thus used, includes Blackford, Five Oaks, Lincolnshire, Effna, Whitesburg, Athens, and Peery formations. Approximately equivalent to Butts' (1940) Mosheim-Lenoir-Holston-Whitesburg-Athens succession of the southeastern belts of Appalachian Valley.

C. E. Prouty, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 7, p. 1145–1160. Cliffield group in southeastern Virginia and northeastern Tennessee includes Blackford, Five Oaks, Lincolnshire, Thompson Valley (new), Ward Cove (restricted), and Peery formations.

Type section: Exposures along Pounding Mill Branch and U.S. Route 19, south of Norfolk and Western underpass; top is exposed at intersection of U.S. Route 19 and County Road 637, and base is exposed along east side of U.S. Route 19 about 50 yards south of highway underpass. Name taken from Cliffield, a store and station along Norfolk and Western Railroad, about 8 miles southwest of North Tazewell, Tazewell County, Va.

†Cliffwood Clays[1]

Upper Cretaceous: Northeastern New Jersey.

Original reference: H. B. Kummel and G. N. Knapp, 1904, New Jersey Geol. Survey, v. 6, p. 166.

Exposed in clay pits about Cliffwood and at Cliffwood Point on south shore of Raritan Bay.

Clifton Formation[1]

Middle Silurian: West-central Tennessee.

Original reference: J. M. Safford and J. B. Killebrew, 1876, Elements of geology of Tennessee, p. 108, 142–146.

Named for exposures at Clifton, Wayne County.

Clifton Forge Sandstone Member (of Keyser Limestone)[1]

Lower Devonian: Central western Virginia and West Virginia.

Original reference: F. M. Swartz, 1929, U.S. Geol. Survey Prof. Paper 158–C, p. 29.

P. H. Price and E. T.Heck, 1939, West Virginia Geol. Survey [Rept.] Greenbrier County, p. 206. Present in Greenbrier County, W. Va.

H. P. Woodward, 1943, West Virginia Geol. Survey, v. 15, p. 38, 42–44. Big Mountain shale member, which maintains its identity into Bath County, Va., is believed to pass literally into lower portion of Clifton Forge sandstone of Alleghany County, Va., and adjacent areas.

F. G. Lesure, 1957, Virginia Polytechnic Inst. Engineering Expt. Sta. Ser. 118, p. 45. Commonly white to medium-light-gray fine-grained porous crossbedded and cross-laminated sandstone; some medium-dark-gray fine-grained argillaceous limestone. Thickness 79 feet in Clifton Forge iron district. Underlies unnamed upper part of Keyser; overlies Tonoloway limestone.

Named for exposures at Clifton Forge, Va.

†Clifty Conglomerate Lentil[1] (in Lee Formation)

Pennsylvanian: Eastern Tennessee.

Original reference: L. C. Glenn, 1925, Tennessee Geol. Survey Bull. 33B, p. 370–371.

White County.

Clifty Limestone[1]

Middle Devonian: Northwestern Arkansas.

Original reference: H. D. Miser, 1916, U.S. Geol. Survey Geol. Atlas, Folio 202.

H. D. Miser, 1944, Illinois Geol. Survey Bull. 68, p. 132, 134 (fig. 27). Sandy compact light-bluish-gray fossiliferous limestone. Maximum thickness 2½ feet. Overlies Penters chert; underlies Sylamore sandstone member of Chattanooga shale.

Named for East Fork of Little Clifty Creek, Eureka Springs quadrangle, Carroll County.

†Clifty Shale[1]

Pennsylvanian: Eastern Tennessee.

Original reference: L. C. Glenn, 1925, Tennessee Geol. Survey Bull. 33B, p 370–371.

Clifty and Bon Air, White County.

Climax Porphyry

Tertiary(?): Colorado.

E. J. Eisenach and Edward Matsen, 1954, Mining Eng., v. 6, no. 3, p. 27; J. W. Vanderwilt and R. U. King, 1955, Mining Eng., v. 7, no. 1, p. 43–44; S. W. Wallace and others, 1960, *in* Guide to the geology of Colorado: Rocky Mountain Assoc. Geologists, p. 238–252. Name applied to porphyry in Climax stock.

Well displayed in Climax mine at Climax, Lake County.

†Clinch Red Shale[1]

Upper Ordovician: Eastern Tennessee.

Original reference: J. M. Safford, 1869, Geology of Tennessee, p. 297, 298.

Named for exposures on Clinch Mountain, Hancock and Hawkins Counties.

Clinch Sandstone[1] **or Quartzite**

Lower and Middle Silurian: Eastern Tennessee, southwestern Virginia, and southern West Virginia.

Original reference: J. M. Safford, 1856, Geological Reconnaissance of Tennessee 1st Rept., p. 157.

R. L. Miller and J. O. Fuller, 1947, U.S. Geol. Survey and Gas Inv. Prelim. Map 76. Sandstone, in Rose Hill district, Lee County, Va., is 257 feet thick and includes Hagan and Poor Valley Ridge members (both new). Overlies Sequatchie formation; underlies Clinton shale.

John Rodgers, 1953, Tennessee Div. Geol. Bull. 58, pt. 1, p. 100–104, pls. Safford's description makes it clear that in Clinch Mountain area he included in the Clinch the whole thickness of rocks now classed in the Silurian system. Keith (1896, Morrison folio; 1901, Maynard folio) followed this same usage in mapping this belt. Probably both lower and middle Silurian rocks are included. A few feet of upper Silurian or even lower Devonian is present at top, but representatives of the different series do not appear to be separately mappable. On present map the whole unit in this belt is mapped as Clinch sandstone. Clinch sandstone and Rockwood formation are mainly contemporaneous phases of lower and middle Silurian. In areas intermediate between the two type localities, they grade into each other, though in any one section the sandstone lies chiefly below. Thickness of Clinch sandstone about 500 feet on Clinch Mountain. Overlies Juniata formation.

Named for exposures on Clinch Mountain, Hancock and Hawkins Counties, Tenn., and Scott County, Va.

†Clinch Mountain Sandstone[1]

Upper Ordovician and Silurian: Eastern Tennessee and western Virginia.

Original reference: J. M. Safford, 1856, Geol. Reconn. Tennessee 1st Rept., p. 157.

Named for exposures on Clinch Mountain, Hancock and Hawkins Counties, Tenn., and Scott County, Va.

†Cline[1]

Upper Cretaceous (Gulf Series): Southern Texas.

Original reference: R. T. Hill, 1901, U.S. Geol. Survey 21st Ann. Rept., pt. 7, p. 114.

Probably named for Cline, Uvalde County.

Clinetop Algal Limestone Member (of Dotsero Formation)

Upper Cambrian: Central northwestern Colorado.

N. W. Bass and S. A. Northrop, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 5, p. 892 (fig. 2), 893, 898, 899–904. Proposed for ledge-forming algal limestone and conglomerate unit, 3 to 5 feet thick, at top of Dotsero formation. At most places, lower half of member consists of course flat-pebble conglomerate, and upper half consists of crystalline to dense algal limestone with a crinkly wavy structure. Overlies Glenwood Canyon member (new). Underlies Dead Horse conglomerate member (new) of Manitou formation.

Type locality: In Clinetop area, Garfield County, where unit trends northeastward across NE¼ sec. 35, T. 3 S., R. 90 W., about 1 mile east of Clinetop Road and SW¼ sec. 23, T. 3 S., R. 90 W., near Sixmile Lake.

†Clingman Conglomerate (in Chilhowee Group)[1]

Precambrian: Western North Carolina and eastern Tennessee.

Original reference: Arthur Keith, 1895, U.S. Geol. Survey Geol. Atlas, Folio 16, p. 3.

G. W. Stose and A. J. Stose, 1949, Geol. Soc. America Bull., v. 60, no. 2, p. 280–281. In Knoxville and Mount Guyot quadrangles, Keith (1895, Mount

Guyot folio, unpub.) mapped three conglomerates, the Cades, Thunderhead, and Clingman, which, in region to the south he later classified as Great Smoky quartzite. Cades conglomerate is lower member of Great Smoky quartzite. Thunderhead conglomerate forms the middle and upper members. Nantahala slate, which overlies upper members of Great Smoky, was called Hazel slate. The quartzite, which lies east of Nantahala slate at Newfound Gap, Keith called Clingman conglomerate, and he interpreted the quartzite as overlying the Nantahala (Hazel) slate. Structural evidence shows that these beds are overturned and that the quartzite here is the upper member of the Great Smoky on the east overturned limb of a syncline enclosing Nantahala slate. South of Newfound Gap, upper quartzite member is exposed at Mount Collins on Park Road that leads to Clingman Dome. Southwest of Mount Collins, Nantahala slate is in narrow syncline, on south limb of which are exposed the underlying upper quartzite of Great Smoky formation, and, farther south, the middle (conglomerate) beds. These conglomeratic beds in outcrops at Parking Overlook at Clingmans Dome are massive micaceous quartzite in 20-foot beds. It is these beds that Keith (Mount Guyot folio) called Clingman conglomerate, which he regarded as upper member of the Great Smoky and so mapped it at Clingmans Dome on crest of Great Smoky Mountains to west. The conglomeratic quartzite that crops out at Clingmans Dome is identical in lithologic character and stratigraphic position with middle member of Great Smoky quartzite exposed on U.S. Highway 276 and lies well down in the quartzite.

P. B. King and others, 1958, Geol. Soc. America Bull., v. 69, no. 8, p. 958. Keith originally placed upper part of sequence here termed Great Smoky group in Hazel slate and Clingman conglomerate; these names are now abandoned. Clingman conglomerate was supposed to be highest stratigraphic unit in Great Smoky Mountains. Keith (1907, U.S. Geol. Survey Geol. Atlas, Folio 143) merged it with his Great Smoky conglomerate, apparently on assumption that it had been duplicated structurally. At Clingmans Dome and other parts of the mountains, coarse sandstone overlies, in stratigraphic sequence, argillaceous rocks that are here classed as parts of Anakeesta formation (new). It is believed that these units of coarse sandstone are layers of Thunderhead lithology that intertongue at varying stratigraphic levels with Anakeesta. The type Clingman is probably equivalent to upper beds of Thunderhead sandstone and lower part of Anakeesta formation on Mount Le Conte, but other units mapped as Clingman lie at different and higher levels. It seems best to class these, depending on locality, as beds in the Anakeesta, as tongues of the Thunderhead, or as unnamed parts of the Great Smoky group.

Named for Clingmans Dome, Swain County, N.C.

Clinton Formation, Shale, or Group

Clinton Formation (in Niagara Group)[1]

Clinton Formation (in Red Mountain Group)

Middle Silurian: New York to northeastern Tennessee; also Michigan.

Original reference: T. A. Conrad, 1839, Philadelphia Acad. Nat. Sci. Jour., v. 8, pt. 1, p. 228–235.

Tracy Gillette, 1940, New York State Mus. Bull. 320, p. 22 (fig. 6). Group includes Willowvale shale (new) in Clyde and Sodus Bay quadrangles.

H. P. Woodward, 1941, West Virginia Geol. Survey, v. 14, p. 8, 50–145. Clinton group, in Niagaran series, comprises (ascending) Rose Hill formation, Keefer sandstone, and Rochester shale. Occurs above Tuscarora sandstone of Medinan series.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 2, p. 535, chart 3. In this report [Silurian correlation chart], term Clinton is used as group in central and western New York and from central Pennsylvania to northeastern Tennessee and shown to include many formations. From southeastern Tennessee to northwestern Georgia, the Clinton is shown as a formation in Red Mountain group.

R. L. Miller and J. O. Fuller, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 76 (2 sheets). In Rose Hill oil field, Virginia, Clinton shale, overlies Poor Valley Ridge member (new) of Clinch sandstone. Underlies Cayuga dolomite.

Tracy Gillette, 1947, New York State Mus. Bull. 341, p. 5–190. A comprehensive report on Clinton group of western and central New York. Included in Niagaran series. Overlies Albion group; underlies Lockport group. units discussed are the Thorold, Oneida, Neahga, Maplewood, Furnaceville iron ore, Reynales, Bear Creek, Sodus (lower and upper), Wolcott limestone, Westmoreland (new), Willowvale, Dawes (new), Kirkland, Herkimer, and Rochester.

J. B. Patton, T. G. Perry, and W. J. Wayne, 1953, Indiana Geol. Survey Field Conf. Guidebook 6, pl. 1. Clinton group, in Niagaran series. Comprises (ascending) Osgood, Laurel, and Waldron formations. Overlies Medina group; underlies Louisville formation.

R. L. Miller and W. P. Brosgé, 1954, U.S. Geol. Survey Bull. 990, p. 79–83. Clinton shale, in Lee County, Va., includes about 400 feet of shale and sandstone lying between Clinch sandstone below and Hancock dolomite above.

D. W. Fisher, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 9, p. 1982 (fig. 3), 1993. Discussion of stratigraphy of Medinan group, New York and Ontario. Silurian system is divided into Medinan, Clinton, and Niagara groups, the three comprising Ontarian series. Clintonian [Clinton] group comprises (ascending) Reynales, Irondequoit, Rochester, and Decew formations in vicinity of Hamilton; Neahga, Reynales, Irondequoit, and Decew, at Decew Falls; Thorold (part), Neahga, Reynales, Irondequoit, Rochester, and Decew at Niagara Gorge; and Thorold, Maplewood, Furnaceville, Reynales, Sodus, Williamson, Irondequoit, Rochester, and Decew in Genesee Gorge. For mapping purposes, Grimsby-Thorold contact is retained as Medinan-Clinton boundary.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. No. 1. Rock units of New York Silurian are divided into (ascending) Medina, Clinton, Lockport, Salina, and Bertie groups. Lower and middle parts of Clinton group are in Ontarian stage; upper Clinton strata are in Tonawanda(n) stage (new). Because Thorold of Gillette (1947) is not continuous with type Thorold at Thorold, Ontario, name Kodak (Chadwick, 1917) is revived for basal sandstone of Clinton group in New York. Term Wallington is proposed for limestone formerly regarded as Reynales at Rochester and eastward. Niagaran series.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. As mapped, Clinton group includes Rose Hill formation, Keefer sandstone, and Rochester shale.

Characteristically exposed around Clinton, Oneida County, N.Y.

Clinton Granitic Gneiss

Pre-Triassic: South-central Connecticut.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Described as red or pink medium- to coarse-grained platy gneiss; composed of pink microcline, quartz, white oligoclase or albite, and biotite.

H. M. Mikami and R. E. Digman, 1957, Connecticut Geol. Nat. History Survey Bull. 86, p. 25, 51, pls. 1, 2. Described in Guilford quadrangle where is has concordant relationship with Haddam tonalite.

Named for town of Clinton, Middlesex County.

†Clinton Quartzites[1]

Silurian: Eastern New York.

Original reference: C. A. Hartnagel, 1905, New York State Mus. Bull. 80, p. 346.

Clipper Gap Formation[1]

Mississippian(?): Northern California.

Original reference: W. Lindgren, 1900, U.S. Geol. Survey Geol. Atlas, Folio 66.

N. L. Taliaferro, 1943, California Div. Mines Bull. 125, p. 283. Cosumnes formation (new) rests unconformably on the Calaveras (Clipper Gap) formation.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (column 15). Shown on correlation chart in Chesterian series.

Named for exposures at village of Clipper Gap, Placer County.

Cloice Member (of Lake Waco Formation)

Cretaceous (Gulf Series): Central Texas.

W. S. Adkins and F. E. Lozo *in* F. E. Lozo, 1951, Fondren Sci. Series, no. 4, p. 122, 139 (fig. 17), 144 (fig. 18). Consists of dark, silty, calcareous shales with subordinate limestone beds. Thickness 35 feet. Middle member of formation; underlies Bouldin member (new); overlies Bluebonnet member (new).

Type section: Cloice Branch, McLennan County; type area is along the Bosque Escarpment southwest to Moody Hills.

†Cloquet Slate[1]

Precambrian (upper Huronian): Northeastern Minnesota.

Original reference: J.E. Spurr, 1894, Am. Jour. Sci., 3d, v. 48, p. 159–166.

Exposed along St. Louis River not far from Duluth, near Thomason, Carlton, and Cloquet, Carlton County.

Clore Limestone[1]

Clore 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, 129.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 766 (fig. 1), 838–839. Assigned to Elvira group (new). In standard Mississippian section, underlies Degonia sandstone and overlies

Palestine sandstone. Recognized as distinct formation as far east as central Christian County, Ky. Farther east, overlying Degonia is not distinguishable, and beds from base of Clore to top of Chester constitute one of thickest limestone sections of Chester series in Eastern Interior basin. This consists of 250 to 300 feet of light- to dark-gray or locally bluish limestone with lenticular shale and sandstone strata and some chert. East of Logan County, Ky., this part of geologic column becomes predominantly shale, and Clore formation has not been differentiated from remainder of Elvira group. In Indiana, the Clore is known as the Gennet Creek formation and consists of 10 to 35 feet of predominantly shaly beds.

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

T. G. Perry and N. M. Smith, 1958, Indiana Geol. Survey Bull. 12, pl. 1. Clore limestone shown on stratigraphic column of upper Chester rocks in Indiana as 10 to 35 feet of soft greenish-gray shale and thin beds of yellow impure limestone. Term Elvira group not applied in Indiana.

Named for Clore School, Randolph County, Ill. Typically exposed in heads of ravines along southwest side of high ridge extending from Clore School to Randolph County Farm.

Closed Volcanics

Tertiary: Northwestern Wyoming.

R. D. Krushensky, 1960, Dissert. Abs., v. 21, no. 4, p. 849. Volcanic breccias and some sandstones and conglomerates. Overlie Squaw flows (new); underlie unit referred to as post-Closed volcanics.

Hurrican Mesa area, Park County.

Cloudburst Formation

Upper Cretaceous(?) and Tertiary: Southeastern Arizona.

J. D. Pelletier, 1957, Mining Engineer, v. 9, no. 7, p. 760. Contains two members. Upper member is conglomerate made up mainly of quartz monzonite fragments but containing some fragments of older rocks in area. Matrix tends to be arkosic, but granitic sand and gravel not uncommon. Con glomerate poorly cemented but relatively well sorted, having beds of sand and gravel alternating with beds of larger boulders. Tuff beds in conglomerate and in the underlying member, which is composed of interbedded flows, flow breccias, and conglomerate. Unconformably underlies Gila(?) conglomerate.

At San Manuel mine [just south of town of Tiger].

Cloudcap 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. Cloud Cap, on eastern crest of rim, marks point of departure of stream of dacite which spreads to northeast. It forms large part of Redcloud Cliff, which takes its name from the reddish-yellow tuff or tuffaceous dacite that underlies principal flow. This flow, which appears to be made up of at least three streams, forms prominent cliff for over one-half mile along rim of Crater Lake and has thickness of over 300 feet. It appears to form one-third of inner slope of crest. This flow presents series of cliffs about its borders, especially on northwest. [See Sun Creek Dacite Flow.]

Howel Williams, 1942, Carnegie Inst. Washington Pub. 540, p. 40, 54. Cloudcap and Redcloud dacites were erupted after andesitic phase of Mazama's activity had come to end. Cloudcap flow is older than the much thicker Redcloud flow (lava).

Cloudcap is on eastern side of Crater Lake.

Cloud Chief Formation

Cloud Chief Gypsum[1] (in Double Mountain Group or Whitehorse Group)

Cloud Chief Gypsum Member (of Whitehorse Formation)

Permian: Southwestern Oklahoma and northern Texas.

Original reference: C. N. Gould, 1924, Am. Assoc. Petroleum Geologists Bull., v. 8, p. 324–341, map.

N. H. Darton, L. W. Stephenson, and Julia Gardner, 1937, Geologic map of Texas (1:500,000): U.S. Geol. Survey. Mapped in Double Mountain group.

Robert Roth, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21 no. 4, p. 421–433. Cloud Chief formation mentioned in general discussion of loose application of Kansas formation names in Texas.

D. A. Green, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 12, p. 1527–1529. Upper member of Whitehorse group. Cloud Chief dolomite facies of Weatherford area should not be considered as Quartermaster as was proposed by Green (1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 11). Overlies Rush Springs sandstone; underlies Doxey shale of Quartermaster group.

Robert Roth, N. D. Newell, and B. H. Burma, 1941, Jour. Paleontology, v. 15, no. 3, p. 313. Table shows Cloud Chief gypsum as member of Whitehorse formation. Whitehorse and Quartermaster formations are placed in Custer group.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 668, pl. 2. Uppermost formation in Whitehorse group. Term Double Mountain group abandoned.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Formation as mapped includes Day Creek dolomite member in northwestern Oklahoma and Weatherford member in central western part. Shown above Whitehorse group.

L. V. Davis, 1955, Oklahoma Geol. Survey Bull. 73, p. 75–77. In Grady County, formation is about 15 feet thick. Unconformably overlies Rush Springs sandstone. Crops out in widely scattered outliers so only lower part is present.

A. J. Myers, 1959, Oklahoma Geol. Survey Bull. 80, p. 40–43. In Harper County, name Cloud Chief formation applied to dolomite, red shale, and gypsum overlying Whitehorse group. Thickness 25 feet; only lower part present. Includes Day Creek dolomite member at base. Doubtfully referred to Ochoan series. Correlated with Taloga formation and Day Creek dolomite of Kansas.

C. O. Dunbar, 1960, Geol. Soc. America Bull., v. 71, no. 12, pt. 1, chart 7. Permian. Correlation chart shows Cloud Chief present in Oklahoma but not in Texas.

Typically exposed near town of Cloud Chief, Washita County, Okla.

Cloudy Pass Diorite

Tertiary: North-central Washington.

E. A. Youngberg and T. L. Wilson, 1952, Econ. Geology, v. 47, no. 1, p. 4 (fig. 2), 5. Named on map legend. Believed to be related to Tertiary Cloudy Pass intrusives which are exposed to west of area.

Occurs at Holden mine, at Holden, Chelan County.

Clough Formation or **Quartzite**

Clough Conglomerate[1]

Lower Silurian: Western New Hampshire, north-central Massachusetts, and southeastern Vermont.

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

M. P. Billings, 1937, Geol. Soc. America Bull., v. 48, no. 4, p. 468, 481–483. Further description of conglomerate.

J. B. Hadley, 1942, Geol. Soc. America Bull., v. 53, no. 1, p. 119, 129–130. Termed a formation in Mount Cube quadrangle, New Hampshire, because considerable mica-schist is present and conglomerate beds are subordinate. Thickness 600 to 1,200 feet in this area.

J. B. Hadley, 1949, Bedrock geology of the Mount Grace quadrangle, Massachusetts: U.S. Geol. Survey Geol. Quad. Map [GQ–3]. Formation geographically extended to Massachusetts. Age shown as Silurian.

G. E. Moore, Jr., 1949, Geol. Soc. America Bull., v. 60, no. 10, p. 1617, 1626–1628, pl. 1. Termed a quartzite in Keene-Brattleboro area, New Hampshire-Vermont, since quartzite more abundant than quartz conglomerate, quartz-mica schist and mica schist.

M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000) U.S. Geol. Survey. Mapped as quartzite. Represented in chlorite metamorphic zone by gray to white quartzite and quartz conglomerate. More coarsely crystalline white quartzite and quartz conglomerate in garnet and staurolite zones where mica schist with biotite, garnet and (or) staurolite also occurs. Similar schist with sillimanite rather than staurolite occurs in the sillimanite zone.

A. J. Boucot and others, 1958, Geol. Soc. America Bull., v. 69, no. 7, p. 855–870. Upper part of Clough formation at Skitchewaug Mountain, near Springfield, Vt., and on Croydon Mountain, near Claremont, N.H., contains fossils of Silurian or Devonian age. On lithologic basis, it is probable that lower part of Bernardston formation, including the conglomerates, quartzites, and calcareous quartzite, is lateral equivalent of Clough formation and that limestone associated with Bernardston formation is lateral equivalent of Fitch formation. If Clough formation at Skitchewaug Mountain were of Devonian age, the stratigraphy of Connecticut Valley region would be complicated by fact that the Clough and overlying Fitch formations elsewhere are of Silurian age.

Named for Clough Hill district, Moosilauke quadrangle, New Hampshire.

Clovelly Stage

Miocene: Southeastern Louisiana (subsurface).

C. M. McLean, 1957, Gulf Coast Assoc. Geol. Soc. Trans., v. 7, p. 241, 242 (fig. 1), 243. A stage name, based on faunal assemblages occurring in the sediments commonly termed "Lower" Miocene in the subsurface of southeastern Louisiana. Duck Lake and Napoleonville stages proposed as replacements for the "Middle" and "Upper" Miocene respectively. Names were selected arbitrarily only because the denoted fields demonstrate representative sections for each; nothing in way of principal producing members is implied.

Clover Formation

Oligocene(?): Northeastern California.

Cordell Durrell, 1957, Pacific Petroleum Geologist, v. 11, no. 3, p. 3. Andesite mudflow breccia about 550 feet thick. Unconformable below Delleker formation (new), unconformity marked by faulting. Lies on Lovejoy basalt (new) and other older rocks.

Occurs in Grizzly Mountains and to the northwest in Blairsden quadrangle, Plumas County.

Clover Member (of Loysburg Formation)

Middle Ordovician (Chazyan): Central and south-central Pennsylvania.

G. M. Kay, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1969. Laminated, rather pure limestone. Thickness 46 feet at type locality. Upper member of formation; overlies unnamed lower member.

G. M. Kay, 1944, Jour. Geology, v. 52, no. 1, p. 3, 4, 5, 7. Upper member of formation. Principally sublithographic, somewhat magnesian limestone in Centre, Huntingdon, and northern Blair Counties. White-weathering dense laminated sublithographic limestone occurs north of Union Furnace. Thickness 40 to 80 feet in type section. Overlies "tiger-striped" beds of the formation; underlies Eyer member of Hatter formation. Formerly included in Carlim limestone of the Tyrone district. Derivation of name.

Type section: At Union Furnace, Huntingdon County. Named for Clover Creek east of Williamsburg, Blair County.

Clover Quartzites[1]

Clover Canyon Quartzites[1]

Precambrian: Northwestern Nevada.

Original reference: C. King, 1878, U.S. Geol. Expl. 40th Par., v. 1, p. 69.

Humboldt Range, Pershing County.

Clover Creek Granodiorite

Jurassic-Cretaceous: Central California.

D. C. Ross, 1958, California Div. Mines Spec. Rept. 53, p. 11, pl. 1. Chiefly granodiorite; distinguished by salt and pepper appearance resulting from imperfectly formed hornblende and sphere crystals sprinkled through the rock. Finer fabric was significant factor in separating these rocks from mineralogically similar Giant Forest pluton.

Three small masses totaling about a square mile crop out near West Fork of Clover Creek and south of Colony Meadow, Sequoia National Park.

Clover Creek Greenstone[1]

Permian: Northeastern Oregon.

Original reference: James Gilluly, 1937, U.S. Geol. Survey Bull. 879.

W. D. Smith and J. E. Allen, 1941, Oregon Dept. Geology and Mineral Industries Bull. 12, p. 6 (fig. 2), 7–8. Described in Wallowa Lake quadrangle where it is 3,000 to 5,000 feet thick. Base not observed. Conformably underlies a unit termed Lower Sedimentary Series, or where series is lacking unconformably underlies Martin Bridge formation.

Named for exposures along Clover Creek in secs. 24, 25, 26, and 35, T. 7 S., R. 42 E., Baker County.

Clover Creek Limestone (in Chester Group)[1]

Mississippian: Western central Kentucky.

Original reference: A. F. Foerste, 1910, Kentucky Geol. Survey Rept. Prog. 1908 and 1909, p. 83, 85.

Named for exposures at mouth of Clover Creek, Breckinridge County.

Cloverly Formation[1]

Cloverly Group

Lower Cretaceous: Central eastern, and northern Wyoming and central southern Montana.

Original reference: N. H. Darton, 1904, Geol. Soc. America Bull., v. 15, p. 394–401.

P. W. Richards, 1955, U.S. Geol. Survey Bull. 1026, p. 42–45. In Bighorn Canyon-Hardin area, Montana-Wyoming, formation is 300 to 400 feet thick, includes Pryor conglomerate member at base and Birdhead sandstone member at top. Overlies Morrison formation; underlies Thermopolis shale. Lupton (1916, U.S. Geol. Survey Bull. 621) called the 20 feet of sandstone at top of Darton's type Cloverly Greybull sandstone. This unit has been called member of Cloverly but not always top member. Overlying Greybull sandstone member in Bighorn Basin is unit of shales and rusty-weathering sandstones which Darton called "rusty series" or "rusty beds." The "rusty beds" have been included in Thermopolis shale by some workers and in Greybull sandstone by other workers. If Cloverly formation from Birdhead sandstone down to the variegated beds is correlative with Darton's "rusty beds," then Cloverly in Bighorn Canyon-Hardin area includes strata younger than type Cloverly. Inclusion of "rusty beds" in the Cloverly constitutes a redefinition of Cloverly as described by Darton. This redefinition is justifiable because Darton's upper unit of Cloverly, the Greybull sandstone member, is not readily separated in many localities from underlying "rusty beds." Top of Cloverly—if it is to occur at a lithologic break of considerable area extent—should be placed either below Greybull sandstone member and above variegated beds in middle of Cloverly or below black Skull Creek shale (or its stratigraphic equivalent) and above the so-called rusty beds.

R. K. Hose, 1955, U.S. Geol. Survey Bull. 1027–B, p. 56–57. In Johnson County, Wyo., overlies Morrison formation and underlies Skull Creek shale. Thickness 135 to 165 feet.

A. B. Shaw, 1957, Rocky Mountain Assoc. Geologists Guidebook to geology of North and Middle Parks Basin, Colorado, p. 48, 49 (fig. 1). Base of Cretaceous comprises tripartite unit traditionally divided into Lakota sandstone, Fuson shale, and Dakota sandstone. In Laramie Basin, same division is recognizable, but the three names are not used; instead, entire unit is called Cloverly formation. In this report, both sets of names are used for North Park, Colo., but Cloverly is elevated to rank of group.

R. M. Moberly, Jr., 1958, Dissert. Abs., v. 18, no. 1, p. 198. Includes Little Sheep mudstone (new), Pryor conglomerate tongue, and Lovell member (new).

W. J. Mapel, 1959, U.S. Geol. Survey Bull. 1078, p. 35–37. Described in Buffalo-Lake DeSmet area, Johnson and Sheridan Counties, Wyo., where it is 156½ feet thick, overlies Morrison formation, and underlies Skull Creek shale.

Ralph Moberly, Jr., 1960, Geol. Soc. America Bull., v. 71, no. 8, p. 1143 (fig. 2), 1145–1149, pl. 1. As redefined here, includes nonmarine sedimentary rocks which lie above Morrison formation and below Sykes Mountain formation (new). Comprises (ascending) Little Sheep Mountain (new), Pryor conglomerate, and Himes (new) members. Thickness 382 feet at type locality.

D. L. Eicher, 1960, Yale Univ. Peabody Mus. Nat. History Bull. 15, p. 5–11, 13, 15–16. Underlies rusty beds of Thermopolis shale.

Arthur Mirsky, 1960, Dissert. Abs. v. 21, no. 4, p. 850–851. Formation, in southern Big Horn Mountains, Wyo., includes Otter Creek sandstone member (new) in lower part. Upper part of Cloverly is referred to as the Mudstone member. Overlies Morrison formation; underlies Rusty Beds member of Thermopolis.

Type locality: Near Cloverly, about 15 miles northeast of Basin, Bighorn County, Wyo.

Clovis Beds

Clovis Formation

Pleistocene: Central eastern New Mexico.

Ernst Antevs, 1936, Acad. Nat. Sci. Philadelphia Proc., v. 87, p. 305–306 [1935]. A generalized profile comprises (descending) several feet of red-brown wind-blown sand; a few feet of blue-gray clay—a lake deposit—forming one to three distinct beds (containing bones of mammoth and extinct bison, mollusks, diatoms, Folsom points, other points and charcoal and burned animal bones); and yellow sand with bones of horse and camel but without artifacts.

Ernst Antevs *in* H. M. Wormington, 1949, Denver Mus. Nat. History Pop. Ser. 4, p. 189. The beds which contain the old artifacts, extinct horse, camel, bison, and mammoth, diatoms and mollusks are separated by disconformities from beds below and above and constitute the Clovis formation.

Exposed some 15 miles southwest of Clovis and an equal distance to the southeast.

Cloyd Conglomerate Member (of Price Formation)

Mississippian (Kinderhookian): Southwestern Virginia.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 343–346, 347. Coarse-grained white quartz sandstone having lenses and layers of conglomerate with quartz pebbles as much as 1½ inches in diameter; lies at base of formation. Name Ingles conglomerate has been applied to this sandstone because similar sandstone occurs in Ingles Mountain a few miles southeast of Radford; sandstone in Ingles Mountain, however, is Clinch sandstone; hence, name Cloyd is here substituted for Ingles.

Lynn Glover, 1953, (abs.) Virginia Jour. Sci., new ser., v. 4, p. 260–261. Rusty-weathering flaggy marine sandstones and shales overlie the Devonian Broadford sandstone and are terminated by the Cloyd member of Mississippian Price formation.

Named for exposures in Cloyd Mountain, the part of Little Walker Mountain southwest of New River in Pulaski County.

Clugston Limestone[1]

Paleozoic(?): Northeastern Washington.

Original reference: C. E. Weaver, 1920, Washington Geol. Survey Bull. 20, p. 71, map.

Mapped around headwaters of Clugston Creek, Stevens County.

Clyde Formation (in Wichita Group)[1]

Clyde Group

Permian (Wolfcamp Series): Central and central northern Texas.

Original reference: F. B. Plummer and R. C. Moore, 1922, Texas Univ. Bull. 2132, p. 192, 197–198, charts.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 94. Rank raised to group. Includes Grape Creek formation below and Talpa formation above. Underlies Lueders group; overlies Belle Plains group.

R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80, sheet 2. Described in Colorado River valley as a formation where it is 500 feet thick and consists of regular beds of moderately hard medium- to fine-grained gray limestones, in layers 1 to about 10 feet, alternating with shale and marl beds of about same thickness. Includes strata above Bead Mountain limestone member of Belle Plains formation to base of Lueders limestone. Comprises Grape Creek limestone member below and Talpa limestone member above. Division of the Clyde into members in this area is not as natural as in country north of Abilene; in area herein mapped, units might appropriately be treated as formations.

P. T. Stafford, 1960, U.S. Geol. Survey Bull. 1081–G, p. 274–276, pls. 11, 12. Described in Brazos River area. Includes all rocks between top of Bead Mountain limestone member of underlying Belle Plains formation and base of overlying Lueders limestone. Thickness 220 feet in northwestern Callahan County; 225 feet in west-central Throckmorton County. Includes five members (ascending): unnamed shale, Grape Creek limestone, unnamed shale, Talpa limestone, and unnamed shale. Wichita group.

Named for town of Clyde, 8 miles west of Baird, Callahan County.

Coachella Fanglomerate[1]

Miocene, upper(?): Southern California.

Original reference: F. E. Vaughan, 1922, California Univ. Pubs., Dept. Geol. Sci. Bull., v. 13, no. 9, p. 344, 386–387, 391, map.

W. P. Woodring, 1932, Carnegie Inst. Washington Pub. 418, p. 12, 25. Discussion of age of marine Tertiary deposits of Colorado Desert, Calif. Vaughan considered Coachella fanglomerate to be Quaternary age. It is much older and occupies same stratigraphic position as "Indio formation" (Buwalda and Stanton, 1930). Paleontological evidence points to the conclusion that the marine beds of Colorado Desert are of Miocene age. There is little on which to base a conclusion as to what part of coastal Miocene section is represented, but evidence indicates late Vaqueros age, that is, late lower Miocene. The "Indio formation" and "Coachella fanglomerate" occupy the same stratigraphic position with reference to marine beds [Imperial formation; late lower Miocene] as the Palm Spring formation (new) which overlies the Imperial, but because both are closer to head of trough, their base may lie at lower horizon.

C. R. Allen, 1957, Geol. Soc. America Bull., v. 68, no. 3, p. 323–326, pls. 1, 4. Described in San Gorgonio Pass area where it is composed of two members; an upper, 3,750 feet thick, consisting of massive conglomerate with interlayered flows of olivine basalt and associated dikes, and a lower, 850 feet thick, consisting of well-indurated massive conglomerate and basal breccia of gray schist fragments. Fanglomerate shows marked lateral variation in composition. In typical section noted, eastward-dipping Coachella beds lie with depositional contact on crystalline complex and to the east are unconformably overlain by Painted Hill formation. Some rocks mapped by Vaughan as Coachella fanglomerate belong to younger units in section, but formational name is retained for the prominent cliff-forming beds exposed along east wall of Whitewater Canyon near trout farm. No fossils have been found in the Coachella, but its unconformable position beneath early Pliocene(?) Imperial formation and its high degree of induration and well-developed jointing suggest an age at least as old as late Miocene. Map bracket shows upper Miocene(?); figure 2 shows upper Miocene; table 1 shows upper Miocene(?).

Typical section exposed in Whitewater Canyon near trout farm, Riverside County. Rocks crop out over area of about 6 square miles north of Painted Hill and east of Whitewater River. Named for Coachella Valley.

Coahuila Group

Coahuila Series

Lower Cretaceous: Southwestern Texas, and Coahuila, Durango, and Nuevo Leon, Mexico.

R. W. Imlay, 1940, Geol. Soc. America Bull., v. 51, no. 1, p. 124–125. Proposed as a group term to designate Lower Cretaceous strata older than Trinity as that term is generally understood in Texas. Includes strata older than *Dufrenoya texana* zone which were deposited in ancestral Gulf of Mexico, in Mexican sea, and in closely connected waters.

R. W. Imlay, 1944, Geol. Soc. America Bull., v. 55, no. 8, p. 1005–1007, chart 10a. Redefined as Coahuila series and subdivided into Nuevo Leon and Durango groups. This usage retains Comanche series in sense originally defined by Hill, emphasizes magnitude of Coahuila time, and permits convenient grouping of Mexican formations.

Named after Mexican state of Coahuila, where it is fully developed in both near-shore and off-shore facies. Crops out in small areas in southwestern Texas.

Coahuila Silt[1]

Pleistocene: Southern California.

Original reference: G. D. Hanna, 1926, California Acad. Sci. Proc., 4th ser., v. 14, no. 18, p. 435.

Exposed where San Diego-El Centro Highway crosses New River about 1 mile west of El Centro, Imperial County.

Coalbank Hill Member (of Molas Formation)

Mississippian-Pennsylvanian: Southwestern Colorado.

W. M. Merrill and Richard W. Winar, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 9, p. 2115 (fig. 4), 2116–2119. Basal member of formation. Includes red mudstones and siltstones containing solution-rounded limestone boulders and chert fragments and overlying structureless mudstones and siltstones. This is "transition zone" mentioned by earlier writers; the "rubble breccia" of upper Redwall and the "residual soil" in lower part of basal member of Naco (Huddle and Dobrovolny, 1952, U.S. Geol. Survey Prof. Paper 233–D); and lowest member of Molas as subdivided by Wengerd and Strickland (1954). Thickness about 56 feet at type locality; 13 feet at Stag Mesa; 5 feet at Ouray. Underlies middle unnamed member; unconformably overlies Leadville limestone. Where Leadville is absent, overlies Ouray limestone; contact appears gradational. No fossils. Age defined only by stratigraphic position, post-Leadville, pre-middle Molas. Mississippian-Pennsylvanian boundary probably contained within it or overlying member.

Type area: Coalbank Hill on U.S. Highway 550, 33 miles north of Durango County.

Coal Bluff Marl Member (of Naheola Formation)

Coal Bluff Beds (in Nanafalia Formation)

†Coal Bluff Beds or Series[1] } (in Wilcox Group)
Coal Bluff Formation

Paleocene: Southern Alabama.

Original reference: D. W. Langdon, Jr., 1894, Alabama Geol. Survey Rept. on Coastal Plain, p. 421.

J. E. Brantly, 1920, Alabama Geol. Survey Bull. 22, p. 148–150. Nanafalia divisible into three phases based both on lithology and fossil content. Lowest of the three phases is referred to as Coal Bluff beds, and two upper phases as Gullette Bluff beds. Smith used term Coal Bluff to apply to lignite beds at base of Nanafalia. In present report, name is extended to include all strata (42 to 70 feet) below Gullette Bluff beds.

J. A. Cushman, 1944, Cushman Lab. Foram. Research Contr., v. 20, pt. 2, p. 29–52. Allocated to member status in Naheola formation. Deposits, from which fauna herein described as collected, have been considered lower part of Coal Bluff beds of Langdon and Ackerman formation of Cooke (1933, Am. Assoc. Petroleum Geologists Bull., v. 17, no. 2). Paleocene.

Lyman Toulmin, Jr., 1944, Alabama Acad. Sci. Jour., v. 16, p. 42. "Coal Bluff beds" listed as uppermost unit in Naheola formation. Overlies "Oak Hill beds".

F. S. MacNeil, 1946, U.S. Geol. Survey Strategic Minerals Inv. Prelim. Rept. 3–195, p. 13–14. Name Coal Bluff marl member is restricted to lower glauconitic sandy marls and shales of Brantly (1920). The upper coarse sands are considered to be of Wilcox age. Thickness varies from place to place, probably averages 35 feet. Present at top of formation. Traced from western Butler County west to eastern Choctaw County, beyond which it becomes nonfossiliferous and is not differentiated from rest of Naheola.

L. D. Toulmin, P. E. LaMoreaux, and C. R. Lanphere, 1951, Alabama Geol. Survey Spec. Rept. 21, p. 42, 44, 48–49, 51 (fig. 7). Member described in Choctaw County where it consists of fine- to medium-grained marine sand and thin platy limonite zones; disconformably overlies lignite at top of Oak Hill member (new); unconformable with overlying glauconitic sand and marl of Nanafalia formation of Wilcox group or with gravelly basal sand member of Nanafalia where it is present. Thickness 60 feet.

W. F. Roux, Jr., 1958, Dissert. Abs., v. 19, no. 5, p. 1056. Coal Bluff formation, Wilcox group, consists of lower glauconitic and upper nonglauconitic members. Overlies Naheola formation; underlies Nanafalia formation.

P. E. LaMoreaux and L. D. Toulmin, 1959, Alabama Geol. Survey County Rept. 4, p. 79–95. Term "Coal Bluff Section" was used by Smith (1886, Alabama Geol. Survey Bull. 1) and "Coal Bluff beds" was used by Brantly (1920) to designate 40 to 70 feet of glauconitic sand, crossbedded sand, and laminated clay and sandy clay that overlie Oak Hill member. Lignite at bottom of the "Coal Bluff beds" is now included in Oak Hill member, and a bed 20 feet or more thick, of yellow to white crossbedded sand with clay pebbles 10 to 40 feet above the lignite bed is now included in Nanafalia formation as Gravel Creek sand member (new). The intervening beds make Coal Bluff marl member.

Named from Coal Bluff, on west side of Alabama River in sec. 7, T. 11 N., R. 7 E., Wilcox County.

Coalburg Sandstones (in Kanawha Formation[1] or Group)

Pennsylvanian: Western West Virginia.

Original reference: I. C. White, 1908, West Virginia Geol. Survey, v. 2–a, p. 271, 468.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 91, 104. Upper and lower Coalburg sandstones in Kanawha group. Lower unit typically exposed in Logan and Mingo Counties.

Probably named from occurrence at Coalburg, Kanawha County.

Coalburg Shale (in Kanawha Formation)[1]

Pennsylvanian: Southern West Virginia.

Original reference: D. B. Reger, 1921, West Virginia Geol. Survey Rept. Nicholas County, p. 243.

At Mollie Frame Farm mine, 0.3 mile west of Birch River village, and at south end of Powell Mountain, on Brushy Fork of Muddlety Creek, Nicholas County.

Coal City Limestone (in Henrietta Group)

Coal City Limestone Bed (in Pawnee Limestone Member of Oologah Formation)

Coal City Limestone Member (of Pawnee Limestone)

Pennsylvanian (Des Moines Series): Southeastern Iowa and northeastern Missouri.

L. M. Cline, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 59–60, 63, 64. Light-blue-gray hard finely crystalline limestone in two massive beds; weathers buff; fossiliferous. About 2 feet thick. At type locality, base of limestone is about 12 feet above top of Mystic coal. In Putnam County, Mo., lies several feet below underclay of Worland cyclothem and is separated from underlying Pawnee limestone by several feet of shales. Henrietta group.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. v. (fig. 1), 7. In Missouri, Coal City limestone member of Pawnee limestone is lateral equivalent of the Laberdie member; term Coal City has priority, and Laberdie is suppressed in favor of Coal City. Overlies Mine Creek shale member; underlies Bandera formation.

R. D. Alexander, 1954, Oklahoma Geol. Survey Circ. 31, p. 15, 16 (fig. 2). In Nowata County, Okla., considered a bed in Pawnee limestone member of Oologah formation.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull., 15, p. 31, fig. 5. Uppermost member of Pawnee limestone. Thickness 2 to 2½ feet in Appanoose County; about 1 foot in Madison County. Overlies Mine Creek shale member. Underlies Bandera shale.

Type section: In east bluff of Chariton River in SE¼ sec. 16, T. 67 N., R. 16 W., near Coal City in southeastern Appanoose County, Iowa.

Coal Creek Limestone[1] Member (of Topeka Limestone)

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, 1949, Kansas Geol. Survey Bull. 83, p. 126 (fig. 22), 164–165. Coal Creek limestone member of Topeka formation; overlies Holt shale member; underlies Severy shale of Wabaunsee group. This classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma, May 1947. In Kansas, consists of light-bluish-gray limestone and nodular shale or dark-blue massive limestone which weathers light bluish gray or brown. Thickness 2 to 5 feet. Not positively identified south of Kansas River.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull., 15, p. 15, fig. 5. Medium- to dark-gray dense limestones interbedded with fossiliferous shales; locally contains dark chert. Thickness 5 to 6 feet. Upper unit of Topeka; overlies Holt shale member.

Type locality: About three-fourths mile north of Union, Cass County, Nebr.

Coal Creek Quartzite[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.

G. D. Fraser, 1949, (abs.), Geol. Soc. America Bull., v. 60, no. 12, pt. 2, p. 1960. Fine-grained quartz-muscovite-biotite schist interbedded with the quartzite contains a few garnet crystals and, locally, abundant cordierite. Believed to be younger than Idaho Springs formation and older than some of the granite in the area. Outcrop area described.

Crops out in triangular area 7 miles long and up to 3 miles wide near mouth of Coal Creek Canyon, Jefferson and Boulder Counties.

Coal Creek Serpentine

Precambrian: Central Texas.

V. E. Barnes, 1940, *in* Geol. Soc. America [Guidebook] 53d Ann. Mtg., p. 53 (geol. map.) Named and mapped in Cut Off Gap area.

Frederick Romberg and V. E. Barnes, 1949, Geophysics, v. 14, no. 2, p. 152–154, fig. 1. Discussed as Coal Creek serpentine mass. Bordered along south and for the western half of its distance along north by Big Branch gneiss; for remainder of distance on northern side, bordered by Packsaddle schist.

V. E. Barnes, [1952?]. Geologic map of the Willow City quadrangle, Gillespie and Llano Counties, Texas (1:31,168): Texas Univ. Bur. Econ. Geology. Only about 15 percent of mass is in Willow City quadrangle. The rest is in Blowout quadrangle.

V. E. Barnes, [1952?], Geologic map of the Blowout quadrangle, Blanco, Gillespie, and Llano Counties, Texas (1:31,680): Texas Univ. Bur. Econ. Geology. Age of serpentine is in question. It is cut by aplites, pegmatites, and quartz bodies derived from Town Mountain granite, making it the older. Its outcrop shape is that of an intrusive into Big Branch gneiss but it is not proven that Big Branch gneiss did not actually assimilate the Packsaddle schist from around the serpentine.

Name derived from Coal Creek, an intermittent stream which crosses the mass in Willow City quadrangle.

Coaldale Chert

Ordovician(?): Central western Nevada.

B. M. Page, 1949, (abs.) Geol. Soc. America Bull., v. 60. no. 12, pt. 2, p. 1943. Mentioned in discussion of structure of Candelaria district. Numerous pre-Permian contortions and faults occur in unit.

Candelaria district, Mineral County.

Coaledo Formation (in Arago Group)[1]

Eocene, upper: Southwestern Oregon.

Original reference: J. S. Diller, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 3, p. 319–320.

F. E. Turner, 1938, Geol. Soc. America Spec. Paper 10, p. 27–31. As exposed in sea cliffs about Cape Arago and Sunset Bay, comprises three divisions. Lower, approximately 1,600 feet thick, consists principally of sandstone with subordinate amounts of shale; middle, about 3,200 feet thick, predominantly soft fine sandstone and shales; upper, about 1,200 feet, principally medium and coarse sandstone with occasional thin beds of shale and one 10-foot bed of low-grade lignite. Contact with overlying Bassendorf shales obscured. Fauna discussed.

J. E. Allen and E. M. Baldwin, 1944, Oregon Dept. Geology and Mineral Industries Bull. 27, p. 21–27, pls. 1, 5. Lower, middle, and upper members mapped and described in Coos Bay quadrangle. Thickness about 6,015 feet. Underlies Bastendorf [Bastendorff] shale; unconformable above Umpqua formation. Upper Eocene.

D. C. Duncan, 1953, U.S. Geol. Survey Bull. 982–B, p. 58–60, pl. 5. Thickness about 5,600 feet where exposed along sea cliffs at mouth of Coos Bay. Overlies Umpqua formation; underlies Bastendorf [Bastendorff] shale. Late Eocene.

Well exposed in vicinity of Coaledo, Coos County.

Coalfield Sandstone (in Crooked Fork Group)

Pennsylvanian (Pottsville Series): Eastern Tennessee.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [folio], p. 6, 19, pls. 2, 3, 4. Includes both massive and thin phases. Thickness 30 to 60 feet; in Crooked Fork section 42 feet; west of Oneida and in southeast part of Barthell Southwest quadrangle thins to 10 or 15 feet. In Morgan County, sandstone locally splits into two or three benches. Underlies Glenmary shale (new); overlies Burnt Mill shale (new).

Underlies town of Coalfield, Petros quadrangle, Morgan County.

†Coalinga Beds[1]

Miocene and Pliocene: Southern California.

Original reference: F. M. Anderson, 1905, California Acad. Sci. Proc., 3d ser., v. 2, p. 174–185.

Named for exposures north, northwest, and west of Coalinga, Fresno County.

Coalmont Formation[1]

Paleocene-Eocene: Northern Colorado.

Original reference: A. L. Beekly, 1915, U.S. Geol. Survey Bull. 596, p. 20, 49–71.

R. F. Walters, 1957, Rocky Mountain Assoc. Geologists Guidebook to the geology of North and Middle Park Basins, Colorado, p. 86–87. Continental deposits of heterogeneous lithology with sandstone predominant. On basis of floral fossil evidence, has been considered Paleocene in age; no diagnostic vertebrates found. It is possible, on basis of regional geologic history, that uppermost part of formation is lower Eocene (Wasatch) in age.

W. J. Hail, Jr., and E. B. Leopold, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B260–B261. Presence of Paleocene leaves indicates Paleocene age for lower part of formation; presence of pollen of *Platycarya*. Gramineae, and *Tilia crassipites* indicate upper part of formation is Eocene. Formation has aggregate thickness of as much as 9,000 feet in parts of North Park. Unconformably overlies rocks mostly of Cretaceous age and is unconformably overlain locally by White River formation of Oligocene age and by North Park formation of late Miocene age.

Well exposed along North Platte River, North Park. Name derived from Coalmont, Jackson County.

Coalvale Formation or cyclothem (in Cherokee Group)

Pennsylvanian (Des Moines Series): Southeastern Kansas.

G. E. Abernathy, 1937, Kansas Geol. Soc. Guidebook 11th Ann. Field Conf., p. 18, 20, 22; 1938, Kansas Acad. Sci. Trans., v. 41, p. 193, 196. Cherokee group is divided into 15 cyclic formational units. The Coalvale, 11th in the sequence (ascending), occurs below the Croweburg and above the Fleming. Average thickness 9 feet. Includes coal here named Arcadia. [For complete sequence see Cherokee group.]

R. C. Moore, 1949, Kansas Geol. Survey Bull. 83, p. 45. Overlies Fleming cyclothem and underlies Ardmore cyclothem redefined to include Croweburg cyclothem of Abernathy (1937).

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.

Coal Valley Formation (in Wassuk Group)

Pliocene, lower and middle: Western Nevada.

D. I. Axelrod, 1956, California Univ. Pubs. Geol. Sci., v. 33, p. 29–33, 64–66, figs. 2, 3, and 4. Consists of five mappable lithologic units (ascending): alternating conglomerate, sandstone, lake beds, with hornblende andesite pyroclastics and flows, rhyolite tuffs—thickness 850 feet; grit and andesite tuff—thickness 150 feet; sandstone, diatomaceous shale, pebble conglomerate, and andesite tuff—thickness 1,350 feet; sandstone—thickness 575 feet; and alternating sandstone, conglomerate, diatomaceous shale, andesite tuff, granitic breccia—thickness 400 feet. Aggregate thickness 3,325 feet. Conformably underlies Morgan Ranch formation (new) and unconformably overlies Aldrich Station formation (new). Chart shows Coal Valley overlying and interfingering with Kate Peak andesite. Represents a deposit which records a change from subaerial and fluviatile to lacustrine conditions within a short distance, a change comparable to that found in small lake-delta deposit.

D. I. Axelrod, 1958, California Univ. Pubs. Geol. Sci., v. 34, no. 2, p. 97–104. In Verdi area, overlies Kate Peak andesite.

D. I. Axelrod and W. S. Ting, 1960, California Univ. Pubs. Geol. Sci., v. 39, no. 1, p. 3. In fault contact with upper Pliocene Wichman formation (new).

Type area in Coal Valley adjacent to Lewis Terrace, which lies 4 miles south of Morgan's Ranch, Hawthorne quadrangle.

Coalville Member (of Frontier Formation)

Upper Cretaceous: Northeastern Utah.

L. A. Hale, 1960, Wyoming Geol. Assoc. Guidebook 15th Ann. Field Conf., p. 136 (chart 1), 138, 139 (fig. 2), 145 (fig. 3). Marine sandstone and coal of late Greenhorn age. Thickness 175 feet (east) to 223 feet (west). Contains the prominent "Wasatch" coal. Overlies Chalk Creek member (new); contact transitional. Underlies Allan Hollow shale member (new). Comprises units 11–13 as described by Wegemann (1915, U.S. Geol. Survey Bull. 581, pt. 2), and Cobban and Reeside (1952).

Well exposed in ridge that strikes N. 35 E., from Coalville townsite, Summit County.

Coamo 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. 149-152. Chiefly massive tuff breccias and bedded tuffs including ashflow deposits. Between Ciales and Orocovis, formation is characterized by abundance of tuffs, tuff breccias, and volcanic conglomerates and by an extensive and thick basal sequence of redbeds including numerous ashflows. In north-central Puerto Rico consists of two distinct parts: lower, mostly red, sequence that consists principally of andesitic tuffs (mostly ashflows) and an upper massive nonred sequence of poorly stratified andesitic tuff breccia; locally in lower red part of formation is rudistid-bearing Botijas limestone member (new). Along southern flank of Puerto Rico anticlinorium, conformably overlies Cariblanco formation (new); along north side of anticlinorium, strata tentatively assigned to the Coamo lie in several fault blocks; eastward along its northern belt of outcrops, strata equivalent to the Coamo both thin and interfinger into upper part of strata correlated with the Cariblanco. Southeast of Rio Piedras, identity of Coamo is lost. Because of this interfingering and thinning, thickness of the Coamo ranges from a few inches to approximately 7,000 feet. Appears to be gradational into overlying rocks of probable early Tertiary age. Name credited to Lynn Glover (in press).

Named for outcrops in and near Coamo in south-central Puerto Rico.

Coamo Tuff Limestone[1]

Upper Cretaceous: Puerto Rico.

Original reference: C. P. Berkey, 1915, New York Acad. Sci. Ann., v. 26, p. 19, 61.

R. C. Mitchell, 1954, Puerto Rico Univ. Agr. Expt. Sta. Tech. Paper 13, p. 36 (table 2), 47. In Ponce district, underlies Guayabal limestone and overlies Peñuelas shale. Thickness 300 feet.

Well developed in vicinity of Coamo Reservoir near Coamo Springs.

Coamo Springs Limestone Member (of Naranjo Formation)

Coamo Springs Limestone Series[1]

Eocene, middle: 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. 153.

R. C. Mitchell, 1954, Puerto Rico Univ. Agr. Expt. Sta. Tech. Paper 13, p. 36 (table 2), 52, 54. Underlies Canas Arriba formation (new); overlies Rio Jueyes series. Thickness 1,000 feet. On basis of fossil evidence, age is considered to be Eocene, probably upper. 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. 73–77. Member of Naranjo formation (new). Overlies Miramar member (new). Interfingers with Río Descalabrado member and is also overlain by it. Mitchell (1922, New York Acad. Sci. Scientific survey of Porto Rico and the Virgin Islands, v. 1) called slightly different facies of the limestone both Coama (equivalent to Coamo) tuff limestone and Guayabal limestone. Older name of Hodge takes priority. Hodge did not select type area; type area for amended Coamo Springs is herein designated.

E. A. Pessagno, Jr., 1960, Caribbean Geol. Conf., 2d, Mayagüez, Puerto Rico, 1959, Trans., p. 84. Member of Naranjo formation. Consists of 0 to 3,800 feet of pure massive algal limestone, characteristically white, but may vary to gray, red, or pale orange. Overlies Los Puertos member (new). Traced for about 60 kilometers from Salinas to southeast part of Jayuya quadrangle.

Type area: Northwest end of Cerro de las Cuevas. Excellent exposures occur at quarries along Camino Naranjo in this area. Named from a thermal spring in Coamo River Water Gap, Coamo-Guayama district.

Coane Formation (in Veredas Group)

Pennsylvanian (Missouri Series): Central New Mexico.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 27 (table 2), 58 (fig. 6), 59–61. Name applied to basal formation of group. At type locality, consists of light-bluish-gray to gray cherty limestone; in other areas, lower part of formation contains clastic beds of gray shales and sandstones. Thickness varies from about 58 feet at type section to more than 100 feet in the Ladron Mountains. Underlies Adobe formation (new); overlies Bolander group (new).

Type locality: West face of northwest side of Oscura Mountains, eastern part of SE¼ sec. 36, T. 5 S., R. 5 E., Socorro County.

Coasters Harbor Island Arkose[1]

Carboniferous: Southern Rhode Island.

Original reference: A. F. Foerste, 1899, U.S. Geol. Survey Mon. 33, p. 380.

Occurs at south end of Coasters Harbor Island.

Coast Range Diorite[1]

Age(?): Alaska.

Original reference: A. C. Spencer, 1906, U.S. Geol. Survey Bull., 287, map opposite p. 12.

Coast Range Intrusives[1]

Jurassic or Cretaceous: Southeastern Alaska, and British Columbia and Yukon Territory, Canada.

Original reference: A. F. Buddington, 1929, U.S. Geol. Survey Bull. 807, p. 116–119.

Hyder district, Alaska.

†Coata Sandstone Member (of Atoka Formation)[1]

See Coody Sandstone Member.

Cobb Mountain Volcanics (in Clear Lake Volcanic Series)

Quaternary: Northern California.

J. C. Brice, 1953, California Div. Mines Bull. 166, p. 12 (fig. 2), 47, pl. 7. Rhyolite flows and tuffs about 200 to 1,500 feet thick. Shown on columnar section above Boggs Mountain flows (new) and below a 100 to 300 foot unit of pyroxene dacite; age relations of individual units of series are imperfectly known because some units are isolated and contacts of contiguous flows are commonly obscured by sliding.

Vicinity of Cobb Mountain, Lower Lake quadrangle, in Coast Ranges, about 70 miles north of San Francisco.

Cobham conglomerate member[1] (of Knapp formational suite)

Devonian or Carboniferous: Northwestern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 61, 112, 116, 117, table opposite p. 61.

Exposed along southeast and southwest faces of Cobham Hill, at Glade, Warren County.

Cobleskill Limestone or Dolomite[1]

Upper Silurian (Cayuga Series): New York, and Ontario, Canada.

Original reference: C. Schuchert, 1903, Am. Geologist, v. 31, p. 160–175.

D. W. Fisher and L. V. Rickard, 1953, New York State Mus. Circ. 36, p. 9–10, 11, 13, fig. 1. In the west, overlies Bertie limestone; eastward overlies Brayman shale (redefined). Underlies Rondout dolomite.

L. V. Rickard, 1955, New York State Geol. Assoc. Guidebook 27th Ann. Mtg., p. 7. Lower Devonian Helderbergian series (revised) consists of nine formations, five of which are present in central New York: Cobleskill, Rondout, Manlius, Coeymans, and Kalkberg. Cobleskill consists of nearly barren central and western dolomite facies, 10 to 17 feet thick.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. Shown on correlation chart as Upper Silurian, Murderian stage (new).

Named for exposures on Cobleskill Creek, Schoharie County, N.Y.

Cobourg Limestone[1] (in Trenton Group)

Middle Ordovician: Ontario, Canada, and northwestern New York.

Original reference: P. E. Raymond, 1921, Canada Geol. Survey Mus. Bull. 31, Geol. Ser. 38, p. 1.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 277–281. Term Cobourg limestone replaced "Picton limestone" which had been applied to the heavy-bedded limestones with gastropod fauna and underlying thinner bedded limestone with *Rafinesquina deltoidea* exposed at Picton, Ontario. Term Picton preoccupied. Formation separable into two members here designated as Hallowell and Hillier. In standard section of Trenton group, occurs above Sherman Fall formation and below Collingwood shale.

G. M. Kay, 1943, Am. Jour. Sci., v. 241, no. 10, p. 598, 601–602. Along West Canada Creek, N.Y., the Cobourg is subdivided into Rust and Steuben members (both new). Overlies Russia member (new) of Denmark formation. Underlies Holland Patent (upper Utica). Thickness 175 feet.

Named for Cobourg, Northumberland County, Ontario.

Cobourgian (Cobourg) Stage or Substage

Middle Ordovician (Trentonian): Eastern North America.

G. M. Kay, 1937, Geol. Soc. America Proc. 1936, p. 82. Stage in later Trenton. Followed by Collingwood and Gloucester stages.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 277–283, 293, 298. Discussion of stratigraphy of Trenton group. List of formations of Cobourg age. Cobourg time [followed Sherman Fall] marked by retreat of sea from Adirondack arch into Ontarian basin. In Cobourg stage, the arch continued to rise, and trough on east was restricted by incursion of sediments on its eastern side; boreal faunas again invaded northern part of region. Cobourg followed by Collingwood and Gloucester stages.

Marshall Kay, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1415. Stage in upper Trentonian. Most of true Utica is Cobourgian.

Marshall Kay, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 7, p. 30–31. Probably term stage is too high an order for the named divisions of the Trentonian; they can be considered substages of a smaller number of stages. The Cobourg-Collingwood-Gloucester seems to be time-equivalent of Utica group but name Utica is strongly associated with black shale facies. Hence, uppermost Trentonian stage is designated Pictorian. The Cobourgian forms most of section in gorge at Trenton Falls.

Name derived from Cobourg, Ontario, Canada, from which Cobourg limestone was named.

†Cobscook Series[1]

Silurian and Devonian: Southeastern Maine.

Original reference: N. S. Shaler, 1886, Am. Jour. Sci., 3d, v. 32, p. 44–60.

Named for development in Cobscook Bay district, east coast of Washington County.

Cobscook Bay Series[1]

Silurian and Devonian: Southeastern Maine.

Original reference: H. S. Williams, 1900, U.S. Geol. Survey Bull. 165, p. 34–35.

On extreme southeast coast.

Coburn Formation[1] or Limestone (in Trenton Group)

Middle Ordovician: Central and south-central Pennsylvania.

Original reference: R. M. Field, 1919, Am. Jour. Sci., 4th, v. 48, p. 404, 420.

G. M. Kay, 1944, Jour. Geology, v. 52, no. 1, p. 3 (fig. 3); no. 2, p. 114. Coburn limestone comprises the somewhat coquinal limestone succeeding the Salona and underlying black shale of Antes formation (new). Section at type locality has not been described, and only section at Salona seems to have been studied adequately. Here thickness is 300 feet. Correlated with Cobourg limestone of Ontario. Trenton group. Mohawkian.

Named from town in Center [Centre] County.

Cobwebb Basalt

Pliocene, lower(?): West-central Arizona.

S. G. Lasky and B. N. Webber, 1949, U.S. Geol. Survey Bull. 961, p. 14 (table 2), 34–35, pls. 1, 2. Hypersthene(?)-augite-olivine basalt. Most of rock is gray to brown and fine-grained to aphanitic and contains only a few vesicles, but where relatively thick the upper part is black, mostly is aphanitic, and highly vesicular. Maximum thickness about 250 feet. Lies conformably upon Chapin Wash formation (new), but overlaps onto Artillery formation (new) along Burro Wash, where Chapin Wash formation thins out. Unconformably underlies Sandtrap conglomerate (new). Because of its conformity with Chapin Wash formation, it is thought to belong to same geologic epoch as that formation and, therefore, to be tentatively of lower Pliocene age. Shown on plate 1 as Pliocene(?) and on plate 2 as early Pliocene(?).

Named from exposure on Cobwebb Hill, in upper Chapin Wash in Artillery Mountains, about 30 miles east of Colorado River.

Cocalico Shale[1]

Ordovician: Southeastern Pennsylvania.

Original reference: G. W. Stose and A. I. Jonas, 1922, Washington Acad. Sci. Jour., v. 12, p. 359, 365.

F. M. Swartz, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1568. Cocalico shale is known by this name only along a 24-mile belt centering about 30 miles east-southeast of Harrisburg. Rests on Beekmantown, and is perhaps 1,000 feet thick, with its summit everywhere truncated by present level of erosion, so that relations to overlying sediments are not directly established.

Named for exposures on Cocalico Creek, Lancaster County.

Cochahee Sandstone Member (of Vamoosa Formation)

Cochahee Sandstone Member (of Nelagoney Formation)[1]

Pennsylvanian (Virgil Series): Northeastern Oklahoma.

Original reference: D. E. Winchester, K. C. Heald, and others, 1918, U.S. Geol. Survey Bull. 686–G, p. 60.

W. F. Tanner, 1956, Oklahoma Geol. Survey Circ. 40, p. 12 (fig. 1), 47–48, pl. 1. Reallocated to Vamoosa formation. Near type locality, the Cochahee is a buff thin- to medium-bedded fine-grained sandstone exhibiting "bar structure," ripple marks, and crossbedding. In T. 24 N., member consists of at least 10 feet of buff sandstone and may include a 12-foot contorted sandstone separated from the lower bed by 20 feet of shale. Occurs above Jonesburg sandstone member and below Wynona sandstone member.

Named for exposures on headwaters of Cochahee Creek, in southwest part of T. 25 N., R. 10 E., Osage County. [Probably considered type locality by Tanner.]

Cochise Formation[1]

Middle Cambrian: Southeastern Arizona.

Original reference: A. A. Stoyanow, 1936, Geol. Soc. America Bull., v. 47, no. 4, p. 466, 479, 480, 482.

D. J. Cederstrom, 1946, Am. Jour. Sci., v. 244, no. 9, p. 607. Represented by 50 feet of poorly exposed shales beneath Abrigo formation in Dragoon Mountains.

Type locality: Whetstone Mountains, Cochise and Pima Counties.

Cochise limestones[1]

Lower Cretaceous (Comanche Series): Southeastern Arizona.

Original reference: C. R. Keyes, 1922, Pan-Am. Geologist, v. 38, p. 250, 336.

Probably named for exposures at or near Cochise, Cochise County.

Cochise Peak Quartz Monzonite

Triassic or Jurassic: Southeastern Arizona.

James Gilluly, 1956, U.S. Geol. Survey Prof. Paper 281, p. 9, 63–65, pl. 5. Generally light greenish gray, weathering to rather dark-grayish-brown colors. Generally spangled with conspicuous flesh-colored crystals of microcline as much as 4 centimeters long. Abundance of crystals ranges greatly. In places, rock grades into mylonites. Most contacts are faults and thus give little direct clue to original intrusive relations. Older than Stronghold granite with which it is in contact in three areas of Pearce quadrangle.

Crops out in belt extending from northern side of Cochise Peak, south-southeastward for nearly 3 miles, to the divide at Middle Pass, central Cochise County. Belt ranges in width from about 1,000 feet to nearly one-half mile. Numerous other small bodies and blocks recognized in area but are too small to be mapped.

Cochran Formation

Cochran Conglomerate[1]
Cochran Quartzite } (in Chilhowee Group)

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

Original reference: A Keith, 1895, U.S. Geol. Survey Geol. Atlas, Folio 16.

G. W. Stose and A. J. Stose, 1947, Am. Jour. Sci., v. 245, p. 626 (table), 628–629 (fig. 1). Cochran quartzite listed with rocks exposed in Hot Springs window, North Carolina. Thickness 1,200 to 1,400 feet. Includes Nichols shale and quartzite lentil of Keith. Overlies Sandsuck shale; underlies Nebo quartzite. Lower Cambrian.

S. S. Oriel, 1950, North Carolina Div. Mineral Resources Bull. 60, p. 12, 13 (table 3). Two sets of formation names for Lower Cambrian clastic rocks are in current usage in eastern Tennessee and western North Carolina. The northeast Tennessee names, Unicoi, Hampton, and Erwin, are used in this report for same rocks which Keith (1904, U.S. Geol. Survey Geol. Atlas, Folio 116) and Stose and Stose (1947) named Cochran, Nichols, Nebo, Murray, and Hesse, all defined by Keith (1895) in Chilhowee Mountains area, Blount and Sevier Counties, Tenn. Hot Springs area lies midway between type localities for each group of names. Cochran conglomerate included in Unicoi formation of this report.

P. B. King and others, 1958, Geol. Soc. America Bull., v. 69, no. 8, p. 955 (table 1), 962. Base of Cochran formation redefined at higher level, at base of persistent beds of arkose and quartzite, in part maroon; shale, sandstone, and conglomerate beneath is redefind as Sandsuck formation. Cambrian and Precambrian(?).

U.S. Geological Survey currently designates the age of the Cochran Formation as Early Cambrian(?) on the basis of a study now in progress.

Type locality (Rodgers, 1953): Cochran Creek on south side of Chilhowee Mountain, Blount County, Tenn. Makes crest of mountain northwest of lower course of creek.

Cochrane Glacial Substage

Pleistocene (Wisconsin): North America.

Kirk Bryan and L. R. Ray, 1940, Smithsonian Misc. Colln., v. 99, no. 2, p. 70; Kirk Bryan, 1941, Smithsonian Misc. Colln., v. 99, no. 23, p. 57 (table 1). Cochrane glacial substage mentioned in discussion of Folsom culture of late glacial age. Long Draw glacial substage of Colorado is considered equivalent of the Cochrane and Fennoscandian substages, to which an age of 10,000 years may be assigned.

T. N. V. Karlstrom, 1955, (abs.) Geol. Soc. America Bull., v. 66, no. 12, pt. 2, p. 1582. Radiocarbon determinations give Wisconsin glaciations beginning 7,000 B.C. (Cochrane). "Little ice age" began 3,500 B.C.

T. N. V. Karlstrom and Meyer Rubin, 1955, (abs.) Geol. Soc. America Bull. v. 66, no. 12, pt. 2, p. 1582; T. N. V. Karlstrom, 1956, U.S. Geol. Survey Bull. 1021–J, p. 303–330. Precise position of Cochrane readvances in Pleistocene continental chronology has long been uncertain. Recent radiocarbon results indicate that the Cochrane preceded rather than followed the Altithermal climatic period and suggest that the Cochrane be considered a Wisconsin event of substage rank. Radiocarbon dates also substantiate correlation of the Mankato with Fennoscandian substage of European chronology, and correlation of the Cochrane with a post-Fennoscandian climatic event.

M. M. Leighton, 1957, Jour. Geology, v. 65, no. 1, p. 109. Cochran[e] excluded from classification of Wisconsin stage because it is believed to represent only a minor incident in final climatic adjustment to present intraglacial stage, the Recent.

Name derived from Cochrane, Ontario.

Cochrane Limestone Member (of Chimneyhill Limestone)

Lower Silurian: South-central Oklahoma.

R. A. Maxwell, 1936, Northwestern Univ. Summ. of Doctoral Dissert., v. 4, p. 132, 133. White to grayish-white, but locally bluish- or greenish-gray, massive crystalline limestone containing glauconite. Average thickness 12 to 15 feet. Unconformably underlies Dillard limestone member (new); conformably overlies Keel limestone member (new).

T. W. Amsden, 1957, Oklahoma Geol. Survey Circ. 44, p. 4 (fig. 2), 6 (fig. 3), 13 (fig. 5), 16–19. Unconformally underlies Clarita member (name replaces Maxwell's preoccupied Dillard); unconformably overlies Keel member. Type locality stated.

Type section: SE¼ sec. 5, T. 2 N., R. 6 E. [Pontotoc County]. Well exposed along banks of small tributary entering Chimneyhill Creek.

Cockeysville Marble[1]

Cockeysville Formation

Lower Paleozoic(?): (Glenarm Series): Maryland, northern Delaware, southeastern Pennsylvania, and northeastern Virginia.

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. Mining Engineers, Feb. 1892.

A. J. Stose and G. W. Stose, 1946, Maryland Dept. Geology, Mines and Water Resources [Rept. 12] Carroll and Frederick Counties, p. 55. On geologic map of Carroll County (1928), all marble and limestone exposed in crystalline rocks of Piedmont upland are mapped as Cockeysville, but name Cockeysville is now restricted to narrow band of marble overlying Setters formation in southeast corner of Carroll County. Marble in northeastern Carroll County is now mapped as Wakefield marble, and in western part of Carroll County and eastern part of Frederick County, where marble is associated with volcanic rocks, the albite-chlorite schist facies of the Wissahickon formation, and the Marburg schist, it is mapped as Wakefield marble and Silver Run limestone on the Frederick County geologic map (1938). Thickness estimated 400 feet.

W. C. Rasmussen and others, 1957, Delaware Geol. Survey Bull. 6, v. 1, p. 95 (table 13), 96 (fig. 21), 100–102, pls. Cockeysville marble crops out in two places in Delaware, one near Hockessin in headwaters of Mill Creek and the other in valley of Pike Creek at foot of Pleasant Hill. Underlies Wissahickon formation. Glenarm series. Precambrian(?).

P. W. Choquette, 1960, Geol. Soc. America Bull., v. 71, no. 7, p. 1027–1052. Formation is sequence of intricately folded carbonate-rich metasedimentary rocks about 750 feet thick and of pre-Silurian age. Formation lies near base of Glenarm series which mantles five elongated domes of Precambrian(?) basement gneiss at eastern edge of Piedmont province. Overlies Setters formation; underlies Wissahickon formation.

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

Named for exposures at Cockeysville, Baltimore County, Md.

Cockeysville Volcanics[1]

Precambrian: Maryland.

Original reference: E. B. Mathews, 1963, Geologic map of Maryland: Maryland Geol. Survey.

Cockfield Formation (in Claiborne Group)[1]

Cockfield Formation (in Yegua Group)

Eocene, middle: Northwestern Louisiana, Mississippi, and eastern Texas.

Original reference: T. W. Vaughan, 1895, Am. Geologist, v. 15, p. 220.

J. Huner, Jr., 1939, Louisiana Geol. Survey Bull. 15, p. 119–142. Described in Caldwell and Winn Parishes, La., where it overlies Little Natches member (new) of Cook Mountain formation. Underlies Jackson group. Name Cockfield has been in common use in Louisiana since 1905, although there have been many suggestions to alter it.

E. P. Thomas, 1942, Mississippi Geol. Survey Bull. 48, p. 68–73. In this report, formation is expanded to include all beds below Moodys Branch of basal Jackson and above the Wautubbee. This usage is in agreement with usage of term Cockfield in Louisiana where type section is located. Term Cockfield does not have priority over either Yegua or Lufkin but is well established in Louisiana literature and is preferred over Yegua in this report. Cockfield of Mississippi has been considered both a member of Lisbon formation and a separate formation. Formation maintains thickness of about 50 feet across Clarke County and gradually thickens northwestward from this area to maximum of about 450 feet in Holmes and Yazoo Counties.

F. S. MacNeil, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 29. Formation shown on correlation chart in Mississippi; overlies Gordon Creek shale member of Cook Mountain formation; underlies Moodys Branch marl.

A. A. L. Mathews, 1950, Texas Eng. Expt. Sta. Research Rept. 14, p. 1, 4. Included in Yegua group. In Brazos County, overlies Easterwood shales (new); underlies Rock Prairie sandstone (new) of Jackson group. Estimated thickness 723 feet.

U.S. Geological Survey has restored the term Cockfield for use in Mississippi, Louisiana, and Arkansas to replace the term Yegua which is restricted to Texas.

Named for Cockfield Ferry on Red River, near Petite Ecore, Winn Parish, La.

†Cockfield Lignite[1]

Eocene, middle: Louisiana and Mississippi.

Original reference: E. N. Lowe, 1915, Mississippi Geol. Survey Bull. 12, p. 77.

Named for Cockfield Ferry, Winn County, La.

Cockfield Ferry Beds[1]

Eocene, middle: Northwestern Louisiana, Mississippi, and eastern Texas.

Original reference: T. W. Vaughan, 1895, Am. Geologist, v. 15, p. 220.

Named for Cockfield Ferry, on Red River, near Petite Ecore, Winn County, La.

Cockrum Sandstone (in Dakota Group)

Upper Cretaceous: Southwestern Kansas and southeastern Colorado.

B. F. Latta, 1941, Kansas Geol. Survey Bull. 37, p. 21 (table 1), 73–79, pl. 1. Name introduced to designate sandstone that overlies Kiowa shale; classed as uppermost division of the Dakota, here considered a group, and includes beds that have formerly been designated under name of Dakota sandstone. Composed of fine- to medium-grained light-tan, buff, brown, or reddish-brown sandstone, commonly ferruginous, and light-colored shale or clay. Thickness as much as 125 feet. In Stanton County, disconformably underlies Ogallala formation; in Hamilton County, conformably underlies Graneros shale; basal contact not exposed in Stanton County but is exposed in Prowers County, Colo.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 153. Rocks which comprise Dakota formation, Kiowa shale, and Cheyenne sandstone formerly were classed as Dakota group. Use of this grouping has been discontinued. Cockrum sandstone of southwestern Kansas is equivalent in age to part of Dakota formation.

Named from outcrops along Cockrum Branch of Bear Creek in S½ sec. 9, T. 29 S., R. 43 W., and from outcrops along Bear Creek in southwestern Stanton County, Kans.

Cocoa Sand Member (of Yazoo Clay)

Cocoa Sand Member (of Jackson Formation)[1]

Eocene, upper: Southwestern Alabama and eastern Mississippi.

Original reference: J. A. Cushman, 1925, Cushman Lab. Foram. Research Contr., v. 1, pt. 3, p. 65–69.

[U. B. Hughes] 1940, Mississippi Geol. Soc. [Guidebook] Field Trip Feb. 10 and 11, second day's field trip, p. 2. Referred to as sand member of Yazoo clay.

C. W. Cooke, Julia Gardner, and W. P. Woodring, 1943, Geol. Soc. America Bull., v. 54, no. 11, chart 12; F. S. MacNeil, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 9, p. 1315 (fig. 1). Correlation chart shows Cocoa sand member of Yazoo clay.

H. A. Tourtelot, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 6. In Choctaw County, Ala., member consists of lower marly fine-grained sand phase and upper coarser calcareous sand phase. Lower phase, 10 to 20 feet thick, is clayey and marly fine-grained micaceous sand that is bluish gray or greenish blue on fresh outcrop; upper phase, 20 to 50 feet thick, is medium-grained calcareous sand containing irregular ledges of glauconitic limestone and marl at top.

G. E. Murray, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 10, p. 1838 (fig. 6), 1839. In Mississippi and Alabama, Cocoa sand member is overlain by Pachuta marl member and underlain by North Creek clay member (both new).

Named for abandoned country post office called Cocoa, which stood in SW¼ sec. 13, T. 11 N., R. 5 W., Choctaw County, Ala., about 2½ miles east of Melvin, on road to Gilberton.

Coconino Sandstone (in Aubrey Group)[1]

Permian: Arizona, southeastern Nevada, and southern Utah.

Original reference: N. H. Darton, 1910, U.S. Geol. Survey Bull. 435, p. 21, 27.

E. D. McKee, 1938, Carnegie Inst. Washington Pub. 492, p. 14–17. Conformably underlies Toroweap formation (new).

E. D. Koons, 1945, Geol. Soc. American Bull., v. 56, no. 2, p. 154. In Grand Canyon area, overlies Hermit shale and underlies Toroweap formation. Thickness 100 feet in eastern part of area, thinning westward to 50 feet along Queantoweap Valley.

A. H. McNair, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 3, p. 532–534. Type section not designated by Darton or by later workers. Section at Aubrey Cliffs can be considered as type section, because it is near place where Marvine (1875, U.S. Geog. and Geol. Surveys West of 100th Meridian, v. 3, pt. 2) studied rocks he designated Aubrey group of which the Coconino is a member. Thickness 405 at Aubrey Cliffs section. Lowest beds in abrupt contact with Supai redbeds.

C. B. Hunt, Paul Averitt, and R. L. Miller, 1953, U.S. Geol. Survey Prof. Paper 228, p. 38 (table), 46. In Henry Mountains region, Utah, is as much as 600 feet thick. Consists of tangentially cross-laminated gray to white fine-grained quartz sandstone. Believed to be equivalent to and grade laterally into Cutler formation to east. Underlies Kaibab limestone. Base of section in this report.

R. E. Lehner, 1958, U.S. Geol. Survey Bull. 1021–N, p. 540–543. Described in Clarkdale quadrangle, Arizona, where it is 500 to 650 feet thick. Conformably overlies Supai formation and passes laterally into its upper part through intertonguing. Underlies Toroweap formation, contact sharp. McKee (1934, Carnegie Inst. Washington Pub. 440) reported thickness of 1,000 feet at Pine, Ariz.; this is thickest section known.

Type section (McNair): Aubrey Cliffs, Coconino County, Ariz. Underlies entire Coconino Plateau as well as extensive plateau country north of Grand Canyon.

Codell Sandstone Member (of Benton Shale)

Codell Sandstone Member (of Carlile Shale)[1]

Upper Cretaceous: Western Kansas, eastern Colorado, and southeastern South Dakota.

Original reference: N. W. Bass, 1926, Kansas Geol. Survey Bull. 11, p. 28, 64.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull, 89, p. 24. Referred to as Codell sandstone zone in Blue Hill shale member of Carlile shale.

W. A. Cobban and J. B. Reeside, Jr., 1952, Geol. Soc. America Bull., v. 63, no. 10, chart 10b (column 53). Shown on correlation chart as member at top of Benton shale, Morgan County, Colo.

R. C. Barkley, 1953, South Dakota Geol. Survey Rept. Inv. 72, p. 17, 18. Thickness about 6 feet where exposed in Davison County. Occurs at top of Carlile.

T. G. McLaughlin, 1954, U.S. Geol. Survey Water-Supply Paper 1256, p. 16 (table 3), 121. Uppermost member of Carlile shale. In Baca County, Colo., consists of 2½ to 3 feet of light-tan to rusty-brown hard finely crystalline limestone containing a few sand grains. Overlies Blue Hill shale member; underlies Fort Hays limestone member of Niobrara formation.

M. A. Jenkins, Jr., 1957, Rocky Mountain Assoc. Geologists Guidebook to the geology of North and Middle Parks Basin, Colorado, p. 53, pl. 1. Upper member of Benton formation in Red Dirt Creek area, Grand County, Colo. Thickness about 46 feet. Underlies Fort Hays member of Niobrara.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. Shown on correlation chart as uppermost member of Carlile shale. Overlies Blue Hill shale member; underlies Fort Hays limestone member of Niobrara chalk.

Named for exposures in bluffs along Saline Valley in Ellis County, Kans., 5 miles south and west of Codell.

Codorus Limestone[1]

Cambrian and Ordovician: Southeastern Pennsylvania.

Original reference: J. P. Lesley, 1892, Pennsylvania 2d Geol. Survey Summ. Final Rept., v. 1, p. 454.

Codorus Creek, York County.

Cody Shale[1] **(in Colorado Group or Montana Group)**

Upper Cretaceous: Wyoming and Montana.

Original reference: C. T. Lupton, 1916, U.S. Geol. Survey Bull. 621, p. 166, 171, table.

E. B. Branson and C. C. Branson, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 126 (fig. 2), 138. In Wind River Mountains, consists of about 4,500 feet of dark-gray shales interbedded with thin sandstone members. Overlies Frontier formation; underlies Mesaverde formation. Name Cody preferred to Steele because Cody was described as resting on the Frontier in Bighorn basin whereas the Steele was described as resting on the Niobrara. Near Wind River Mountains, there is no lower division that should be differentiated as Niobrara formation although fossils of Niobrara age are present.

S. K. Fox, Jr., 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1967. Analysis of 94 species of late Cretaceous Foraminifera from three well-exposed sections of Cody shale in northern Wyoming and southern Montana indicates correlation of the Cody with Niobrara chalk of Great Plains and with upper part of Alberta shale of Canada. Correlation of entire Cody shale with the Niobrara supports Reeside's conclusions from mollusk evidence but is contrary to frequent practice of designating the lower Cody as Carlile in age.

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 area in central Wyoming] shows that Cody shale overlies Wall Creek sandstone member of Frontier formation and underlies Parkman sandstone member of Mesaverde formation. Includes Shannon sandstone member in upper part. Term Cody as used here replaces terms Carlile shale, Niobrara shale, and Steele shale as used in this area by Hares (1916, U.S. Geol. Survey Bull. 1641–I.)

G. R. Downs, 1947, Wyoming Geol. Assoc. Guidebook 2d Ann. Field Conf., p. 138, 139. Consists of series of gray to black marine shales, shaly buff sandstones (upper part only), gray calcareous shale, and a few thin bentonites. Maximum thickness about 3,500 feet at type locality; thins to about 2,600 feet in southeastern part of Bighorn basin. Unconformably overlies Frontier formation and conformably underlies Mesaverde formation. Near Elk basin oil field and Montana-Wyoming line, Claggett shale, Eagle sandstone, and Telegraph Creek formation occupy same stratigraphic interval as upper part of Cody elsewhere in Bighorn basin. Near city of Cody, the Eagle sandstone and Telegraph Creek sandy shale "shale out," and the shale facies are included in the Cody as there defined. The buff to gray Claggett sandy shale equivalent forms top of the Cody shale. Montana group.

J. D. Love and others, 1948, Wyoming Geol. Survey Bull. 40, p. 5–8, 41. Measured sections show that Cody shale underlies Bacon Ridge sandstone (new) in southeast part of Jackson Hole area. Overlies Frontier formation. This contact is established in conformity with U.S. Geological Survey classification and common usage for central Wyoming. At type area of Frontier, this contact may come well down within the Frontier. Contact is arbitrarily placed at approximate point below which sandstones predominate and above which sandy shales predominate. This contact is gradational within an interval of approximately 20 feet. Maximum thickness 2,211 feet.

P. W. Richards and C. P. Rogers, Jr., 1951, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map OM–111; P. W. Richards, 1955, U.S. Geol. Survey Bull. 1026, p. 50–62, pls. 1, 2. Cody shale, in Bighorn River Canyon, Hardin area, Big Horn County, Mont., comprises (ascending) lower shale, 205 feet; Greenhorn calcareous member, 97 feet; Carlile shale member, 280 feet; Niobrara shale member, 409 feet; Telegraph Creek member, 867 feet; shale member equivalent to Eagle sandstone, 375 feet; Claggett shale member, 367 feet. Overlies Frontier formation; underlies Parkman sandstone. Colorado and Montana groups.

J. B. Wilson, 1951, Wyoming Geol. Survey Rept. Inv. 3, p. 3–11. In Powder River basin, includes Shannon sandstone and Sussex sandstone members. Sussex is known primarily in subsurface.

R. K. Hose, 1955, U.S. Geol. Survey Bull. 1027–B, p. 61–63, pls. 6, 8. Described in Crazy Woman area, Johnson County, Wyo., where it is about 3,670 feet thick, overlies Frontier formation and underlies Parkman sandstone. Includes Shannon sandstone member.

J. D. Love, J. L. Weitz, and R. K. Hose, 1955, Geologic map of Wyoming (1:500,000): U.S. Geol. Survey. Cody, as mapped in northeastern Wyoming, includes Shannon sandstone member 2,000 feet above base and Sussex sandstone member 2,500 feet above base.

M. M. Knechtel and S. H. Patterson, 1956, U.S. Geol. Survey Bull. 1023, p. 12 (fig. 3), 15, 16, 17–34, pls. 1, 2. Described in Hardin district, Montana and Wyoming where it includes all units between Mowry shale and Judith River formation. As thus defined, the Cody comprises (ascending) Belle Fourche shale, Greenhorn calcareous shale, Carlile and Niobrara shale (undifferentiated), Telegraph Creek shale, unnamed sandy shale, and Claggett shale members. Colorado and Montana groups. Strata formerly designated Frontier formation are assigned to Belle Fourche member. Following changes in local nomenclature favored by the authors have not been adopted by the Geological Survey: elimination of name "Cody shale"; introduction of name Steele shale to designate a formation containing the three members of the Cody (Telegraph Creek, unnamed member, and Claggett member) that fall within Montana group; promotion to formation rank of each of the three members of the Cody (Belle Fourche, Greenhorn, and Carlile-Niobrara) that are included in the Colorado group.

W. J. Mapel, 1959, U.S. Geol. Survey Bull. 1078, p. 46–57, pls. 1, 3. Formation includes sequence of marine sandstone and shale of Late Cretaceous age which in Buffalo-Lake De Smet area overlies conglomeratic sandstone of Frontier formation and underlies Parkman sandstone. Intense folding and faulting at some places and poor exposures at other prevent reliable measurement of thickness of formation in Buffalo-Lake De Smet area; thickness about 3,550 feet near Elgin Creek about 3 miles south of area. Seven members recognized (ascending): unnamed lower shale, Greenhorn calcareous, Carlile shale, Niobrara shale, unnamed sandstone and shale, Shannon sandstone, unnamed upper shale. Colorado and Montana groups.

Named for exposures at Cody, Park County, Wyo.

Coe Group

Middle Silurian (Niagaran): Northwestern Illinois.

H. A. Lowenstam, 1949, Illinois Geol. Survey Rept. Inv. 145, p. 9 (fig. 2), 18. Includes all Niagaran formations in the clastic-free sedimentation belt. As here defined, comprises the Waukesha, Racine, and Port Byron formations as Savage (1926, Geol. Soc. America Bull., v. 37) differentiated them. Interreef rocks of group are distinguished by brownish-gray color, low terrigenous clastic content, absence of chert, and limited facies variations; differ from Bainbridge group in being predominantly dolomite. [Report deals with Niagaran reefs in Illinois and their relation to oil accumulation; much data relative to thickness and distribution of units are based on subsurface studies.]

Typical strata are well exposed in Coe Township, Whiteside County, especially in bluff extending eastward from Cordova and crossing the township in secs. 1–4, T. 19 N., R. 2 E.

Coetas Formation[1]

Pliocene: Western Texas

Original reference: L. T. Patton, 1923, Texas Univ. Bull. 2330, p. 80–86.

Well exposed on Coetas Creek, in eastern part of Potter County.

Coeur d'Alene facies (of Belt Series)

Precambrian: Northern Idaho and western Montana.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc. America Bull., v. 48, no. 12, p. 1877. Within its northern basin, Belt series is divisible into facies that differ in lithology, stratigraphic sequence, thickness, recorded conditions of deposition, fauna, and flora. Coeur d'Alene facies characterized by sandstones and argillaceous beds throughout the Striped Peak (lower Spokane), by reduction of carbonate rocks in the Siyeh equivalent (lower Wallace), and by tripartite division of Ravalli, which is clastic throughout. Closely related to Purcell.

In Coeur D'Alene region.

†Coeur d'Alene Series[1]

Precambrian (Belt Series): Northeastern Idaho and central western Montana.

Original reference: D. F. MacDonald, 1906, U.S. Geol. Survey Bull. 285, p. 42–43.

Coeur d'Alene Mountains region, Idaho.

Coeymans Limestone (in Helderberg Group)[1]

Coeymans Limestone Member (of Helderberg Limestone)

Lower Devonian: Eastern New York, western Maryland, New Jersey, eastern Pennsylvania, Virginia, and northern West Virginia.

Original reference: J. M. Clarke and C. Schuchert, 1899, Science, new ser., v. 10, p. 874–878.

F. M. Swartz, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 51–55, 89. Includes Stormville sandstone member at top in Monroe County and Elbow Ridge sandstone member (new) in Franklin County. Thicknesses: 40 feet at Nearpass quarries. New Jersey; 80 feet, Monroe County; 40 to 50 feet, Carbon County; 3 to 10 feet, central and south-central Pennsylvania; 50 to 55 feet near Monterey, Va. Overlies Keyser limestone; underlies New Scotland formation.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 274–276. Member is limited at top by New Scotland limestone or Healing Springs sandstone where present at base of New Scotland. Overlies Keyser limestone member. Thickness 17 to 50 feet.

H. P. Woodward, 1943, West Virginia Geol. Survey, v. 15, p. 32, 67–82. Coeymans formation of this report is a well-defined lithologic unit that apparently can be traced continuously in several belts from Pennsylvania across Maryland into West Virginia and western Virginia. Consists of limestone with sandstone facies in northwestern belts.

Thickness as much as 35 feet. Overlies Keyser limestone; underlies New Scotland limestone. Helderberg group.

Ernst Cloos, 1951, Maryland Dept. Geology, Mines and Water Resources Washington County [Rept. 14], p. 83. Member consists of blue massive crystalline and very fossiliferous limestone, some chert, and sandstone bed near base. Thickness 8 to 13 feet. Underlies New Scotland limestone member; overlies Keyser limestone.

L. V. Rickard, 1955, (abs.) Geol. Soc. America Bull., v. 66, no. 12, pt. 2, p. 1608. Westward from Helderbergs of eastern New York, Coeymans limestone thickens to nearly 100 feet at Cherry Valley. The thickened Coeymans splits into three parts: lower and middle parts grade laterally into Olney, Elmwood, Clark Reservation, and Jamesville members of type Manlius; upper part continues westward to Chittenango Falls. Thus, most of Manlius in central New York is facies of Coeymans of eastern New York. Lower Devonian. Silurian-Devonian boundary appears to be stratigraphically lower than is currently placed.

L. V. Rickard, 1955, New York State Geol. Assoc. 27th Ann Mtg., p. 7. Helderbergian series (revised) consists of nine formations, only five of which are present in central New York: Cobleskill, Rondout, Manlius, Coeymans, and Kalkberg. New Scotland (restricted), Becraft, Alsen, and Port Ewen are not present in central New York. Coeymans limestone of central New York, overlying Jamesville member of Manlius, is entirely younger than Coeymans of eastern New York. Name Deansboro is proposed for this part of the Coeymans. Underlies Kalkberg cherty limestone. Helderbergian series.

L. V. Rickard, 1956, Dissert. Abs., v. 16, no. 1, p. 102. Coeymans formation thickens to nearly 100 feet at Cherry Valley. Slightly further, the Coeymans splits into three parts. Lower part, for which name Dayville limestone is proposed, grades laterally into Olney limestone of Syracuse area. Middle part rapidly changes into the Elmwood, Clark Reservation, and Jamesville members of the Manlius. For upper beds, which continue westward as far as Chittenango Falls, name Deansboro limestone is proposed. Base of Devonian system of New York is apparently not at base of Coeymans limestone of eastern part of state where it had been placed for many years. Present information indicates that underlying Rondout and Cobleskill formations are probably also Devonian in age.

F. G. Lesure, 1957, Virginia Polytechnic Inst. Bull., Engineering Expt. Sta. Ser. 118, p. 20 (table 2), 46–47. In Clifton Forge district, underlies Healing Springs sandstone and overlies Keyser formation. Thickness 12 to 20 feet. Helderberg group. Lower Devonian.

W. A. Oliver, Jr., 1960, Jour. Paleontology, v. 34, no. 1, p. 59–100. Oldest formation in Helderberg group in eastern New York. West of Albany area, higher formations of group (New Scotland and Becraft limestones) and Oriskany group are cut out one by one by pre-Onondaga erosion until, in area between Oriskany Falls and Manlius, the Coeymans limestone is overlain directly by Onondaga limestone, except where local patches of Oriskany intervene. A bioherm or reef facies is present in Coeymans at several places within Oriskany Falls-Manlius area. This facies has not previously been noted in print. Rugose coral fauna described. Fauna strongly suggests Early Devonian age.

Named for exposures at Coeymans, Albany County, N.Y.

Coffee Sand[1] } (in Selma Group)
Coffee Formation }

Upper Cretaceous: Western Tennessee and northeastern Mississippi.

Original reference: J. M. Safford, 1864, Am. Jour. Sci., 2d, v. 37, p. 361, 362–363.

L. W. Stephenson and W. H. Monroe, 1940, Mississippi Geol. Survey Bull. 40, p. 140–147. Crops out in Mississippi in belt about 10 miles wide west of Eutaw formation and east of Selma chalk except in central Lee County where it intertongues and merges with lower part of Selma chalk. Includes Tupelo tongue. Average thickness about 200 feet in Prentiss and Alcorn Counties.

W. E. Belt and others, 1945, Geologic map of Mississippi (1:500,000): Mississippi Geol. Survey. Included in Selma group.

W. S. Parks, 1960, Mississippi Geol. Survey Bull. 87, p. 22, 26, 40–52, pl. 4. Formation described in Prentiss County where it is about 27 feet thick. Disconformably overlies Tombigbee sand member of Eutaw formation; conformably underlies Demopolis formation.

Named for exposures at Coffee Landing, Hardin County, Tenn.

Coffee Creek Formation

Mississippian: Central Oregon.

C. W. Merriam, 1942, Jour. Paleontology, v. 16, no. 3, p. 372. Marine limestones and sandstones 900 to 1,000 feet thick. Disconformably underlies Spotted Ridge formation (new). Lower Carboniferous.

C. W. Merriam and S. A. Berthiaume, 1943, Geol. Soc. America Bull., v. 54, no. 2, p. 149–151. Type section shows about 75 feet of strata dipping about 53° NW.; these outcrops probably represent higher part of formation. Thickness difficult to determine due to deformation; estimate is based on width of outcrop in anticlines on Coffee Creek and north of Coyote Butte, where in latter locality strata are nearly vertical. Base of formation nowhere exposed.

Type section: In sec. 30, T. 18 S., R. 25 E., one-fourth mile east of spring at Mills sheep camp, southeast of Paulina, Crook County. Named for exposures on Coffee Creek which enters Grindstone Creek south of Wade Butte.

Coffee Mill Hammock Marl Member (of Fort Thompson Formation)

Coffee Mill Hammock Marl[1]

Pleistocene: Southern Florida.

Original reference: E. H. Sellards, 1919, Florida Geol. Survey 12th Ann. Rept. p. 73, 74.

G. C. Parker and C. W. Cooke, 1944, Florida Geol. Survey Bull. 27, p. 73. Name Coffee Mill Hammock marl revived and given member status in Fort Thompson formation. Member is contemporaneous with upper part of Anastasia formation.

J. R. DuBar, 1958, Gulf Coast Assoc. Geol. Soc. Trans., v. 8, p. 136 (fig. 4), 145, 146–147. At type locality and at most river localities, Coffee Mill Hammock marl conformably overlies a fresh-water marl or limestone and is, in turn, overlain unconformably by sands of Pamlico formation or by Lake Flirt marls. Thickness at type locality 3 to 6 feet; in some areas, marl does not form actual bed but is preserved as fillings in solution holes and pockets in limestone below.

In this report, all Fort Thompson deposits that underlie Coffee Mill Hammock marl have been grouped together and named Okaldakoochee marl.

Named for exposures at Goodno's Landing, Fort Thompson, and at Coffee Mill Hammock, De Soto County, 12 miles above Labelle. [Referred to as type locality by some authors.]

Coffeen 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), 71, pl. 1. Name applied to limestone overlying Witt coal member (new). Thickness as much as 20 inches. Stratigraphically below Millersville limestone member. Name credited to H. J. Gluskoter (unpub. ms.). Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification is retained but is entirely independent of rock-stratigraphic classification.

Type locality: NE¼NW¼SE¼ sec. 7, T. 8 N., R. 2 W., Montgomery County. Named from village of Coffeen, 5 miles southwest of type exposure.

Coffee Ranch[1]

Pliocene: Western Texas.

Original reference: R. D. Reed, 1933, Geology of California, p. 303.

In Hemphill County.

Coffeyville Formation[1] (in Skiatook Group)

Pennsylvanian (Missouri Series): Southeastern Kansas and northeastern and central Oklahoma.

Original reference: F. C. Schrader and Erasmus Haworth, 1905, U.S. Geol. Survey Bull. 260, p. 448.

R. C. Moore and others, 1937, Kansas Geol. Soc. Guide Book 11th Ann. Field Conf., p. 39, 40. Name Coffeyville restricted to strata between top of Checkerboard limestone below and base of (Hogshooter) Dennis formation above. Included in Skiatook group.

M. C. Oakes, 1940, Oklahoma Geol. Survey Bull. 62, p. 33–39. Consists of seven zones, four of shale and three of sandstone. Thickness 175 to 235 feet. In all but a few localities, the Winterset (upper) member of Hogshooter is the capping bed, but locally the Coffeyville is succeeded by the Canville, Stark, or Lost City members.

M. C. Oakes, 1952, Oklahoma Geol. Survey Bull. 69, p. 57–60. In Tulsa County, consists of five zones, two of sandstone, and three of shale. Thickness as much as 440 feet.

W. F. Tanner, 1956, Oklahoma Geol. Survey Bull. 74, p. 63–70. Coffeyville, in Seminole County, is made up of six lithologic units. De Nay limestone member, a shale, a middle (No. 1) sandstone, a shale, an upper (No. 2) sandstone, and a shale. Maximum thickness 260 feet. Overlies Seminole formation; underlies Nellie Bly formation. Interval designated by Morgan (1924, Oklahoma Bur. Geology Bull. 2) as Francis formation is herein described under headings of Coffeyville and Nellie Bly.

M. C. Oakes, 1959, Oklahoma Geol. Survey Bull. 81, p. 14, 17–20, pls. 1, 2. Described in Creek County where it conformably overlies Checkerboard limestone and conformably underlies Hogshooter formation. Shiatook group. Thickness 375 to 500 feet. Name Coffeyville not in current use in Kansas.

Named for exposures at Coffeyville, Montgomery County, Kans. Mapped as far south as Okfuskee County, Okla.

†Coffeyville Limestone[1]

Pennsylvanian: Southeastern Kansas.

Original reference: E. Haworth and J. Bennett, 1908, Kansas Acad. Sci. Trans., v. 21, pt. 1, p. 74.

Named for Coffeyville, Montgomery County.

Coffin Butte Volcanics

Eocene, middle: Northwestern Oregon.

I. S. Allison, 1953, Oregon Dept. Geology and Mineral Industries Bull. 37, p. 3–5. Proposed for a complex of basaltic flows, breccias, tuffs, and tuffaceous shales that make up eastern edge of Coast Range in northwest part of quadrangle. Thickness on Coffin Butte about 600 feet; formation crops out across a belt at least 2 and perhaps 3½ miles wide in direction perpendicular to regional strike; if moderate dip persists, uniformly thickness may be 5,000 to 10,000 feet, or at steeper angles, 10,000 to 15,000 feet. Stratigraphic relationship not clear; regional contact inferred to be a high-angle fault contact, probably a thrust. Correlation with Siletz River volcanic series (Snavely and Baldwin, 1948) to northwest appears reasonabe; because the two are disconnected and are not yet known to be exactly contemporaneous, separate names are retained.

Type locality: Coffin Butte, Albany quadrangle, where volcanics are exposed in several large cuts and quarries. Volcanics extend southwesterly from Coffin Butte on northeast through Vineyard Hill and other ridges north and northwest of Corvallis to vicinity of Philomath and Wren, and westward across northern Benton County.

Coffman Conglomerate Member (of Maroon Formation)[1]

Coffman Conglomerate Member (of Minturn Formation)

Coffman Conglomerate Member (of Weber ? Formation)

Pennsylvanian: 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. Paleont. Contr., v. 6, no. 4, p. 60. Contains *Calamites* and *Lepidodendron* which tentatively date bed as Pennsylvanian.

J. T. Stark and others, 1949, Geol. Soc. America Mem. 33, p. 35 (table 7), 39 (table 10), 40–41, 150, pl. 8. Reallocated to member status in unit termed Weber(?) formation. Overlies middle unnamed shale and limestone member; underlies Chubb siltstone member of Maroon formation. Arkosic conglomerate with interbedded sandstone and shale. Thickness 20 to 1,000 feet. Pennsylvanian.

K. G. Brill, Jr., 1952, Geol. Soc. America Bull., v. 63, no. 8, p. 811, 814, 820, 836. Reallocated to member status in Minturn formation. Basal unit of formation; underlies Chubb siltstone member.

Type section: In unnamed valley in sec. 24, T. 13 S., R. 77 W., about 2 miles north of Coffman Park, Chaffee and Park Counties.

Coggon Limestone[1] Member (of Wapsipincon Formation)

Middle Devonian: Central eastern Iowa.

Original reference: W. H. Norton, 1894, Iowa Acad. Sci. Proc., v. 1, pt. 4, p. 23, 24.

E. H. Scobey, 1940, Jour. Sed. Petrology, v. 10, no. 1, p. 38–40. Lowermost member of Wapsipinicon. Underlies Otis limestone member; overlies Gower formation. Bertam member of Norton (1895) is here considered a local phase of the Coggan. Age shown on chart as Middle Devonian(?).

Type exposures at Coggon, Linn County, at crossing of Buffalo River by Illinois Central Railway.

Cohansey Sand[1]

Miocene(?) and Pliocene(?): New Jersey.

Original reference: H. B. Kummel and G. N. Knapp, 1904, New Jersey Geol. Survey, v. 6, p. 137.

W. B. Spangler and J. J. Peterson, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 1, p. 4 (fig. 2), 61. Thickness 100 to 250 feet. Chiefly quartz sand with local beds of clay and gravel. Overlies Kirkwood formation; underlies Beacon Hill gravel. Chart shows age as middle Miocene.

D. S. Malkin, 1953, Jour. Paleontology, v. 27, no. 6, p. 766, 771. Classified as upper Miocene but is probably a diachronic facies including beds of middle and late Miocene.

J. P. Owens and J. P. Minard, 1960, Johns Hopkins Univ. Studies in Geology No. 18, p. 27. Age of Cohansey sand is problematical. May be late Miocene or younger, perhaps Pliocene.

Named for exposures along Cohansey Creek, Cumberland County.

Coharie Formation (in Columbia Group)[1]

Pleistocene: Atlantic Coastal Plain from Delaware to Florida.

Original reference: L. W. Stephenson, 1912, North Carolina Geol. Survey, v. 3, p. 273–277.

G. E. Siple, 1957, Carolina Geol. Soc. Guidebook for South Carolina Coastal Plain Field Trip, Nov. 16–17, table 1, following p. 1. In sequence listed for South Carolina and Middle Atlantic Coast, Coharie occurs below Sunderland and above Hazelhurst.

Named for Great Coharie Creek, a tributary of Black River in North Carolina.

Cohn Coal Member (of Mattoon Formation)

Pennsylvanian: Eastern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 41, 51 (table 1), 83, pl. 1. Name applied to coal member in lower part of formation. Stratigraphically below Merom sandstone member. Thickness 2 inches. Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification retained but is entirely independent of rock-stratigraphic classification.

Type locality: NE¼ sec. 1, T. 11 N., R. 12 W., Clark County. Exposure is 2 miles southeast of Cohn, now called Livingston.

Cohn cyclothem (in McLeansboro Group)

Cohn cyclothem (in Mattoon Formation)

Pennsylvanian: Southeastern Illinois.

W. A. Newton and J. M. Weller, 1937, Illinois Geol. Survey Rept. Inv. 45, p. 9, 18–19; J. M. Weller, 1942, Illinois Acad. Sci. Trans., v. 35, no. 2, p. 145 (table 1). Occurs above the LaSalle cyclothem and below the Bogota cyclothem (new). Total thickness 7½ inches.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 52 (table 2), pl. 1. In lower part of Mattoon formation (new). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification retained but is independent of rock-stratigraphic classification.

Type locality: About 2 miles northwest of Cohn in NE¼ sec. 1, T. 11 N., R. 12 W., Clark County.

Cohutta Conglomerate[1]

Lower Cambrian(?): Northwestern Georgia.

Original reference: C. W. Hayes, 1891, Geol. Soc. America Bull., v. 3, pl. 3, p. 4.

A. S. Furcron and K. H. Teague, 1947, Georgia Geol. Survey Bull. 53, p. 19. Several zones of pebbles and cobbles occur in Ocoee series of Murray County; they are unusual and represent an inconspicuous part of the series. Perusal of Hayes unpublished report of Dalton quadrangle indicates that these local conglomerates represent his "Cohutta conglomerate," but it is questionable if they have sufficient stratigraphic continuity to deserve formational recognition.

Probably named for Cohutta Mountain, Gilmer and Fannin Counties.

Cohutta Schist

Precambrian; Northwestern Georgia.

A. S. Furcron, K. H. Teague, and J. L. Calver, 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1195. Thrust faults supplementary to the mapped overthrust, which separates the eastern crystalline block from known Paleozoic sediments of the Great Valley, bring up a Precambrian biotite augen gneiss, Fort Mountain gneiss, intruded by granite upon which Ocoee rocks are unconformable. Talc deposits and associated schists, Cohutta schist, occur in upthrust block of Fort Mountain gneiss but not in Ocoee series.

A. S. Furcron and K. H. Teague, 1947, Georgia Geol. Survey Bull. 53, p. 6–9, pl. 1. Cohutta schist, believed to be oldest formation in area (Murray County), represents remnants of a metasedimentary formation which is included in Fort Mountain gneiss. Intruded by Corbin granite. Derivation of name given.

Named from Cohutta Mountain one of southernmost conspicuous elevations of Great Smoky Mountains. Formation contains talc deposits in Fort and Cohutta Mountain districts.

Coker Formation (in Tuscaloosa Group)

Upper Cretaceous: West-central Alabama.

L. C. Conant and W. H. Monroe, 1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 37. Consists of apparently nonmarine beds above the Eoline formation (new) and below the Gordo formation (new). Thickness 150 to 250 feet. Examples of varied lithology are (1) basal strongly cross-bedded channel sand, upper part locally finely laminated and containing macerated plant remains; (2) massive carbonaceous and varicolored clay containing nodules of granular siderite; locally clay occupies a channel which in places may extend to base of formation; (3) interbedded purple and gray mottled clay and highly crossbedded fine-grained micaceous yellow sand containing brecciated clay; (4) bentonite bed near base in one area; and (5) local occurrences of chert gravel which resemble gravel of the Gordo. The gravel is tentatively retained in the Coker because of the strikingly abrupt and widespread appearance of gravel in the Gordo; further investigations may indicate advisability of redefining contact so as to include all of the gravel and coarse sand in the Gordo.

W. H. Monroe, L. C. Conant, and D. H. Eargle, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 2, p. 197–200. At designated type locality, both top and bottom contacts are well exposed.

C. W. Drennen, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 3, p. 536. Stratigraphically extended below to include all outcropping pre-Gordo sediments of the Tuscaloosa group except sediments designated Vick formation (Conant, 1946), which may be Tuscaloosa in age. Coker thus consists regionally of a lower Eoline member and an upper unnamed member.

Type locality: Section on road from Spring Hill School in secs. 21 and 22, T. 21 S., R. 11 W., 3 miles south of Coker, Tuscaloosa County.

Coki Point megabreccia lithofacies (of Tutu Formation)

Upper Cretaceous: Virgin Islands.

T. W. Donnelley, 1960, Dissert. Abs., v. 20, no. 7, p. 2756; 1960, Caribbean 2d Geol. Conf. Trans., Mayagüez, Puerto Rico, p. 153. An intercalated slumped mass of andesite and limestone blocks, which have neritic fauna of corals, gastropods, pelecypods (including rudistid *Caprinuloidea*), and echinoids, and is of apparent Cenomanian age.

Report discusses geology of St. Thomas and St. John Islands.

Colbert cyclothem

Lower Pennsylvanian: Southern Illinois.

H. R. Wanless, 1956, Illinois Geol. Survey Circ. 217, p. 5, pl. 1. Substituted for former cyclothem name, Davis, because latter name is preempted. Underlies Dekoven cyclothem; overlies Stonefort cyclothem. Includes Davis coal bed which name is retained.

Type section: One-half mile west of Colbert School in the SE¼SW¼ sec. 23, T. 10 S., R. 7 E., Saline County.

Colbert Porphyry[1]

Precambrian: Central southern Oklahoma.

Original reference: C. A. Reeds, 1926, Am. Mus. Nat. History Jour., v. 26, p. 470–474, map.

R. E. Denison, 1959, (abs.) Oklahoma Acad. Sci. Proc. 1958, p. 124. Incidental mention in discussion of rhyolites of Oklahoma.

Occurs in Arbuckle Mountains. Derivation of name not stated.

Colchester Coal Member (of Carbondale Formation)

Pennsylvanian: Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 34, 35, 36, 46 (table 1), 62, 67, pl. 1. Basal member of Carbondale formation (redefined). Occurs below Shawneetown coal member (new) or below Francis Creek shale member. In western and northern area, replaces LaSalle (No. 2) coal so that name LaSalle can be retained for LaSalle limestone. Thickness about 2 feet. Coal named by Worthen (1868, *in* Geology and Paleontology, v. 3, Illinois Geol. Survey). Presentation of new rock-stratigraphic classisfication of Pennsylvanian strata in Illinois.

Type locality: Secs. 12 and 13, T. 5 N., R. 4 W., Colchester quadrangle, McDonough County.

†Colchester Formation[1]

Lower Cambrian: Northwestern Vermont.

Original reference: A. Keith, 1923, Am. Jour. Sci., 5th, v. 5, p. 110, 129.

Named for good exposures 1 to 2 miles north of Colchester village in town of Colchester, Chittenden County.

Cold Spring horizon[1]

Miocene or Pliocene: Eastern Texas.

Original reference: E. T. Dumble, 1915, Geol. Soc. America Bull., v. 26, p. 468, 470, 472, 473, 476.

West of Trinity River, San Jacinto County.

Cold Springs Granite[1]

Precambrian: Southwestern Oklahoma.

Original reference: C. H. Taylor, 1915, Oklahoma Geol. Survey Bull. 20.

Cold Springs area, Kiowa County.

Coldwater Formation

Coldwater Sandstone Member (of Tejon Formation)[1]

Eocene: Southern California.

Original reference: W. S. W. Kew, 1924, U.S. Geol. Survey Bull. 753.

W. C. Putnam, 1942, Geol. Soc. America Bull., v. 53, no. 5, p. 697 (fig. 3). Shown on columnar section of Ventura region as underlying Sespe formation and overlying Cozy Dell member. Thickness 1,500 to 2,000 feet. Member of Tejon formation.

F. R. Kelley, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 1, p. 6. Sediments locally known as Coldwater in Santa Barbara County redefined as Sacate formation.

T. L. Bailey, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 11, p. 1924. Referred to as Coldwater formation. Type locality stated.

Type locality: On Coldwater Creek, a westerly branch of lower Sespe Creek, 5½ miles northwest of Fillmore, Ventura County.

Coldwater Shale[1]

Coldwater Formation

Mississippian: Southern Michigan.

Original reference: A. C. Lane as reported by M. E. Wadsworth, 1893, Michigan Geol. Survey Rept. 1891 and 1892, p. 66.

V. B. Monnett, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 4, p. 630 (fig. 1), 636–651. Formation consists of the gray and gray-blue shales underlying Marshall formation in all parts of Southern Peninsula of Michigan. At most places, overlies black shale of Sunbury formation, but locally, especially in western and southwestern Michigan, it directly overlies Ellsworth green shale or Antrim black shale. Character of Coldwater sediments changes from east to west. Western facies consists of 565 to 1,080 feet of shale, in many places calcareous, with some interbedded dolomites; eastern facies characterized by siltstones and fine-grained sandstones interbedded with the shales; red shales and siltstones common in upper sediments of facies. A redbed at base of formation is only zone that can be recognized in both western and eastern facies. Kinderhook. Subsurface data.

Named for exposures on Coldwater River, in Branch and Hinsdale Counties.

Colebrooke Schist[1]

Pre-Cretaceous: Southwestern Oregon.

Original reference: J. S. Diller, 1903, U.S. Geol. Survey Geol. Atlas, Folio 89.

R. W. Imlay and others, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2784. In Port Orford area, basal beds of Days Creek formation (new) containing *Buchia crassicollis* Keyserling rest generally on Riddle formation, but locally overlap onto Colebrooke schist. Contact with Colebrooke schist is masked by slumping of the schist and is inferred from mapping. Contact of Days Creek with Galice formation and Colebrooke schist is interpreted as angular unconformity.

W. P. Irwin, 1960, California Div. Mines Bull. 179, p. 30. Colebrooke schist is considered correlative with South Fork Mountain schist (new). Colebrooke schist occurs in Port Orford quadrangle, Oregon, principally in two areas surrounded by sandstone and shales of Myrtle formation of Diller that ranges from late Late Jurassic to Cretaceous in age. Diller (1903, U.S. Geol. Survey Geol. Atlas, Folio 89) described the Colebrooke as sericite schists, phyllites, and slates that were derived from sedimentary rocks, and he considered it equivalent to schists along South Fork of Trinity River. On geologic map of Oregon, Wells (1955, U.S. Geol. Survey Mineral Inv. Field Studies Map MF-38) discarded name Colebrooke schist and showed those areas of rocks as having been derived from Rogue formation, which consists of lava flows, tuff, agglomerate, flow breccia, mostly of dacitic and andesitic composition, and of Jurassic age. He described rocks formerly named Colebrooke schist as banded crystalline rocks made up of dark hornblende-rich layers and light siliceous layers. Colebrooke schist is overlain unconformably by Myrtle formation of Diller.

Colebrooke Butte and surrounding country in Port Orford quadrangle are mapped as in this formation.

†Cole Camp Sandstone (in Van Buren Formation)[1]

Lower Ordovician (Beekmantown): Central Missouri.

Original reference: A. Winslow, 1894, Missouri Geol. Survey, v. 6, p. 331, 364–369.

Named for outcrops on Cole Camp Creek, Cole County.

Cole Canyon Dolomite[1]

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), 8. Described in East Tintic Mountains, where it conformably overlies Bluebird dolomite and concordantly underlies Opex formation. As mapped by U.S. Geological Survey, it is 830 to about 900 feet thick and includes lower dolomite member of Opex dolomite as defined by Loughlin (1930). Lower 600 feet consists of alternating beds of light-gray laminated dolomite resembling Dagmar limestone and massive dusky-blue-gray commonly "twiggy" dolomite resembling the Bluebird; light-gray beds weathering creamy white are 1 foot or so to about 25 feet thick, but one bed is 60 to 90 feet thick; dark-colored beds are 10 to 30 feet thick. Zone that was formerly considered part of Opex is 125 to about 300 feet thick, consists chiefly of dusky blue-gray dolomite with some "twiggy" beds, some beds of mottled crossbedded dusky-blue-gray dolomite, and few, if any, interlayered white beds. Base of Cole Canyon is placed at base of lowest creamy-white laminated dolomite, and top is placed at base of sequence of thin-bedded limestones and dolomites of Opex. Middle Cambrian.

J. K. Rigby, 1958, Utah Geol. Soc. Guidebook 13, p. 14 (fig. 3), 21–22, geol. map. In Stansbury Mountains, 320 to 370 feet thick; underlies Opex formation and overlies Bluebird dolomite. Mapped as originally used by Loughlin.

J. K. Rigby, 1959, Utah Geol. Soc. Guidebook 14, p. 14 (table 1), 25–26, 29 (fig. 9), pl. 1. In southern Oquirrh Mountains, about 200 feet thick; underlies Opex dolomite and overlies Bluebird dolomite. Cole Canyon dolomite of type area as originally defined by Loughlin (1919) probably correlates well with the rocks here included in the formation.

R. E. Cohenour, 1959, Utah Geol. and Mineralog. Survey Bull. 63, p. 12 (table 1), 52–53, pls. 1, 17. Described in Sheeprock Mountains where it is about 899 feet thick and consists of nearly equal parts of dolomite and limestone. Overlies Marjum formation; in fault contact with Opex formation.

Named for exposures along west slope of Cole Canyon, which extends north from Eureka Gulch three-fourths mile west of Eureka, Tintic district, Juab County.

Coleman Bed, Clay, or Limestone (in Admiral Formation)[1]

Permian: Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept. pt. 1, p. 421, 424.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 96. Name Jim Ned shale proposed to replace Drake's Coleman bed; name Coleman preoccupied.

Named for Coleman, Coleman County.

†Coleman division[1]

Permian: Central Texas.

Original reference: E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept., p. lxvii, pl. 3.

Named for Coleman County and for occurrence near town of Coleman.

Coleman 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 Coleman, Somerset County.

Coleman Junction Limestone Member (of Putnam Formation)[1]

Coleman Junction 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. 421.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Rank raised to formation in Putnam group. Underlies Hords Creek formation in Admiral group.

R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80, sheet 2. Described in Colorado River valley as member of Putnam formation. Consists of two to four subdivisions of limestone that are separated by thin shales. Thickness 8 to 25 feet. Overlies Santa Anna Branch shale member; underlies Lost Creek shale member of Admiral formation.

P. T. Stafford, 1960, U.S. Geol. Survey Bull. 1081–G, p. 271–272, pl. 11. Extended into Brazos River valley where it is 4 to 15 feet thick. Overlies Santa Anna Branch shale member. In area of present report, the Admiral formation cannot easily be distinguished from underlying Putnam formation or overlying Belle Plains formation; therefore; the Coleman Junction limestone member of the Putnam, the four members of the Admiral formation, and Jim Ned shale member of Belle Plains formation have been mapped as one unit.

Named for Coleman Junction, Coleman County.

Coleraine Shale or Formation

Upper Cretaceous (Colorado Series): Minnesota.

C. R. Stauffer *in* C. R. Stauffer and G. A. Thiel, 1933, Minnesota Geol. Survey Bull. 23, p. 18. Name appears in geologic column of Minnesota as Coleraine (Pierre) shale. Stratigraphically above Dakota sandstone.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 8 (geol. column), 104–105. Discussed as Coleraine formation in Colorado series. Mostly iron-bearing shales but includes conglomerates and sandstones; some shales fossiliferous. Thickness in Itasca County about 32 feet and here consists mostly of conglomerates and iron ore and occurs above Precambrian Biwabik formation; in Stearns County, about 73 feet and here consists mostly of argillaceous shales (data taken from well). Geologic column shows Coleraine (Benton) formation stratigraphically above Dakota formation. Underlies drift, sands, gravels, and boulder beds.

H. R. Bergquist, 1944, Jour. Paleontology, v. 18, no. 1, p. 7, 8–9. Coleraine formation as used in this report includes all Cretaceous conglomerates of Mesabi Range as well as the shales. Probably more than 100 feet thick. Shales occur only in upper part of Cretaceous sediments in western part of area; conglomerate exposures seem to be more extensive and are only representative of formation in eastern part. Section in Canisteo-Walker pits near Coleraine was considered as type, but subsequent mining has removed much of the Cretaceous.

Well exposed in opencut mines at Coleraine and Calumet, Itasca County.

Coles Brook Limestone[1]

Precambrian: Western Massachusetts.

Original reference: B. K. Emerson, 1898, U.S. Geol. Survey Mon. 29, p. 27–28.

Well exposed 1 mile northwest of Bancroft Station, in Middlefield, where Boston and Albany Railroad cuts off a loop of Westfield River and Coles Brook enters this loop from north.

Colesburg dolomite[1]

Silurian (Niagaran): Central eastern Iowa.

Original reference: C. R. Keyes, 1912, Iowa Acad. Sci. Proc., v. 19, p. 149, 150.

Charles Schuchert, 1943, Stratigraphy of the Eastern and Central United States: New York, John Wiley and Sons, p. 697. Listed with abandoned names. Lower Silurian (Alexandrian).

Named for Colesburg, Delaware County.

Colestin Formation

Eocene, upper: Southwestern Oregon.

F. G. Wells, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–89. Stratified water-deposited tuffs and conglomerates derived from volcanic rocks; contains a few interbedded flows. Varies in thickness and in some places is absent; maximum thickness is 2,000 feet in valley of Cottonwood Creek. Transitional with overlying Roxy formation (new); gradationally overlies Umpqua formation.

Well exposed both in natural cliffs and road cuts along former and present U.S. Highway 99, in valley of Cottonwood Creek, Jackson County. Name derived from Colestin Springs.

Colfax Formation[1]

Upper Jurassic: Northern California.

Original reference: J. P. Smith, 1910, Jour. Geology, v. 18, charts facing p. 217, 221.

R. W. Imlay, 1952, Geol. Soc. America Bull., v. 63, no. 9, p. 975. Upper part of Mariposa slate was separated by Smith (1910), as Colfax formation, apparently because it contained ammonite *Perisphinctes colfaxi* Hyatt, which he and Crickmay (1931, Am. Philos. Soc. Proc., v. 70, no. 1) considered Portlandian. Such an age assignment needs checking by additional fossil collecting because type of *P. colfaxi* is reported to be lost and original description and illustrations are not adequate for generic determination.

Occurs in Gold Belt region, northern Sierra Nevada.

Colgate Member (of Fox Hills Sandstone)[1]

Upper Cretaceous: Eastern Montana, southwestern North Dakota, northwestern South Dakota, and western Wyoming.

Original reference: W. R. Calvert, 1912, U.S. Geol. Survey Bull. 471, p. 189–198.

A. J. Collier and M. M. Knechtel, 1939, U.S. Geol. Survey Bull. 905, p. 10, pls. 1, 3. In McCone County, Mont., member is about 80 feet thick. Upper member of Fox Hills; overlies an unnamed basal member; underlies Hell Creek member of Lance formation. Footnote (page 10) states that since present report was written the Hell Creek has been raised to rank of formation in the official classification of the Geological Survey.

C. P. Bromley, 1955, U.S. Atomic Energy Comm. [Pub.] RME–1066 (rev.), p. 7 (fig. 2). Mapped in Niobrara County, Wyo.

R. E. Stevenson, 1957, Areal geology of McIntosh quadrangle (1:62,500): South Dakota Geol. Survey. Geographically extended into McIntosh quadrangle, South Dakota, where it caps several small buttes and rims the lower Hump Creek and White Shirt Creek valleys. Varies from gray calcareous or siliceous graywacke sandstone to a buff or white subgraywacke sand. Characterized by clay seams, carbonaceous streaks, clay pebble layers, cross-lamination, oscillation ripple marks, wood fragments, and *Inoceramus*. Thickness not more than 15 feet. Overlies Bullhead member.

Typically developed between Colgate Station and Glendive, Dawson County, Mont.

†Colgate Member (of Skaneateles Shale)[1]

Middle Devonian: Central New York.

Original reference: G. A. Cooper, 1930, Am. Jour. Sci., 5th, v. 19, p. 219, 221.

G. A. Cooper, 1941, Washington Acad. Sci. Jour., v. 31, no. 5, p. 180. Name abandoned. Replaced by Chenango sandstone member.

Named from exposures on campus of Colgate University.

Colina Limestone (in Naco 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, 23–25, 38–41; James Gilluly, 1956, U.S. Geol. Survey Prof. Paper 281, p. 8, 42–44, pl. 5. Most characteristic lithologic feature is dominance of dense limestone that appears very dark gray to almost black on fresh fracture. It seems safe to conclude that in central Cochise County any continuous such limestone that is as much as 25 feet thick is part of the Colina limestone. Generally weathers dark gray but locally weathers light gray or almost white. Contains abundance of gastropods, especially of a very large *Omphalotrochus*. Thickness at type section 633 feet. Lower boundary of Colina taken arbitrarily at highest of the dolomite beds that weather to an orange-red surface. Overlies Earp formation (new); underlies Epitaph dolomite (new) with gradational contact and underlies Scherrer formation with sharp contact. Age considered as Wolfcamp (Permian?) and Leonard(?).

Elliot Gillerman, 1958, New Mexico Bur. Mines Mineral Resources Bull. 57, p. 38–39, tables 1, 2, pl. 1. Crops out on western slope of main ridge of Peloncillo Mountains and north and east of Cienega Peak, N. Mex. Incomplete section north of Cienega Peak 504 feet thick. Mapped as Permian.

Type section: On west slope of Colina Ridge (from which named), in Tombstone Hills, 4,000 feet south of Horquilla Peak, Ariz.

Collao Member (of Robles Formation)

Upper Cretaceous: Puerto Rico.

H. L. Berryhill, Jr., and Lynn Glover 3d, 1960, U.S. Geol. Survey Misc. Geol. Inv. Map I–319. A succession of rocks consisting of siltstone and fine-grained sandstone, lenses of conglomerate, a unit of limestone, and unit of lapilli tuff characterized by reddish-brown color. A thin andesite lava is interstratified with the siltstone northeast of Vertedero. Estimated thickness about 200 meters. Overlies Las Tetas lava member; underlies Cariblanco formation (new).

Type section: Begins on Highway 1 at point 1.1 kilometers S. 75° E. of intersection of Highway 1 and Highway 162 and extends northwestward along banks of Highway 1 and Highway 162 and up north side of ridge south of Highway 162 to top of ridge above prominent outcrops of limestone, Cayey quadrangle.

Collazo Shale[1]

Tertiary: Puerto Rico.

Original reference: C. A. Reeds, 1916, New York Acad. Sci. Annals, v. 26, p. 437 [1915].

J. D. Weaver *in* R. Hoffstetter and others, 1956, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2b, p. 321. Name apparently synonymous with San Sebastián shales. Name not now used.

College Hill Limestone[1]

Upper Ordovician: Central Tennessee.

Original reference: J. M. Safford, 1869, Geology of Tennessee, p. 276.

Well exposed on College Hill, Nashville, Davidson County.

College Point Stage[1]

Pleistocene: Southeastern New York.

Original reference: J. B. Woodworth, 1901, New York State Mus. Bull. 48, p. 621–663.

Nassau County and Borough of Queens, Long Island.

Collier Flows

Recent: Southwestern Oregon.

Howel Williams, 1944, California Univ. Pub., Dept. Geol. Sci. Bull. 27, p. 62. Discussion of volcanoes of Three Sisters region. Name is applied to flows from Collier Cone.

Collier Cone is between North Sister Mountain and Yapoah Cone.

Collier Limestone Member (of Collier Formation)

Cambrian(?): Southeastern Oklahoma.

W. D. Pitt, 1955, Oklahoma Geol. Survey Circ. 34, p. 16–18, pl. 1. Consists largely of interbedded fissile shale and dark-bluish-gray finely crystalline limestone at top of Collier formation. Thickness 50 to 150 feet. Contact with Crystal Mountain sandstone above is generally traceable in mapped area (Ouachita Mountains) and it is recommended that unit be considered a separate formation if it also proves traceable in type area of Collier shale in Arkansas.

Prominent outcrops occur along west side of ridge in NW¼ sec. 27, T. 5 S., R. 23 E., McCurtain County.

Collier Shale[1]

Collier Formation

Cambrian: Southwestern Arkansas and southeastern Oklahoma.

Original references: A. H. Purdue, 1909, Geol. Soc. America Bull., v. 19, no. 557; 1909, Slates of Arkansas: Arkansas Geol. Survey, p. 30, 31.

W. D. Pitt, 1955, Oklahoma Geol. Survey Circ. 34, p. 15–18, pl. 1. Described in Ouachita Mountains of Oklahoma as Collier shale formation. Overlies Lukfata sandstone (new). Lower part consists of variegated normally brown fissile shale which locally contains numerous laminations of siltstone, sandstone, and silty limestone about 180 feet thick. Upper part is a limestone varying in thickness from 50 to 150 feet and termed the Collier limestone, upper member of Collier shale. Limestone underlies Crystal Mountain sandstone and forms prominent outcrops in mapped area. It is recommended that the limestone be considered a separate formation if it also proves traceable in the type area of the Collier shale. Cambrian(?).

Named for Collier Creek, Montgomery County, Ark.

Collierstown Limestone

Middle Ordovician: Western Virginia.

B. N. Cooper, 1946, Geol. Soc. America Bull., v. 57, no. 1, p. 85 (fig. 7), 90, 104. Predominantly shell limestone and medium-grained calcarenite with intercalated buff argillaceous limestones and buff shales, some of which are probably metabentonites. Thickness commonly less than 75 feet; at type locality 58 feet. Overlies Edinburg formation (new); underlies Martinsburg formation.

Type locality: North of State Highway 251, about 2 miles east of Collierstown (8 miles west of Lexington), Rockbridge County, Va. In Shenandoah Valley, occurs in westernmost belt of Middle Ordovician limestone, along foot of Little North Mountain; thicker and more widespread in middle and western belts of James River district.

Collings Ranch Conglomerate

Pennsylvanian (Virgil Series): Southern Oklahoma.

W. E. Ham, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 9, p. 2035–2045. Thick-bedded limestone boulder conglomerate; nonfossiliferous. Thickness about 2,000 feet. Complete section nowhere exposed because of erosion at top and faulting locally at base. Rests with pronounced angular unconformity upon steeply dipping rocks of Arbuckle anticline. Exposed 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. Underlies Vanoss limestone.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped with rocks of Virgil age.

Type area: Sec. 25, T. 1 S., R. 1 E. Named from Ellsworth Collings Ranch [Murray County], near U.S. Highway 77.

Collingston Conglomerate

See Collinston Conglomerate.

Collingsworth Gypsum Member (of Blaine Formation)[1]

Permian: Southwestern Oklahoma and central northern Texas.

Original reference: F. W. Cragin, 1897, Am. Geologist, v. 19, p. 356, footnote.

G. L. Scott, Jr., and W. E. Ham, 1957, Oklahoma Geol. Survey Circ. 42, p. 17 (fig. 3), 23–24, pl. 1. Described in Carter area, Oklahoma, as massive white gypsum 22 feet thick, underlain by an unnamed gray dolomite 1 foot thick and overlain by an unnamed red shale unit generally 15 feet thick. Occurs below the Mangum dolomite member and above the Cedartop gypsum member.

Named from Collingsworth County, Tex., just west of Greer County, Okla., where the gypsum is well exposed.

Collingwood Formation[1]

Upper Ordovician: Ontario, Canada, and surface and subsurface in Michigan and subsurface in Wisconsin.

Original reference: P. E. Raymond, 1912, Canada Geol. Survey Summ. Rept. 1911, p. 354.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 250 (fig. 8), 283–284. Consists of alternating beds of limestone and shale. In type section, overlain by Blue Mountain shale. Thickness 26 feet at type section. Underlies Gloucester shale. Believed to persist from Collingwood to shore of Lake Ontario. In Jefferson County, N.Y., there are many exposures of contact of Deer River black shale on upper Cobourg limestone along Sandy Creek; former is considered to be of Collingwood age. In Oneida County, Holland Patent shale, upper member of Utica formation, is, in its lower part, of Collingwood age. In present report, included in Trenton group, above Cobourg limestone and below Gloucester shale. Mohawkian series. Middle Ordovician.

A. E. Wilson, 1946, Canada Geol. Survey Mem. 241, p. 28. Eastview and Billings formations of Ottawa-St. Lawrence Lowland represent continuous sequence of beds. Together they make up former Collingwood and Gloucester of the basin. They are defined by lithology, the Eastview being limestone interbedded with shale and the Billings all shale. Terms Collingwood and Gloucester are retained as time terms.

G. V. Cohee, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 33. In subsurface of southeastern Michigan, the Upper Ordovician rocks are about 750 feet thick and are divided into three units: Utica, Lorraine, and Queenston shales. The dark-gray to black Utica is 150 to 200 feet thick. It thins northward, and, in Northern Peninsula, Bruce Peninsula, and on Manitoulin and adjacent islands, it is represented by Collingwood formation. Collingwood was identified in one well in Door County, Wis., but could not be identified farther south. In southwestern Ontario, beds of Upper Ordovician age crop out locally on Manitoulin and adjacent islands, along shore of Georgian Bay, and southeastward in Ontario where they are divided into (ascending) Collingwood, Gloucester, Dundas, Meaford, and Queenston formations. The Collingwood, 30 to 40 feet thick, was formerly assigned to Utica because of its lithologic similarity to the Utica of New York. According to Sproule (1936, Canada Geol. Survey Mem. 202), the Collingwood rests on Trenton limestone. At north edge of Sheguindah, Manitoulin Island, Ontario, the Collingwood rests on the Precambrian. Overlying Collingwood are dark-brown to black shales which in earlier reports were referred to as Gloucester formation. In recent reports, the Canada Geological Survey includes both Collingwood and Gloucester in Billings formation which is 100 to 270 feet thick in southwestern Ontario. Kay (1937) correlates the Collingwood and Gloucester with the Trenton of New York.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2 (column 46). Shown on correlation chart in Northern Peninsula of Michigan. Occurs above Stewartville limestone. Trentonian.

B. A. Liberty, 1954, Michigan Geol. Soc. [Guidebook] Ann. Field Trip June 19–20, p. 7–17. Discussion of Ordovician of Manitoulin Island. Collingwood has been used in Ontario nomenclature as time term. In present report, strata of this unit comprise rock unit to which name Collingwood is applied. Unit is about 22 feet thick, but thickness varies over short distances. Where it lies, under transgressive overlap conditions, on apices of Precambrian quartzite ridges, thickness may be only a few inches. Contact with overlying Sheguindah formation.

Well exposed at Collingwood, Ontario.

Collingwoodian (Collingwood) Stage or Substage

Middle Ordovician (Trentonian) : Eastern North America.

G. M. Kay, 1937, Geol. Soc. America Proc. 1936, p. 82. Collingwood and Gloucester are stages in latest Trenton.

Marshall Kay, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 7, p. 30–31. Trenton group was divided by Raymond (1916, Harvard Coll. Mus. Comp. Zoology Bull., v. 56) into succession of faunal zones that he thought time-stratigraphic but which he called formations. In time, these became stages: Rocklandian, Kirkfieldian, Shorehamian, Denmarkian, Cobourgian, Collingwoodian, and Gloucesterian of Kay (1937; 1943; 1948). The Cobourg-Collingwood-Gloucester seems to be time-equivalent to Utica group, but name Utica is strongly associated with black shale facies. Hence, term Pictonian stage is applied to uppermost Trentonian.

Name derived from Collingwood, Ontario, Canada, for which Collingwood formation was named.

Collins Hill Formation

Middle or Upper Ordovician(?) : Central Connecticut.

John Rodgers, R. M. Gates, and J. L. Rosenfeld, 1959, Connecticut Geol. and Nat. History Survey Bull. 84, p. 19, 20, 21, 22, 24, fig. 3. Rusty-weathering graphitic garnetiferous two-mica schist, commonly containing sillimanite and (or) kyanite. Commonly has basal conglomerate gneiss associated with overlying well-banded unit consisting of fine-grained quartzite with manganiferous garnet and cummingtonite and of laminated amphibolite with relatively large garnets locally. Persistent amphibolite and calc-silicate layers in lower part. Interbedded calc-silicate and fine-grained biotite-muscovite-gneiss abundant to west in upper part. Unconformably overlain by Bolton group from Great Hill north. Rests unconformably on Middletown formation and on granitic rocks (Glastonbury and Maromas gneisses), which have discordant, possibly intrusive, contacts with Middletown but fail to transgress into the Collins Hill along many miles of mutual contact. Unit has been included in Bolton schist by many recent workers. Middle Ordovician(?).

G. P. Eaton and J. L. Rosenfeld, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 2, p. 170 (fig. 1), 171 (table 1). Unconformably underlies Great Hill formation (new). Unconformably overlies Glastonbury and Maromas formations. Previous workers with the exception of Percival (1842, Report on the Geology of the State of Connecticut: New Haven) grouped the sequence of rocks from Collins Hill schist through Camp Jenkins schist as a single formation, and believed it to be intruded by Glastonbury, Maromas, and Haddom gneisses. Present work shows that these rocks represent four distinct formations, with unconformity separating Collins Hill from the others.

Named from Collins Hill in central Portland, Middlesex County.

Collinston Conglomerate (in Salt Lake Group)

Miocene, upper, and Pliocene, lower: Northeastern Utah.

Neal Smith, 1953, Intermountain Assoc. Petroleum Geologists [Guidebook] 4th Ann. Field Conf., p. 73, 75 (fig. 2). Collingston conglomerate consists of about 2,500 feet of boulder and cobble conglomerate with a white calcareous and tuffaceous(?) matrix. Unconformably underlies West Spring formation (new); in fault contact with upper Paleozoic rocks in Cache

Valley; at north end of Wellsville Mountain overlies Wasatch group. 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. 1 (table 2), 2 (table 1), 4–6, 9 (fig. 3). Collinston conglomerate intertongues with Cache Valley formation herein considered to include unit formerly termed West Spring formation. Thickness about 1,500 feet. Poorly exposed.

Type area: Northern end of Wellsville Mountains, Cache County.

Collinsville cyclothem (in McLeansboro Group)

Pennsylvanian: Southeastern Illinois.

W. A. Newton and J. M. Weller, 1937, Illinois Geol. Survey Rept. Inv. 45, p. 9, 11; J. M. Weller, 1942, Illinois Acad. Sci. Trans., v. 35, no. 2, (table 1). In sequence, occurs below Shoal Creek cyclothem and above Trivoli cyclothem. Thickness about 42 feet.

Named from exposures along Canteen Creek, near Collinsville, Madison County.

Collinsville Granite Gneiss[1]

Pre-Triassic: North-central Connecticut.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 105–107 and map.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Described as a gneiss. Pre-Triassic.

Well-exposed at Collinsville, Hartford County.

Collinsville Limestone[1] (in McLeansboro Formation)

Collinsville Limestone (in McLeansboro Group)

Pennsylvanian: Southwestern Illinois.

Original reference: A. H. Worthen, 1873, Illinois Geol. Survey, v. 5, p. 315.

C. L. Cooper, 1946, Illinois Geol. Survey Bull. 70, p. 16 (fig. 2). Shown on correlation chart as formation in McLeansboro group; stratigraphically below Shoal Creek limestone and above Trivoli limestone.

First described near Collinsville, Madison County.

Collores Limestone[1]

Upper Cretaceous: 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. 149.

R. C. Mitchell, 1954, Puerto Rico Univ. Agr. Expt. Sta. Tech. Paper 13, p. 36 (table 2), 47, 48 (table 4). Thickness 300 feet. Lower part equivalent to La Muda limestone and upper part equivalent to Trujillo Alto limestone of Fajardo district.

Named for typical development in barrio of Collores de Piedras, Humacoa district.

Collores Member (of Augustinillo Formation)

Eocene, middle: Puerto Rico.

E. A. Pessagno, Jr., 1960, Geology of the Ponce-Coamo area, Puerto Rico: Puerto Rico Econ. Devel. Adm. and Princeton Univ. Dept. Geology, p. 94–96; 1960, Caribbean Geol. Conf., 2d, Mayagüez, Puerto Rico, 1959, Trans., p. 84–85. Consists largely of thin-bedded hard buff- to creamy-colored argillaceous limestones with some layers of reddish-brown calcareous mudstones and siltstones. Layers and lenses of Coamo Springs limestone not uncommon. Thickness about 6,800 feet. To the west, interfingers with Monserrate member (new) of Augustinillo. Overlies and interfingers with Guayo member of Naranjo formation (both new). Middle Eocene.

Type locality: At Camino Collores bed of the Río Guayo near bend. Crops out in northwest part of Ponce quadrangle. Named for Poblado Collores, 1.4 kilometers southwest of Cerro Augustinillo.

Colma Formation

Pleistocene, upper: Central western California.

J. Schlocker, M. G. Bonilla, and D. H. Radbruch, 1958, U.S. Geol. Survey Misc. Geol. Inv. Map I–272. Sequence of unconsolidated sand deposits that are similar in appearance and physical properties and occupy approximately the same stratigraphic position; they may not all be contemporaneous. Fine- to medium-grained sand with minor amounts of clay; evenly spaced horizontal or nearly horizontal bedding or continuous inclined bedding; rarely massive; in places includes clay beds 6 inches to 5 feet thick. On Angel Island, thickness 5 to 50 feet; at north end of Ocean Beach, at least 40 feet thick and appears to thicken and dip gently southward under dune sand of Golden Gate Park.

Occurs on Angel Island and at several points on San Francisco Peninsula. Name derived from town of Colma, 4½ miles south of San Francisco North quadrangle near center of area in which formation is best developed.

Colmar shales[1]

Upper Ordovician: Iowa.

Original reference: C. R. Keyes, 1931, Pan-Am. Geologist, v. 55, p. 217–222.

Colmena Tuff or Formation (in Vieja Group)

Tertiary: Southwestern Texas.

R. K. DeFord, 1958, Texas Jour. Sci., v. 10, no. 1, p. 13 (fig. 3), 17, 19–20. Named proposed for beds of rhyolitic tuff-conglomerate. Described as light brown, interbedded with variegated tuff principal colors of which are brown, pink, and red; near mouth of Capote Creek, contains beds of tuffaceous nonmarine limestone 4 to 10 feet thick; near Loma Plata, contains beds of silty claystone and a layer of glassy flow-rock. Deposited on rough topography of Gill breccia (new), consequently is missing in some places, though its thickness exceeds 450 feet in others. In most places, overlain by Buckshot ignimbrite (new); where Buckshot is absent, the Colmena is overlain by Chambers tuff (new).

P. C. Twiss, 1959, Texas Univ. Bur. Econ. Geology Quad. Map 23. Described in Van Horn Mountains area, where it is 190 to 310 feet thick. Rests on Chispa Summit formation in the northern Sierra Vieja; on Cox limestone, Finlay limestone, Benevides formation, Eagle Mountains sandstone, Buda limestone, and Chispa Summit formation in isolated outcrops along eastern margin of Van Horns northward to Hammer Handle Canyon; on Eagle Mountains sandstone, Buda limestone, and Chispa Summit formation directly west of Willoughby Wind gap along the western margin; and on Cox sandstone at southeastern and southwestern flanks of Colquitt syncline.

Type locality: Four miles due east of Candelaria, Rim Rock country, Presidio County. Name derived from Colmena Canyon.

†Colob Sandstone[1]

Jurassic(?): Southwestern Utah.

Original reference: E. Huntington and J. W. Goldthwait, 1903, Jour. Geology, v. 11, p. 46–63.

Name probably derived from Colob Creek on Colob Plateau (spelled Kolob on some maps), Washington County.

Colony Creek Shale Member (of Caddo Creek Formation)

Colony Creek Shale

Upper Pennsylvanian: West-central Texas.

M. G. Cheney, 1948, Abilene Geol. Soc. [Guidebook] Spring Field Trip, June 11–12, p. 20. Proposed that name Colony Creek shale be given to beds between Ranger and Home Creek limestones and that name Hog Creek shale, misapplied by Drake and others, be dropped.

D. H. Eargle, 1958, San Angelo Geol. Soc. Guidebook, Apr. 17–19, p. 51. Shown on columnar section, Brown and Coleman Counties, as Colony Creek shale member of Caddo Creek formation. Underlies Home Creek limestone member; overlies Ranger limestone member of Brad formation. Thickness about 20 feet. Mainly gray shale; locally contains thin beds of sandstone; not present in areas of reefs of Ranger limestone.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 67. Because of confusion that has resulted from miscorrelations of Home Creek limestone and misapplication of term "Hog Creek," adoption of Cheney's term Colony Creek shale is herein recommended for shale member below Home Creek limestone member. Unit is gray shale that contains conspicuous fine-grained thinly to thickly and irregularly bedded sandstone near top. In southern part of area, Colony Creek is about 25 feet thick; locally, member is absent and Home Creek limestone member is contiguous with limestone members of Brad formation. Average thickness of member about 60 feet in north-central Brown County.

Type area: Branching headwaters of Colony Creek in vicinity of Colony School, 4 miles west of Ranger in northeastern Eastland County.

Colony School Conglomerate (in Strawn Group)

Pennsylvanian: Central Texas.

F. B. Plummer, 1950, Texas Univ. Bur. Econ. Geology Pub. 4329, p. 85. Basal conglomerate that occurs at contact of the Strawn and Marble Falls limestone. Made up of well-rounded pebbles ranging from size of large sand grains to 1 inch in diameter and set in matrix of reddish brown sand. Thickness about 1 foot.

Located 0.15 mile east of Colony School, San Saba County.

†Colorado Conglomerate[1]

Pennsylvanian: Pennsylvania.

Original reference: J. F. Carll, 1875, Pennsylvania 2d Geol. Survey Rept. I, p. 38–40, 46.

In hilltops at Colorado, Warren County.

Colorado Group,[1] Shale,[1] or Formation[1]

Lower and Upper Cretaceous: Colorado, Idaho, Iowa, Kansas, Montana, Nebraska, New Mexico, North Dakota, South Dakota, and Wyoming.

Original reference: F. V. Hayden, 1876, U.S. Geol. and Geog. Survey Terr. 8th Ann. Rept., p. 45.

Eugene Stebinger, 1919, U.S. Geol. Survey Bull. 691–E, p. 154 (table), 157–164. Colorado shale, in Birch Creek-Sun River area, Montana, overlies Kootenai formation and underlies Virgelle sandstone of Montana group. Thickness about 1,800 feet. Includes Blackleaf sandy member (new) at base.

C. F. Bowen, 1919, U.S. Geol. Survey Bull. 691–F, p. 189 (table), 195–197. Colorado shale, in Musselshell Valley, Mont., is about 2,200 feet thick, overlies Kootenai formation and underlies Eagle sandstone of Montana group. Includes Big Elk sandstone member (new). Upper Cretaceous.

A. J. Collier and S. H. Cathcart, 1922, U.S. Geol. Survey Bull. 736–F, p. 172 (table). Group, in Little Rocky Mountain region, Montana, comprises (ascending) Thermopolis, Mowry, and Warm Creek (new) shales. Overlies Kootenai formation; underlies Eagle sandstone of Montana group. Upper Cretaceous.

S. G. Lasky, 1936, U.S. Geol. Survey Bull. 870, p. 23–26, pl. 1. Colorado formation, in Bayard area, New Mexico, rests upon Beartooth quartzite with apparent disconformity. Upper limit is either present land surface or an older erosion surface buried under volcanic rocks of region, so that full thickness is not present. Separable into two mappable units: an upper sandstone member and a lower shale member. Thickness 320 to 450 feet.

C. H. Rankin, 1944, New Mexico Bur. Mines Mineral Resources Bull. 20, p. 5–26. Colorado group, in this report [northern New Mexico], comprises (ascending) Graneros shale, Greenhorn limestone, Carlile shale, and Niobrara formation. Overlies Dakota(?) sandstone. Top of Niobrara not recognized with certainty. In previous reports on Cretaceous rocks of New Mexico, writers have followed nomenclature established by Cross (1901 [1899], U.S. Geol. Survey Geol. Atlas, Folio 60) and have described all rocks between Dakota sandstone and Mesaverde coal measures as Mancos shale. Present study reveals that all divisions of Colorado group (Mancos shale) as described in southern Colorado, except Fort Hayes limestone and Apishapa shale, can be recognized in northern New Mexico.

J. B. Reeside, Jr., 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 10. As shown on correlation chart, Colorado group comprises Mowry shale and Warm Creek shale. Overlies Thermopolis shale; underlies Telegraph Creek formation. Upper Cretaceous.

W. A. Cobban and J. B. Reeside, Jr., 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 8, p. 1892–1893. Uncrushed ammonites have been collected from Mowry shale and equivalent rocks at several localities in Colorado, Wyoming, and Montana. These collections show that impressions and crushed internal molds of ammonites previously assigned to Upper Cretaceous genera *Metoicoceras*, *Acompsoceras*, and *Neocardioceras* (as *Kanabiceros*) belong to Lower Cretaceous genera *Gastroplites* and *Neogastroplites*. Largest collection of *Gastroplites* from United States consists of more than 1,400 uncrushed specimens from a single concretion in the Colorado shale near Harlowton, Mont. In northwestern Colorado, it [*Gastroplites*] occurs in middle of Mowry member of Mancos shale; in Wyoming, known from Aspen shale along western edge of Green River basin, and from Mowry on western margin of Bighorn basin, eastern flank of Black Hills. In Montana, genus occurs in Mowry shale in Pryor Mountain and in Colorado shale on Middle Dome, southeast of Harlowton. Largest collection of *Neogastroplites*, containing 800 specimens, is from concretions in Mowry shale near Cody, Wyo. Genus occurs in Aspen shale in Green River basin, and in Mowry shale in Wind River basin and along eastern flank of Bighorn Mountains, in Thermopolis shale in Bighorn Mountains, in Mowry shale near Pryor Mountains, and in Colorado shale in Livingston area, in Judith Basin, and near Great Falls.

W. A. Cobban, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 10, p. 2170–2198. Colorado shale of central and northwestern Montana and equivalent rocks on north flank of Black Hills are dominantly dark-gray marine shales. It has been customary to treat Colorado shale as a single formation, with one or two members. Detailed studies show that Colorado shale is divisible into many lithologic units that can be correlated with standard section in Black Hills. Formation in Black Hills that are equivalent to Colorado shale are (ascending) Fall River sandstone, Skull Creek shale, Newcastle sandstone, Mowry shale, Belle Fourche shale, Greenhorn formation, Carlile shale, and Niobrara formation.

W. A. Cobban and J. B. Reeside, Jr., 1952, Geol. Soc. America Bull., v. 63, no. 10, chart 10b. Reference sequence for Upper Cretaceous, Western Interior, North America, shows Colorado group comprises (ascending) Belle Fourche shale, Greenhorn limestone, Carlile shale, and Niobrara formation. Occurs above Lower Cretaceous Mowry shale and below Telegraph Creek formation.

W. A. Cobban, 1953, U.S. Geol. Survey Prof. Paper 243–D, p. 45–54. Colorado shale, near Mosby, Mont., is 1,930 feet thick, and includes Mosby sandstone member 743 feet below top. Cenomanian ammonite fauna.

R. B. Johnson and G. J. Stephens, 1954, U.S. Geol. Survey Oil and Gas Inv. Map 146. Colorado group, in Huerfano County, Colo., comprises (ascending) Graneros shale, Greenhorn limestone, Carlile shale, Niobrara formation. Overlies Dakota sandstone; underlies Pierre shale of Montana group.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Colorado group mapped in northwestern Oklahoma. Exposed part equivalent to Greenhorn limestone and Graneros shale.

H. L. Jicha, Jr., 1954, New Mexico Bur. Mines Mineral Resources Bull. 37, p. 24, 34 (fig. 3). Colorado shale, in Lake Valley quadrangle, overlies Sarten formation. Upper Cretaceous (Benton age).

J. P. Greis, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 4, p. 449–450. In Williston basin, Colorado group, which formerly included all of Graneros formation around Black Hills, has now been restricted to Upper Cretaceous and includes Belle Fourche shale, together with overlying Greenhorn, Carlile, and Niobrara formations. Term Belle Fourche shale now used in the basin wherever underlying Mowry can be differentiated, except in Little Rocky Mountains where name lower Warm Creek shale is applied.

C. P. Ross, D. A. Andrews, and I. J. Witkind, 1955, Geologic map of Montana (1:500,000): U.S. Geol. Survey. As mapped, Colorado group comprises (ascending) Belle Fourche shale, Greenhorn formation, Carlile shale, and Niobrara formation. Colorado shale includes equivalents of Fall River, Skull Creek, Newcastle, Mowry, Belle Fourche, Greenhorn, Carlile, and Niobrara formations and locally Telegraph Creek formation.

P. W. Richards, 1957, U.S. Geol. Survey Bull. 1021–L, p. 414–417. Colorado shale described in area east and southeast of Livingston, Mont. Name

Colorado shale has been used in parts of Montana for thick predominantly shale sequence that lies above Kootenai formation, and, in most places, below Virgelle sandstone or Eagle sandstone; locally underlies Telegraph Creek sandstone. Colorado shale, which includes sandstone, particularly in west-central Montana, contains both Lower and Upper Cretaceous strata; its vertical range, therefore, does not coincide with Upper Cretaceous Colorado group. Cobban (1951) compared Colorado shale of central Montana with equivalent rocks of Black Hills. From his report, it is evident that some formational names of Black Hills can be used as members of Colorado shale in central Montana. Some formation names in use in Bighorn basin, Wyoming, are not common to Black Hills and central Montana areas but have been used around Pryor Mountains and Bighorn Mountains. In present report, Colorado shale has been divided into 10 units, and these are compared, where possible, with Black Hills and central Montana or Bighorn basin formations. Unit 7, about 100 feet thick, is herein named Boulder River sandstone member.

M. R. Klepper, R. A. Weeks, and E. T. Ruppel, 1957, U.S. Geol. Survey Prof. Paper 292, p. 26–28, pls. 1, 2. Formation described in southern Elkhorn Mountains, Mont. Subdivided into three map units: lower black shale, 215 to 325 feet thick; sand and siliceous mudstone, 610 to 920 feet thick; and upper black shale unit, 265 to 390 feet. Overlies Kootenai formation, probably with slight erosional unconformity. Grades upward into sequence of feldspathic sandstone and tuff beds herein named Slim Sam formation. Where Slim Sam formation is absent, the Colorado underlies Elkhorn Mountains volcanics (new). Colorado formation as herein used includes beds of both Early and Late Cretaceous age.

W. A. Cobban and others, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2786–2796. Colorado group revised on Sweetgrass arch, Montana. Rocks formerly assigned to Colorado shale are divided into lower unit, Blackleaf formation with four named members, and an upper unit, Marias River formation (new) with four named members. Overlies Kootenai formation; underlies Telegraph Creek formation. Early Late Cretaceous.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. Group comprises (ascending) Graneros shale, Greenhorn limestone, Carlile shale, and Niobrara chalk. Overlies Dakota formation; underlies Pierre shale of Montana group.

J. B. Reeside, Jr., and W. A. Cobban, 1960, U.S. Geol. Survey Prof. Paper 355, p. 8–11. Colorado shale, in Teigen area, central Montana, includes Arrow Creek member (new) which underlies Mowry member.

Mineral Research and Devel. Dept. Rept. 12, pt. 2, p. 33–38, 41–42. In southwestern Montana includes Geyser bentonite bed (new) and Greenhorn bentonite bed (new). Great Northern Railway Co. Mineral Resources Research and Development Department. 1960, Great Northern Railway Co.

Colorado shale, in Winnett-Mosby area, Montana, includes following members: Skull Creek Shale, Mowry Shale, Belle Fourche Shale, Mosby Sandstone, Carlile Shale, and Niobrara Shale. In area of Bearpaw Mountains, includes following members: Fall River Sandstone, Skull Creek Shale, Newcastle Sandstone, Mowry Shale, Belle Fourche Shale, Greenhorn Limestone, Carlile Shale, Niobrara Shale, and Telegraph Creek.

Named for exposures along eastern base of Colorado or Front Range, Colo.

†Colorado Series[1]

Upper Cretaceous: Colorado.

Original reference: G. H. Ashley, 1923, Eng. and Min. Jour.-Press, v. 115, no. 25, p. 1106–1108.

Colpitts Group

Middle Jurassic: East-central Oregon.

R. L. Lupher, 1941, Geol. Soc. America Bull., v. 52, no. 2, p. 227 (table 1), 229, 247–255. Name applied to sequence of limestone, sandstone, and shale which crops out only between Snow Mountain and Suplee in western end of pre-Tertiary area. Less than 500 feet thick in most places; may exceed 800 feet of Freeman Creek. Comprises two formations: Weberg below and Warm Springs above (both new). In type area, Colpitts lies across narrow southwestern part of eastward-trending Mowich anticline. Along western part of anticline, Colpitts lies upon Mowich group and below Hyde formation (new) without appreciable angular discordance. Where Mowich group is absent, as along Warm Springs Creek and in Camp Creek valley, Colpitts lies upon Triassic and Paleozoic beds with high-angle discordance.

Type area: On east side of Warm Springs Creek valley in secs. 19, 20, 29, and 30, T. 18 S., R. 26 E., Crook County. Named for Willard Colpitts Ranch on upper Warm Springs Creek.

Colquitt Formation[1]

Upper Cretaceous (Gulf Series): Southwestern Texas.

Original reference: W. S. Adkins, 1933, Texas Univ. Bull. 3232, p. 239, 271, 441, 452.

Type locality: On Colquitt Ranch below Chispa Summit, western Jeff Davis County.

Colter Formation

Miocene, middle: Northwestern Wyoming.

J. D. Love, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 8, p. 1899, 1904–1907, fig. 1. Sequence of gray, green, and brown water-laid pyroclastic rock, sandstone, and claystone. Characterized throughout by abundance of mafic volcanic material, both in lithic fragments and in tuff. Thickness in vicinity of type section 7,000 feet, exclusive of basal part of formation which is so distorted by basalt intrusions that character and thickness of the rocks have not been adequately determined. Unconformably overlain by rocks of middle Pliocene age and unconformably overlies all older rocks. On East Fork of Pilgrim Creek, unconformably overlies Pinyon conglomerate of Paleocene age.

Type section: On Pilgrim Creek about 5 miles northeast of Colter Bay, on Jackson Lake, from which the formation takes its name. Section extends eastward from east face of Pilgrim Peak across Pilgrim Creek for distance of about 1 mile, and lies in secs. 20, 21, 22, 27, 28, and 29, T. 46 N., R. 114 W., unsurveyed, Teton County.

Colton Formation

Eocene: Central Utah.

P. T. Walton, 1944, Geol. Soc. America Bull., v. 55, no. 1, p. 120–121, pls. 2, 3. Consists of reddish-pink sandstones and shales. Varies greatly in thickness; about 3,400 feet near town of Green River, Utah; near Soldier Summit, disappears into Green River formation. Believed to be equivalent in age to part of Green River formation with which it interfingers on its upper boundary. May correlate with unit herein referred to as Uinta(?). Exposed in extreme southwestern part of Uinta basin. Forms base of Roan Cliffs from Price River to Roan Plateau in Colorado.

E. M. Spieker, 1946, U.S. Geol. Survey Prof. Paper 205-D, p. 122, 139. Formal proposal of name. Gray, pepper-and-salt sandstone, greenish-buff sandstone, and siltstone that commonly weathers golden brown, and shale ranging from deep red to variegated and gray. Thickness 1,500 feet at Kyune, 2 miles east of Colton, where it underlies Green River formation; overlies Flagstaff formation; both contacts clearly defined; westward, grades laterally into beds of Green River type. In some areas, overlies North Horn formation. Unit has been referred to as an upper member of Wasatch formation.

C. L. Gazin, 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 135. Spieker's Colton formation may be westward continuation, in Utah, of (upper portion?) De Beque formation.

Named for exposures in hills north of Colton at head of Price Canyon, Utah County.

†Columbia Granite[1]

Precambrian: Central Virginia.

Original reference: A. I. Jonas, 1928, Virginia Geol. Survey prelim. ed. geol. map of Virginia.

G. W. Stose and A. J .Stose, 1948, Am. Jour. Sci., v. 246, no. 7, p. 405–406. In Arvonia slate district, granite near Carys Brook had been termed Columbia granite by Jonas (1932). However, it differs from Columbia granite in texture and composition. The contact of the two granites is an overthrust fault on which the Columbia granite and associated rocks rode northwestward over the granite at Carys Brook and the Peters Creek formation.

Named for occurrence at Columbia, on Fluvanna-Goochland County line, north of James River.

Columbia Group[1]

Pleistocene: Atlantic Coastal Plain from Delaware to Florida.

Original references: W. J. McGee, 1886, Rept. Health Office District of Columbia for 1885, p. 20; 1886, Am. Jour. Sci., 3d v. 31, p. 473.

C. J. Cederstrom, 1957, U.S. Geol. Survey Water-Supply Paper 1361, p. 31–32. Quaternary system in Virginia Coastal Plain is represented chiefly by deposits of sand and clay that mantle the older formations to a height of about 270 feet above sea level. They are collectively called Columbia group. Units included are Brandywine, Coharie, Sunderland, Wicomico, Penholoway, Talbot, and Pamlico formations.

Other units included in group are: Bridgeton, Cape May, and Pensauken Formations.

Named for District of Columbia.

Columbia Ford Limestone[1]

Pennsylvanian: Eastern Kansas.

Original reference: L. C. Wooster, 1905, The Carboniferous rock system of eastern Kansas.

Derivation of name not stated.

Columbian Marble[1]

Columbian Marble Member (of Boardman Formation)

Columbian Marble Member (of Shelburne Formation)

Lower Ordovician: West-central Vermont.

G. W. Bain, 1931, Am. Jour. Sci., 5th ser., v. 22, no. 132, p. 508, 509, 510, 511. In list of formations, Columbian deposit (marble) overlies Intermediate limestone and underlies West Blue deposit. Ordovician (Chazy).

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, p. 25–26, 27. Rank reduced to member at top of Boardman formation (new). Generally white-weathering white and blue-gray marble; occasional threads of green silicates wind irregularly through the white marble. Maximum thickness 600 feet. Underlies Bascom formation; overlies Intermediate dolomite member of Boardman. Lower Ordovician.

J. B. Thompson, Jr., 1959, New England Intercollegiate Geol. Conf. Guidebook 51st Ann. Mtg., p. 75 (table 1). In Clarendon-Dorset area, is uppermost member of Shelburne formation. Thickness 200 to 250 feet. Overlies Intermediate dolomite member.

Occurs in Addison and Rutland Counties.

Columbiana Formation

Middle Ordovician (Mohawkian): Central Alabama.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 57, chart 1 (facing p. 130). Black graptolitic shale. Thickness a few inches to 325 feet. Disconformably underlies Frog Mountain sandstone; overlies Pratt Ferry formation (new). Name attributed to B. N. Cooper and G. A. Cooper.

Type section: Just west of Simpson Springs 2½ miles northwest of Calera, Shelby County. Named from Columbiana 15-minute quadrangle in which east side of Calera is located.

Columbia River Basalt[1]

Miocene and Pliocene(?): Oregon, Washington, and northern Idaho.

Original reference: I. C. Russell, 1893, U.S. Geol. Survey Bull. 108, p. 20–22, map.

R. C. Treasher, 1942, Geologic map of Portland area, Oregon (1:96,000): Oregon Dept. Geology and Mineral Resources. In Portland area, underlies Troutdale formation.

W. C. Warren and Hans Norbisrath, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 2, p. 220 (table 1), 233–234. Overlies Scappoose formation (new) in upper Nehalem River valley. Thickness as much as 1,000 feet.

E. M. Baldwin, 1950, Oregon Country Geol. Soc. News Letter, v. 16, no. 11, p. 93. Underlies Molalla formation (new).

W. D. Lowry and E. M. Baldwin, 1952, Geol. Soc. America Bull., v. 63, no. 1, p. 3–5, pls. 1, 2. Discussion of lower Columbia River valley, Oregon and Washington. Term Columbia River basalt used in present report to apply only to the Miocene flows as restricted by Merriam (1901, California Univ. Pub., Bull. Geology Dept., v. 2, no. 9) and Lindgren (1901, U.S. Geol. Survey 22d Ann. Rept., pt. 2). Basalt is interbedded with Astoria formation of middle Miocene age. Total thickness of basalt flows as much as 1,000 feet in Portland area; 2,000 feet in Columbia River Gorge. Columbia River basalts in vicinity of Salem and Stayton, Oreg., were named Stayton lavas by Thayer (1939) because Columbia River basalt had not then been traced into that area. Now seems advisable to drop name Stayton lavas in preference to Columbia River basalt. In Columbia River Gorge, the basalt lies on erosional surface cut in sediments of Eagle Creek formation (lower Miocene). In central Oregon, the Columbia River basalt lies on erosion surface developed on John Day formation of late Oligocene or early Miocene. Middle and upper Miocene.

H. H. Waldron and L. M. Gard, Jr., 1954, U.S. Geol. Survey Geol. Quad. Map GQ-48. Mapped in Hay quadrangle, Washington, where it may be as much as 5,000 feet thick.

T. P. Thayer, 1956, U.S. Geol. Survey Mineral Inv. Field Studies Maps MF-49 and MF-50. Mapped in Aldrich Mountain and Mount Vernon quadrangles, Oregon, where it underlies Mascall formation and unconformably overlies unnamed volcanic conglomerate. Middle Miocene.

Howel Williams, 1957, A geologic map of the Bend quadrangle, Oregon, and a reconnaissance geologic map of the central portion of the High Cascade Mountains (1:125,000): Oregon Dept. Geology and Mineral Industries. Southern edge of Columbia River basalt plateau passes through northeast corner of Bend quadrangle, where thin, scattered outliers rest conformably or with only slight disconformity on John Day formation. Maximum thickness 300 feet. Middle Miocene.

C. P. Ross and J. D. Forrester, 1958, Idaho Bur. Mines and Geology Bull. 15, p. 15-16. In early geologic studies, such names as Columbia lava and Columbia River basalt were applied to mass of dominantly basaltic rocks in region drained by Columbia River. As originally defined (Russell, 1893), this unit included Snake River basalt. Current usage in Idaho restricts term to unit that consists mainly of flows of basaltic and kindred composition that extend interruptedly from vicinity of South Mountain, Owhyee County, through western Idaho at least as far north as Kootenai County. Maximum thickness of lava in the unit as thus limited probably more than 3,000 feet. Flows are associated with sedimentary beds which in some places reach thicknesses in excess of 1,000 feet. These sedimentary beds include strata that in southern Idaho have been referred to Payette formation (Miocene and Pliocene?) and others farther north that contain flora typical of Latah formation (middle or upper Miocene). Younger than Challis volcanics.

J. W. Hosterman and others, 1960, U.S. Geol. Survey Bull. 1091, p. 7, pls. 3, 4, 5. Although Columbia River basalt may range in age from Miocene to Pliocene, it is considered to be product of many closely related eruptions and is classed as one formation. Thickness ranges from several feet at flanks of steptoes and embayments along eastern margin of Columbia Plateau to more than 1 mile near center where subsidence is greatest. In general vicinity of clay deposits in Washington and Idaho, the Latah formation is interbedded with Columbia River basalt.

Columbia River valley.

Columbus Formation or cyclothem (in Cherokee Group)

Pennsylvanian (Des Moines Series): Southeastern Kansas.

G. E. Abernathy, 1937, Kansas Geol. Soc. Guidebook 11th Ann. Field Conf., p. 18, 20, 21; 1938, Kansas Acad. Sci. Trans., v. 41, p. 193, 196. Cherokee group is divided into 15 cyclic formational units. The Columbus, third in the sequence (ascending), occurs above the Neutral and below the Bluejacket. Average thickness 30 feet. Includes Columbus 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.

Columbus Limestone[1]

Middle Devonian: Central and north-central Ohio, and Ontario, Canada.

Original reference: W. W. Mather, 1859, Rept. State House Artesian Well at Columbus, Ohio, p. 25.

Wilber Stout, Karl Ver Steeg, and G. F. Lamb, 1943, Ohio Geol. Survey, 4th ser., Bull. 44, p. 128–129, chart facing p. 108. Comprises Bellepoint, Marblehead, and Venice members. Thickness 80 to 125 feet. Overlies Lucas formation; underlies Delaware formation; in some area, Marcellus formation is present between the Columbus and Delaware.

J. W. Wells, 1944, Geol. Soc. America Bull., v. 55, no. 3, p. 280–282. In Logan County, includes East Liberty bone bed near top.

Wilber Stout and R. A. Schoenlaub, 1945, Ohio Geol. Survey, 4th ser., Bull. 46, p. 21. In southwestern Delaware County, comprises Bellepoint, Eversole, and Klondike members.

J. W. Wells, 1947, Ohio Jour. Sci., v. 47, no. 3, p. 119–126. Discussion of paleoecological analysis of Devonian rocks of Columbus region. Chart shows that Columbus formation, 105 feet thick, comprises (ascending) Bellepoint, Eversole, and Delhi (Klondike) members. Underlies Delaware formation; overlies Silurian (Monroe formation).

R. C. Moore, 1948, Geol. Soc. America Bull., v. 59, no. 4, p. 309 (fig. 2). Columnar section shows that Columbus formation, 105 feet thick, comprises (ascending) Bellepoint, Eversole, and Delhi members.

G. M. Ehlers, E. C. Stumm, and R. V. Kesling, 1951, Devonian rocks of southeastern Michigan and northwestern Ohio: Ann Arbor, Mich., Edwards Brothers, Inc., p. 9. Prosser (1903, Jour. Geology, v. 11) believed that beds in northwestern Ohio which he called Columbus were same beds that Mather (1859) and Newberry (1873) described by that name from quarries in vicinity of Columbus. As now recognized, Columbus limestone is absent in northwestern Ohio, and the younger Dundee limestone was the one to which Prosser referred.

G. A. Stewart, 1955, Ohio Jour. Sci., v. 55, no. 3, p. 147–179. Discussion of age relations of middle Devonian limestones in Ohio. In central Ohio, the Columbus comprises (ascending) Bellepoint, Eversole(?), and Delhi members; in north-central Ohio comprises (ascending) Bellepoint, Marblehead, and Venice members. Maximum thickness 105 feet. Underlies Delaware limestone. Overlies Bass Island (Silurian) series. Gives review of terminology.

C. R. Stauffer, 1957, Jour. Geology, v. 65, no. 4, p. 376–383. Overlies Detroit River group in northern Ohio and in Ontario. Was correlated with Onondaga limestone of New York by James Hall and others. True Onondaga is now known to occur beneath horizon of Detroit River group in Mackinac Straits region of Michigan and throughout most of its occurrence in Ontario. Eastward along line of major axis of Lake Erie, the Detroit River group pinches out, and Columbus limestone lies directly on Onondaga limestone in Norfolk and Haldimand Counties, Ont.

Named for exposures at Columbus, Ohio.

†Columbus Marl[1]

Upper Cretaceous (Gulf Series): Southwestern Arkansas.

Original reference: R. T. Hill, 1888, Arkansas Geol. Survey Ann. Rept. 1888, v. 2, p. 72, 84–86.

Named for Columbus, Hempstead County.

Columbus Quartzite[1]

Pennsylvanian: Central northern Utah.

Original reference: L. A. Palmer, 1906, Mines and Min., v. 26, p. 438–439.

Probably named for Columbus Consolidated Mine.

†Columbus Sand[1]

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, 36.

Named for occurrence at Columbus, Burlington County.

†Columbus Sandstone (in Cherokee Shale)[1]

Pennsylvanian: Southeastern Kansas.

Original reference: E. Haworth and M. Z. Kirk, 1894, Kansas Univ. Quart., v. 2, p. 106.

Named for outcrops along Brush Creek, east of Columbus, Cherokee County.

†Colville Granite or Granodiorite[1]

Cretaceous: Northeastern Washington.

Original reference: J. T. Pardee, 1918, U.S. Geol. Survey Bull. 677.

W. H. Irwin, 1938, Geol. Soc. America Bull., v. 49, no. 11, p. 1628, 1637–1638. Coarse-grained granite, exposed at Grand Coulee Dam and southward in Grand Coulee, represents a marginal facies of Colville batholith and should be known as Colville granite. Cut by vertical dikes composed of a fine-grained slightly porphyritic granite.

Name derived from Colville batholith in Colville Indian Reservation.

Colville Group

Colville Series[1]

Upper Cretaceous: Northern Alaska.

Original reference: F. C. Schrader, 1902, Geol. Soc. America Bull., v. 13, p. 248.

George Gryc, W. W. Patton, Jr., and T. G. Payne, 1951, Washington Acad. Sci. Jour., v. 41, no. 5, p. 160 (table 1), 164–167, figs. 2, 3. Redefined as Colville group, basal member of which is distinctive unit consisting of black shale with limestone interbeds. Lithologically, group includes clastic rocks ranging from shale to conglomerate, limestone, low-grade oil shale, and coal. Total thickness about 5,200 feet. Divided into nonmarine Prince Creek formation (new) and marine Schrader Bluff formation (new), which are approximately of equivalent age. Formations intertongue and are not always readily distinguishable. Unconformably overlies Nanushuk group; underlies Sagavanirktok (new) and Gubik formations. Type exposures cited. Now evident from faunal analyses that rocks are all of Upper Cretaceous age.

C. L. Whittington, 1956, *in* George Gryc and others, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 244–246, figs. 2, 3, 4. Nonmarine Tuluvak tongue of Prince Creek formation, recognizable in nearly all pertinent surface and subsurface sections, is wedge dividing marine rocks of group into two major formations: Seabee formation below and Schrader Bluff formation above.

R. M. Chapman and E. G. Sable, 1960, U.S. Geol. Survey Prof. Paper 303–C, p. 69–70, 126, pls. 8, 9, 18. Prince Creek formation is only representative of group in Utukok-Corwin region.

Type exposures: Along Colville River from approximately the junction with Prince Creek east and north to 70th parallel. Well exposed in river cuts; on Colville River, cuts form bluffs that are nearly continuous from Umiat north to Ocean Point. Extend west to about longitude of Ikpikpuk River and east to Canning River.

Colville Quartzite[1]

Mississippian(?): Northeastern Washington.

Original reference: C. E. Weaver, 1920, Washington Geol. Survey Bull. 20, p. 68, map.

K. P. McLaughlin and Merton E. Simons, 1951, Jour. Paleontology, v. 24, no. 4, p. 515 (table 1). Mississippian(?) age determination made on basis of fossils collected in limestone occurring in Colville quartzite.

Mapped near Colville, Stevens County.

Colvin Limestone Member (of Washington Formation)[1]

Colvin Run Limestone[1] (in Washington Group)

Permian: Southwestern Pennsylvania and northern West Virginia.

Original reference: I. C. White, 1891, U.S. Geol. Survey Bull. 65, p. 23, 39.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 135, 147, 177, 485. Colvin Run limestone in Washington group described in Klondike district, Fayette County, where it is composed of light- and dark-gray massive limestone beds separated by light calcareous shales. Ranges in thickness from 0 to 12 feet; averages 5 feet. Lies 75 feet above Waynesburg coal and 20 to 25 feet below Woodglen limestone (new).

Named for exposures along Colvin Run, Greene County, Pa.

Colwood Formation[1]

Recent: Northwestern Washington.

Original reference: R. D. McLellan, 1927, Washington Univ. Pub. Geology, v. 2.

San Juan Islands.

Comanche Series[1]

Lower and Upper Cretaceous: Gulf Coastal Plain.

Original reference: R. T. Hill, 1887, Am. Jour. Sci., 3d ser., v. 33, p. 298.

R. W. Imlay, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 3. In terms of European equivalents, Comanche series includes Gargasian, Albian, and Lower Cenomanian stages. Succeeds Coahuila series of Mexico. Includes (ascending) Trinity, Fredericksburg, and Washita groups.

Named for Comanche County, Tex.

Comanche 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, 385.

D. A. Zimmerman and G. D. Glover, 1956, Soc. Econ. Paleontologists and Mineralogists, Permian Basin Sec. [Guidebook] Spring Mtg., p. 72. About 300 feet thick, divided into three parts by 8 to 10 feet of hard massive sandstone associated with 10 to 15 feet of shaly friable sandstone and clay. Underlies Antelope Creek bed; overlies Wilbarker 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 Comanche Creek, Mills County.

†Comanche Peak Group[1]

Lower Cretaceous (Comanche Series): Central Texas.

Original reference: B. F. Shumard, 1860, St. Louis Acad. Sci. Trans., v. 1, p. 583, 584.

Named for Comanche Peak, Hood County.

Comanche Peak Limestone (in Fredericksburg Group)[1]

Lower Cretaceous (Comanche Series): Eastern Texas.

Original reference: R. T. Hill, 1889, Texas Geol. Survey Bull. 4, p. xiv, xvii-xix.

W. O. George, 1952, U.S. Geol. Survey Water-Supply Paper 1138, p. 14 (table 7), 22. Described in Comal County where it is composed chiefly of hard gray-white massive limestone; beds of marl containing *Exogyra texana* Roemer present locally. Thickness 20 to 55 feet; average 40 feet. Conformably overlies Walnut clay, similarity of beds to Walnut clay make it difficult to define lower limits of Comanche Peak. Conformably overlies Edwards limestone.

F. E. Lozo and others, 1959, Texas Univ. Bur. Econ. Geology Pub. 5905, 226 p. Discussed in symposium on Edwards limestone. Hill (1891, Geol. Soc. America Bull., v. 2) emended Comanche Peak formation to exclude most of older strata (Walnut and Glen Rose) originally included in Comanche Peak group by Shumard (1860). White chalky limestone of type section is 100 feet thick and is essentially same facies represented by Goodland limestones from Tarrant County north. Comanche Peak thins to south as Edwards limestone thickens and, in Colorado Valley area, encroaches on underlying marly limestones of Walnut strata. Fredericksburg group.

Named for Comanche Peak, Hood County.

†Combahee Shale[1]

Miocene, lower and upper: Southern South Carolina.

Original references: E. Sloan, 1905, South Carolina Geol. Survey geognostic map of South Carolina, advance copies; published in 1908, in South

Carolina Geol. Survey, ser. 4, Bull. 2; 1907, Summary of mineral resources of South Carolina, p. 12, 18, name only, not defined; 1908, South Carolina Geol. Survey, ser. 4, Bull. 2, p. 435, 464, 465.

Probably named for exposures on Combahee River, Colleton County.

Combe Sandstone[1]

Upper Jurassic: Northern California.

Original reference: C. H. Crickmay, 1933, Geol. Soc. America Bull., v. 44, no. 1, p. 81.

E. D. McKee and others, 1956, U.S. Geol. Survey Misc. Geol. Inv. Map I–175, table 2. Shown on paleotectonic map as overlying Foreman formation.

Type locality: Combe Canyon, north of Mount Jura.

Combined Metals Member (of Pioche Shale)

Combined Metals Bed[1]

Lower Cambrian: Southeastern Nevada.

Original reference: L. G. Westgate and Adolph Knopf, 1932, U.S. Geol. Survey Prof. Paper 171, p. 54–55.

A. R. Palmer, 1958, Jour. Paleontology, v. 32, no. 1, p. 154, 155. Considered a member of Pioche shale.

Pioche district, Highland Peak and Pioche quadrangles.

Combs Limestone[1]

Upper Devonian: Northeastern Nevada.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 52, 78.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1742. Listed with names not included on Devonian correlation chart.

Named for Combs Peak in vicinity of Eureka, Eureka County.

Combs Mountain Siltstone Member (of Brodhead Formation)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 76, 169, 170–171, pl. 15. Predominantly siltstone with lesser amounts of shale and limestone. Thickness 75 to 90 feet. Underlies Indian Fort shale member (new); overlies Conway Cut siltstone member (new). Included in Irvine facies (new) of Brodhead formation.

Type locality: Along secondary road leading to ridge between Floyds Branch and Carpenters Hollow; top of section 1 mile south of Webb School, 8 miles east of Berea, 2¼ miles south of Combs Mountain, Madison County. Name taken from Combs Mountain, a topographic outlier developed on a fault block in southeastern part of Madison County.

Comerio Beds[1]

Lower Cretaceous(?): Puerto Rico.

Original reference: C. P. Berkey, 1915, New York Acad. Sci. Annals, v. 26, p. 61.

Comers Granite Gneiss

Precambrian: Southwestern Virginia.

A. J. Stose and G. W. Stose, 1957, Virginia Geol. Survey Bull. 72, p. 37–38, pl. 1. Equigranular to porphyritic rock which consists of pink microcline and quartz in greenish-gray matrix composed of chlorite and epidote.

Quartz usually has blue color. Injected with pink pegmatite related to Carsonville granite. May be composite rock formed by partial replacement of older rocks by Carsonville granite. Contains less mafic minerals than Carsonville granite, otherwise the two rocks are similar in mineral content.

Named from Comers Rock village in northwestern part of Independence quadrangle. Occurs in wide area in northwestern part of Elk Creek anticline, northwest of Point Lookout Mountain. Well exposed on Elk Creek and its tributaries, south and southeast of Elk Creek village, and on Turkey Fork east of Tims Knob.

Comet Shale

Middle Cambrian: Southeastern Nevada.

J. F. Mason *in* A. W. Grabau, 1936, Paleozoic formations in the light of the pulsation theory, v. 1, Lower and Middle pulsations: 2d ed., Peiping, China, University Press, Natl. Univ. Peking, p. 274–276. Predominantly shaly beds 545 feet thick. Underlies Lyndon limestone; overlies Forlorn Hope shale (new). Pioche shale of Walcott (1908), and Westgate and Knopf (1927) includes Comet shale, Forlorn Hope shale, and Pioche shale as used here.

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1149, 1152–1154, 1158 (fig. 6), 1159, 1160. Thickness at type locality herein designated 370 feet. Overlies Pioche shale (restricted); underlies Lyndon limestone. Base of Comet is 4-foot zone of fossiliferous, gray oolitic limestone banded rusty brown; above this, formation consists of interbedded drab- and green-tan, micaceous, arenaceous, chunky and some fissile shale, and much arenaceous limestone, which is purer and increases in amount upward so that upper 65 feet consists largely of limestone. Derivation of name given.

Type locality: On west face of divide between Burrows Canyon and Lyndon Gulch, Highland Range. Section well exposed and undisturbed by faults. Name derived from Comet mine on west side of Highland Range.

Comet Creek Bed[1]

Lower Cretaceous: Western Oklahoma.

Original reference: R. T. Hill, 1895, Am. Jour. Sci., 3d., v: 50, p. 228.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 100. Oklahoma Geological Survey abandoned name in its earlier sense.

Named for Comet Creek in Custer County.

Commerce Sandstone[1]

Tertiary: Southeastern Missouri.

Original reference: C. L. Drake, 1918, Missouri Bur. Geol. and Mines, v. 15, 2d ser., p. 191.

Well exposed in cuts on St. Louis and San Francisco Railroad in and just north of Commerce, Scott County.

Commercial Limestone Member (of Bingham Quartzite)[1]

Pennsylvanian: Central northern Utah.

Original reference: A. Keith, 1905, U.S. Geol. Survey Prof. Paper 38, p. 40, maps, sections.

Probably named for Commercial mine, Bingham district.

Commonwealth Ore Formation[1]

Age(?): Northern Michigan.

Original reference: C. L. Rominger, 1881, Michigan Geol. Survey, v. 4, pt. 2, p. 223.

Commonwealth mine, Menominee iron region.

†Como Beds[1]

Lower Cretaceous: Wyoming.

Original reference: W. B. Scott, 1897, Introduction to geology, p. 477, 491.

Compton Limestone[1]

Compton Formation (in Chouteau or St. Joe Group)

Compton Limestone Member (of Chouteau Formation)

Mississippian: Southwestern Missouri.

Original reference: R. C. Moore, 1928, Missouri Bur. Geology and Mines, v. 21, 2d ser., p. 60, 108–109, 111, 118–122, 131, 158.

J. G. Grohskopf, E. L. Clark, and S. Ellison, 1943, Missouri Geol. Survey and Water Resources 62d Bienn. Rept., App. 4, p. 9. Average thickness about 15 feet in Barry County. May rest upon Chattanooga, Sylamore, Fortune (new), or Cotter. Oldest limestone of Mississippian age known in southwestern Missouri and represents lower 10 to 15 feet of beds called St. Joe in northern Arkansas.

E. B. Branson, 1938, Missouri Univ. Studies, v. 13, no. 3, p. 10; 1944, v. 19, no. 3, p. 179 (fig. 3), 193. Compton represents lower part of Chouteau and should not be considered a separate formation. Underlies Northview member.

T. R. Beveridge and E. L. Clark, 1952, Missouri Geol. Survey and Water Resources Rept. Inv. 13, p. 71, 72 (fig. 1), 73, 75 [reprinted from Kansas Geol. Soc. Guidebook 16th Field Conf.]. Chouteau is redefined as group to include (ascending) Compton, Sedalia, and Northview formations. Usage of name Compton is extended laterally to replace the "Chouteau (restricted)" of previous literature. Original type area is along James River in vicinity of now nonexistent Compton post office which stood in NW¼NW¼SE¼ sec. 9, T. 29 N., R. 19 W., Webster County. The Compton is not exposed in immediate vicinity of namesake post office site, and type section is herein redesignated. In Christian and Barry Counties, the St. Joe is raised to rank of group comprising (ascending) Compton, Northview, and Pierson formations.

Type section (Beveridge and Clark): Center SE¼SE¼S½ sec., 3, T. 29 N., R. 19 E., on northwest side of gravel road, Webster County. This section is 2 miles northeast of Compton post office site, and shows the Compton in its entirety. Named for exposures along James River in vicinity of Compton, near west line of Webster County.

Comstock Formation

Eocene: Western Oregon.

P. E. Turner, 1938, Geol. Soc. America Spec. Paper 10, p. 21–22, 23. Name proposed for approximately 1,000 feet of nonmarine sediments that occur between overpass south of Comstock and first outcrops of base of Fisher formation, and for a comparable thickness of similar continental beds stratigraphically below base of Fisher along line of its outcrop from Coyote Creek, 20 miles northwest of Comstock, to vicinity of London about 8 miles southeast. Beds consists of sandstones, tuffs, and locally shaly silts. The Fisher is identified on basis of lithologic similarity to type occurrence west of Eugene. Relations of Comstock to formations above and below not entirely clear. At Hill 506 in Cottage Grove quadrangle, the Fisher lies with angular discordance upon the Comstock. Contact with underlying Spencer formation not directly observable. Evidence suggests that Comstock rests with angular discordance upon underlying marine Eocene and that it overlaps successively older beds along the line of its exposure from Coyote Creek to London.

H. E. Vokes, P. D. Snavely, Jr., and D. A. Meyers, 1951, U.S. Geol. Survey Oil and Gas Inv. Map OM–110. Included in redefined Spencer formation.

Area discussed is in Cottage Grove, Elmira, and Eugene quadrangles.

Comus Formation

Lower and Middle Ordovician: North-central Nevada.

R. J. Roberts, 1951, Geology of the Antler Peak quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–10]; 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]. Interbedded chert, slate, and argillite. Chert is dark gray, green, brown, and black. Slate and argillite are dark gray, green, or black. Estimated thickness more than 2,000 feet. In thrust contact with Valmy formation (new) and unconformably overlain by Battle formation (new).

R. J. Roberts and others, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 12, p. 2831–2832. Comus formation was mapped in Golconda quadrangle (Ferguson, Roberts, and Muller, 1952) as in normal contact with Preble formation of Middle or Late Cambrian age. Restudy of type locality has shown that the contact is a high-angle fault. Upper Cambrian rocks that may have been present between Preble and Comus have been cut out along the fault. The chert and shale unit of northwest side of Battle Mountain, originally assigned to Comus, is now referred to upper part of Valmy formation.

Type locality: Near Comus, in Golconda quadrangle, Humboldt County.

Comyn Formation (in Marble Falls Group)

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

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 84 (fig. 5), 85. Name applied to subsurface section of Marble Falls group in Ranger area. Occurs between depths of 4,132 and 4,320 feet in type well. Underlies DeLeon Springs formation (new) of Big Saline group.

M. G. Cheney, 1947, Jour. Geology, v. 55, no. 3, pt. 2, p. 211. Plummer (1944, Texas Univ. Bur. Econ Geology Pub. 4401) assigned name Sloan to outcropping Morrowan rocks and this name should replace Comyn.

G. L. Turner, 1957, Abilene and Fort Worth Geol. Soc. Guidebook Joint Field Trip, p. 63–64. Problem of whether the Comyn is Morrowan or late Mississippian has not been definitely resolved.

Type well: Roxana Petroleum Co. Seaman No. 1, Palo Pinto County. Name derived from town in Comanche County.

Conanicut Arkose[1]

Carboniferous: Southern Rhode Island.

Original reference: A. F. Foerste, 1899, U.S. Geol. Survey Mon. 33, p. 380.

Occurs on eastern side of Mackerel Cove, Conanicut Island.

Conant Limestone Member (of Carbondale Formation)

Pennsylvanian: Southern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 35, 48 (table 1), pl. 1. Proposed for limestone formerly called Jamestown. Name Jamestown to be used for coal member underlying the Conant. Stratigraphically below Anvil Rock sandstone member. Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification retained but is entirely independent of rock-stratigraphic classification.

Type locality: NW¼NE¼ sec. 34, T. 5 S., R. 4 W., Perry County. Name derived from village of Conant about 2 miles east of type outcrop.

Conasauga Shale,[1] Limestone,[1] Formation, or Group

Middle and Upper Cambrian: Northeastern Georgia, northern Alabama, eastern Tennessee, and southwestern Virginia.

Original reference: C. W. Hayes, 1891, Geol. Soc. America Bull., v. 2, p. 143, 144–148.

T. L. Kesler, 1950, U.S. Geol. Survey Prof. Paper 224, p. 17–19, pl. 1. Described in Cartersville district, Georgia, as Conasauga formation. Consists largely of metashale containing unevenly distributed thin and thick beds of weakly calcareous metasiltstone. Maximum thickness 2,000 feet; top not exposed. Overlies Rome formation.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 1 (plates); pt. 2, p. 46 (fig. 3), 47–53. In eastern Tennessee, the Conasauga varies in lithology and three phases are recognized: northwestern phase largely of shale, central phase of alternating shale and limestone formations, and southeastern phase principally of dolomite but including some limestone and shale. In northwestern phase, Conasauga shale includes Pumpkin Valley shale member below and Maynardville limestone member above. In central phase (between Knoxville and Morristown, and north of Clinch Mountain), Conasauga group consists of six formations (ascending): Pumpkin Valley shale, Rutledge limestone, Rogersville shale, Maryville limestone, Nolichucky shale, and Maynardville limestone. Southeast boundary of central phase is marked by disappearance of Rogersville shale and merging of Maryville and Rutledge formations, here largely dolomite, into Honaker dolomite. In southeastern phase, sequence is (ascending) Honaker dolomite, Nolichucky shale, and Maynardville limestone. To the northeast, in Virginia, the shale units thin to disappearance until the whole is carbonate rock with some shaly dolomite beds (the Elbrook dolomite). Overlies Rome formation; underlies Copper Ridge dolomite and to southeast Conococheague limestone.

R. L. Miller and J. O. Fuller, 1954, Virginia Geol. Survey Bull. 71, p. 28–33. Term Conasauga shale extended into western Lee County, Va., where it is applied to beds previously called Nolichucky shale. Only upper half of Conasauga exposed; underlies Low Hollow limestone member of Maynardville limestone.

P. B. King and H. W. Ferguson, 1960, U.S. Geol. Survey Prof. Paper 311, p. 54. Conasauga group is an interfingering complex of shale, limestone and dolomite, mainly of Middle Cambrian but partly of Late Cambrian age, of which Elbrook dolomite, Honaker dolomite, and Nolichucky shale are representatives in northeasternmost Tennessee [this report]. In this region, group is exposed in two separate areas: one to north along southeast edge of Appalachian Valley, and the other to southwest near Elizabethton, in trough of Stony Creek syncline. In northern occurrence, the interval is all dolomite, the Elbrook; to the southwest, the Nolichucky shale is at top and underlying dolomite is Honaker.

Named for exposures in Conasauga Valley, Dalton quadrangle, northwestern Georgia.

Conasaugan Series

Middle Cambrian: Southeastern 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, 282. Both the Nolichucky and Conasauga are here referred to the Middle Cambrian and for this series, as developed in southern Appalachian geosyncline, name Conasaugan is proposed; succeds the Stonehengian.

Concentrator Volcanics

Cretaceous(?): Southwestern Arizona.

James Gilluly, 1937, Arizona Bur. Mines Bull. 141, Geol. Ser. 9, p. 15 (table 1), 27–32, pl. 1; 1946, U.S. Geol. Survey Prof. Paper 209, p. 22–25, pl. 3 [1947]. Andesite, keratophyre and quartz keratophyre flows, breccias, and tuffs, highly altered and of complex structure. Rocks range in color from white through buff and gray to red and brown. Flow breccias most abundant, tuffs next, and flows subordinate. Several hundred to perhaps over 3,000 feet thick. Younger than Cardigan gneiss (new); intruded by Cornelia quartz monzonite (new).

Named from conspicuous outcrops on Concentrator Mountain, southeast of Ajo, Ajo quadrangle, Pima County. Exposed in two relatively small areas, aggregating less than 2 square miles.

Concha Limestone (in Naco Group)

Concha Limestone (in Snyder Group)

Permian: Southeastern Arizona.

James Gilluly, J. R. Cooper, and J. S. Williams, 1954, U.S. Geol. Survey Prof. Paper 266, p. 1, 29–30, 42–43. In Naco group. Lower beds, for most part, are fine-grained calcareous sandstone which weathers gray; probably nowhere more than 50 feet thick. Above basal sandy beds, formation consists of gray medium-grained highly fossiliferous limestone which contains abundant irregular nodules of light-colored chert weathering pale brown. Thickness at type section 129½ feet. Overlies Scherrer formation (new); unconformably underlies Glance conglomerate of Bisbee 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. Type Concha equivalent to only basal part of an additional 1,000 feet of limestone in other localities. Concha limestone (expanded) assigned to Snyder Hill group.

F. F. Sabins, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 3, p. 498. Suggested that terms Chiricahua limestone and Snyder Hill formation be suppressed and term Concha limestone be used for the light-colored cherty limestones of southeast Arizona that contain Kaibab fauna and overlies Scherrer formation.

Elliot Gillerman, 1958, New Mexico Bur. Mines Mineral Resources Bull. 57, p. 41–43. Believed that Concha limestone and Chiricahua limestone are same stratigraphic unit and that terms are synonymous; term Chiricahua has priority. In this report [central Peloncillo Mountains], term Chiricahua is used for cherty limestone overlying Scherrer quartzite and considered uppermost unit of Naco group.

Type section: On east end of Concha Ridge, a conspicuous transverse spur of Scherrer Ridge in Gunnison Hills, NW¼ sec. 28, T. 15 S., R. 23 E., central Cochise County.

Conch Point Shale

Miocene, lower: Panamá.

R. A. Terry, 1956, California Acad. Sci. Occasional Paper 23, p. 52, 77. Massive poorly bedded soft gray clay shale underlying Bastimentos shale which it resembles closely. On Columbus Island, surface structure is gently rounded dome on which early Miocene Conch Point shale crops out at crest, over an area of about 1 mile, surrounded by middle Miocene Bastimentos shale. Seismograph survey indicates structure is cut by fault striking N. 24° E.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 332. Miocene. If these strata are same age as early part of Uscari shale of Costa Rica, name Conch Point should be suppressed. Note on derivation of name.

Conch Point is on west side of Isla de Colón, 8 kilometers northwest of town of Bocas del Toro.

Concord Formation[1]

Oligocene: Western California.

Original reference: B. L. Clark, 1918. California Univ. Pub., Dept. Geol. Bull., v. 11, p. 54–111.

G. C. Lutz, 1951, California Univ., Dept. Geol. Sci. Bull., v. 28, no. 13, p. 373, 374, 381. Mentioned as underlying Sobrante sandstone in southwest limb and in part of northeast limb of Bear Creek anticline. Overlies Kirker tuff. Described as fine- to medium-grained buff-colored mottled sandstone. May be several hundred feet thick.

Occurs in San Francisco Bay region.

Concord Granite[1] (in New Hampshire Plutonic Series)

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

Original reference: C. H. Hitchcock, 1873, Rept. Geol. Survey New Hampshire 1872, p. 9, 12.

Katharine Fowler-Lunn and Louise Kingsley, 1937, Geol. Soc. America Bull., v. 48, no. 10, p. 1369, 1371–1373. Assigned to New Hampshire magma series.

Katharine Fowler-Billings, 1949, Geol. Soc. America Bull., v. 60, no. 8, p. 1250, 1268–1270, pl. 1. Summary discussion.

M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000): U.S. Geol. Survey. Mapped together with Bickford granite; unit designated "binary granite" on map. Included in New Hampshire plutonic series.

City of Concord is in outcrop area.

Concreto Shale[1]

Pennsylvanian: Southeastern Kansas.

Original reference: G. I. Adams, 1904, U.S. Geol. Survey Bull. 238, p. 20.

Named for Concreto, Allen County.

Condor Member (of Highland Peak Formation)

Condor Formation (in Ophir Group)

Condor Member (of Swasey Limestone)

Middle Cambrian: Eastern Nevada and western Utah.

H. E. Wheeler, 1948, Nevada Univ. Bull., Geology and Mining Ser., no. 47, p. 39, fig. 5. Name applied to lowermost 117 feet of type Swasey as described by Deiss (1938). Consists largely of thinly interbedded calcareous, argillaceous, and arenaceous strata. Underlies unnamed upper part of Swasey; overlies Dome limestone. This unit, although more dolomitic, was referred to as Highland Peak unit "F" in Pioche district by Wheeler and Lemmon (Nevada Univ. Bull., Geology and Mining Ser., no. 31).

R. E. Cohenour, 1959, Utah Geol. and Mineralog. Survey Bull. 63, p. 12 (table 1), 35, 46–47, pl. 1, measured sections. In Sheeprock Mountains, rank raised to formation in Ophir group. Thickness 107 to 135 feet. Overlies Dome limestone.

R. A. Robison, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 47, 51. Name Condor as used by Wheeler (1948) and Cohenour (1959) replaced by Whirlwind formation (new).

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

Type section: In Panaca Hills, Pioche district, Nevada. Name derived from Condor Canyon, about 2 miles north of type section; member is exposed on north wall near mouth of canyon. Recognized in Wah Wah and House Ranges, Utah.

Cone Calcareous Member (of Marias River Shale)

Upper Cretaceous: Northwestern Montana.

W. A. Cobban and others, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2792 (fig. 3), 2794; 1959, Billings Geol. Soc. [Guidebook] 10th Ann. Field Conf., p. 89 (fig. 1), 91. Chiefly highly calcareous dark-gray shale at type section. Other less abundant but easily recognized lithologies include persistent bed of large septarian concretions of dark-gray limestone at base; a widespread 4-foot-thick bed of white bentonite 12 feet above base; and several layers of thin-bedded ledge-forming clastic fossiliferous limestone at top. It is the so-called Greenhorn of Sweetgrass arch. About 54 feet thick at type section. Underlies Ferdig shale member (new); overlies Floweree member (new).

Type section: On south side of small conical hill below U.S. Geological Survey vertical angle bench mark (VABM) Cone in NW¼ sec. 13, T. 22 N., R. 1 W., Vaughn quadrangle, Teton County.

Conecuh Sands[1]

Pleistocene: Southeastern Alabama.

Original reference: E. A. Smith, L. C. Johnson, and D. W. Langdon, Jr., 1894, Alabama Geol. Survey Rept. Coastal Plain, p. 27, 56–57.

Probably named for Conecuh River.

Conejo Volcanics[1]

Miocene: Southern California.

Original reference: N. L. Taliaferro, 1924, Am. Assoc. Petroleum Geologists Bull., v. 8, p. 800–801.

O. P. Jenkins and others, 1949, California Div. Mines Bull. 142, p. 140. Composed of basalt flows and pyroclastics with minor basalt and andesite dikes. Overlies olivine basalt which in turn overlies Topanga formation.

W. E. Kennett *in* L. E. Redwine and others, 1952, Cenozoic correlation section paralleling north and south margins, western Ventura basin, from Point Conception to Ventura and Channel Islands, California: Am. Assoc. Petroleum Geologists, Pacific Sec., sheet 2. Cited on chart as underlying Monterey formation and overlying Rincon formation on San Miguel and Santa Rosa Islands. Thickness 2,500 to 2,900 feet.

Occurs in Conejo Mountains, western end of Santa Monica Mountains.

Conejos Formation (in Potosi Volcanic Group)

Conejos Andesite (in Potosi Volcanic Series)[1]

Conejos Quartz Latite (in Potosi Volcanic Series)

Tertiary, middle or upper: Southwestern Colorado and northern New Mexico.

Original reference: E. S. Larsen, 1917, Colorado Geol. Survey Bull. 13, p. 20, 38–39.

E. S. Larsen, Jr., and Whitman Cross, 1956, U.S. Geol. Survey Prof. Paper 258, p. 96–102, pl. 1. Redescribed as quartz latite. Geographically extended into New Mexico where it becomes thinner and is predominantly a sand and gravel formation. Greatest thickness about 4,000 feet in basin at head of Rio Blanco in central part of Summitville quadrangle, Colorado. Thickness of 3,000 feet or more in central area and thins in all directions from central part, but, except on extreme edges of formation, is rarely less than 1,000 feet thick. Underlies Beidell quartz latite.

T. A. Steven and J. C. Ratte, 1960, U.S. Geol. Survey Prof. Paper 343, p. 10, 11–13, pl. 2. Term Conejos formation considered more appropriate than petrographic term quartz latite. In Summitville district, formation consists largely of flat-lying dark rhyolitic rocks. Underlies Fisher quartz latite. Middle or later Tertiary.

W. R. Muehlberger and others, 1960, New Mexico Geol. Soc. Guidebook 11th Ann. Field Conf., p. 100. In Brazos Peak quadrangle, New Mexico, the Conejos quartz latite underlies Toltec andesite member (new) of Treasure Mountain rhyolite.

Named for exposures along Conejos River. Most widely distributed and best exposed in Summitville, Conejos, and Del Norte quadrangles, Colorado. In general way, outcrops confined to an area about 130 miles long in north and south dimension; about 60 miles wide in northern third, and about 50 miles wide just north of Colorado-New Mexico State line.

Conemaugh Formation[1]

Conemaugh Group or Series

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

Original reference: F. Platt, 1875, Pennsylvania 2d Geol. Survey Rept. H, p. 8.

R. E. Lamborn, C. R. Austin, and Downs Schaaf, 1938, Ohio Geol. Survey, 4th ser., Bull. 39, p. 181–211. Conemaugh series in Ohio varies from 350 feet in southern part of Lawrence County to 518 feet at eastern edge of Jefferson County. Comprises 39 members including 12 coal beds.

W. O. Hickok, 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 77–99. Group described in Fayette County, Pa. Consists of sandstone, red and gray shale, limestone, thin coal beds, and small amounts of low-grade fire clay. Base is at top of Upper Freeport coal and top at base of Pittsburgh coal. Divided into nine parts (ascending): Mahoning, Buffalo, Saltsburg, Grafton, Barton, Morgantown, Lonaconing, Connellsville, and one which has not been named but which contains Little Pittsburgh coal.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, p. 665, 666, chart 6. Referred to as series. Above Allegheny and below Monongahela.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 57–72, table 1. Conemaugh series, in Perry County, described on cyclothemic basis. Comprises seven cyclothems. [For sequence see Mahoning cyclothem.] About one-half the strata in the series are present in county.

R. E. Lamborn, 1951, Ohio Geol. Survey, 4th ser., Bull. 49, p. 28–34. Conemaugh series described in eastern Ohio. Following limestone members are discussed (ascending): Mahoning, Cambridge, Bloomfield, Ewing, Ames, Gaysport, Elk Lick, Clarksburg, Summerfield, and Pittsburgh. Cyclothemic classification not used in this report.

T. W. Amsden, 1954, Maryland Dept. Geology, Mines and Water Resources Bull. 13, p. 53–65. Only complete section of formation in Maryland is in Georges Creek-Upper Potomac basin where it ranges from 825 to 925 feet in thickness. Includes claystone, shale, sandstone, fresh-water limestone, red shale, marine shale, and coal beds. Lower and upper members recognized. Lower member extends from top of Upper Freeport coal to top of Barton coal, and upper member comprises strata between Barton coal and base of Pittsburgh coal.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 10 (fig. 3), 24–65. Entire series present in Morgan County. Strata included in series extend from Upper Freeport (No. 7) coal to base of Pittsburgh (No. 8) coal. Total thickness 365 feet. Forty-two members described (including coal members). Cyclothemic classification not used in this report.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 93-157. Series described in Athens County. Thickness about 545 feet. Fifteen cyclothems described. [For sequence see Mahoning cyclothem.]

J. J. Burke, 1958, Science, v. 128, no. 3319, p. 302. Formation in vicinity of Pittsburgh includes (ascending) Nadine limestone (new), Woods Run limestone, and Carnahan Run shale (new).

W. A. Tallon and R. G. Hunter, 1959, West Virginia Geol. and Econ. Survey Rept. Inv. 17, p. 11–13. Series consists of gray and tan sandstones, red and tan shales, some limestones, clays, and several thin coal seams. Average thickness about 600 feet. Main outcrop area is irregular belt extending through central part of state from Preston to Wayne County. Underlies Monongahela series; overlies Allegheny series.

R. R. Dutcher and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 69 (fig. 4), 71, fig. 9. Group, between 600 and 900 feet thick, differs from the Pottsville and Allegheny, in that it contains red beds and more persistent marine beds, the latter being good stratigraphic guides. Such marine beds include Brush Creek, Cambridge, and Ames limestone which grade eastward into marine shale facies. Ames limestone represents highest known occurence of marine strata in coal measures of Pennsylvania. This persistent bed is present throughout Conemaugh belts of western Pennsylvania, West Virginia, Ohio, and Kentucky. There is faunal evidence for Conemaugh equivalents in northern anthracite field of eastern Pennsylvania and Eastern Interior Coal basin of Illinois. Overlies Allegheny group; underlies Monongahela group.

Carlyle Gray, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Conemaugh formation consists of cyclic sequences of red and gray shales and siltstones with thin limestones and coals; massive Mahoning sandstone commonly present at base; Ames limestone present in middle of sections; Brush Creek limestone in lower part of section.

Named for exposures along Conemaugh River, Pa.

Conestoga Limestone[1]

Cambrian(?) and Lower Ordovician: Southeastern Pennsylvania.

Original reference: G. W. Stose and A. I. Jonas, 1922, Washington Acad. Sci. Jour., v. 12, p. 359, 365–366.

A. I. Jonas and G. W. Stose, 1936, Geol. Soc. America Bull., v. 47, no. 10, p. 1671–1673. On basis of fossils collected at Henderson, Conestoga limestone in Chester Valley is of Beekmantown age (upper Canadian of Ulrich). In Norristown area, the Conestoga overlies Elbrook limestone and Ledger dolomite, and southwestward, near Coatesville, overlaps older limestones down to Antietam quartzite and Harpers phyllite. Chester Valley lies south of Mine Ridge anticline, which extends from New Providence eastward to Valley Forge. The Conestoga of type locality, in the Lancaster, York, and Hanover Valleys, lies north of Mine Ridge axis, and its southwestern end is in strike with Frederick Valley, although separated from it by an area of Triassic rocks. Without fossil evidence, it cannot be decided whether the Conestoga or area north of Mine Ridge is of Beekmantown age, as that of Chester Valley, or whether it is in part older, and of Upper Cambrian and basal Ordovician age, like the limestones of Frederick Valley. The Conestoga is not known to be faunal equivalent of Frederick limestone and cannot at present be correlated with it.

B. L. Miller, 1937, Geol. Soc. America Bull., v. 47, supplement, p. 2017–2019. Discussion of the above paper by Jonas and Stose. This author [Miller] believes Conestoga limestones are of Ordovician age, younger than Beekmantown and older than the Martinsburg and to be correlated with Jacksonburg of Lehigh Valley.

A. J. Stose and G. W. Stose, 1944, U.S. Geol. Survey Prof. Paper 204, p. 34–38, pl. 1. Described in Hanover-York district where it is poorly exposed and no continuous section can be measured. Unconformable on underlying formations—Kinzers formation, Ledger dolomite, Vintage dolomite, and Antietam quartzite. Lower Ordovician(?); may be in part Upper Cambrian.

Carlyle Gray, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Formation mapped as Ordovician.

Named for outcrops along Conestoga Creek south of Lancaster.

Conewago Conglomerate Member (of Gettysburg Shale)

Conewago Group[1]

Upper Triassic: South-central Pennsylvania.

Original reference: G. H. Ashley, 1931, Pennsylvania Topog. and Geol. Survey, ser. 4, Bull. G–1, p. 77.

G. W. Stose and A. I. Jonas, 1939, Pennsylvania Geol. Survey, ser. 4, Bull. C–67, p. 107, 115, 118. Member of Gettysburg shale. Consists of thick lenticular zone in which are numerous beds of hard red pebbly arkosic sandstone and conglomerate. Conglomerate beds of the Conewago begin to appear southwest of Airy Hill School at western border of York County. They thicken northeastward and just beyond Harmony Grove make a ridge 400 feet higher than lowland that is crossed by York-Dillsburg Road. Hard conglomerate beds increase in number and thickness northeastward and form Conewago Mountain, a ridge attaining 1,050 feet altitude at its highest point, south and southeast of Andersontown. Conglomerates thin rapidly northeastward and finger into red shale and sandstone, and high ridge ends in two low spurs northwest of Strinetown. Maximum thickness 7,300 feet. Stratigraphically below Heidlersburg member.

A. J. Stose and G. W. Stose, 1944, U.S. Geol. Survey Prof. Paper 204, p. 56. Derivation of name.

Named for Conewago Hills in New Cumberland quadrangle.

Conewango Clay[1]

Pleistocene: Northwestern Pennsylvania.

Original reference: E. H. Williams, Jr., 1920, Am. Philos. Soc. Proc., v. 59, p. 62, 63.

Named for Conewango Creek, Warren County.

Conewango Formation[1]

Conewango Group, Series, or Stage

Devonian or Carboniferous: Southwestern New York and northwestern Pennsylvania.

Original references: C. Butts, 1908, Pennsylvania Topog. and Geol. Survey Rept. 1906–1908, p. 191, 198; 1910, U.S. Geol. Survey Geol. Atlas, Folio 172.

Bradford Willard, 1937, Pennsylvania Acad. Sci. Proc., v. 11, p. 32. Generalized succession for marine Upper Devonian of northwestern Pennsylvania (and southwestern New York) shows Conewango group comprises (ascending) Panama conglomerate, Venango and Riceville formations. Occurs above Conneaut group.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1734, chart 4. Term Conewango is herein elevated to rank of stage. Occurs above Cassadaga stage (new). Bradfordian series, Upper Devonian.

J. G. Woodruff, 1942, New York State Mus. Bull. 326, p. 50–67. Conewangan series includes Cattaraugus and Oswayo formations. Upper Devonian.

I. H. Tesmer, 1954, Hobbies, v. 35, no. 2, p. 30–33. Group comprises (ascending) Cattaraugus, Oswayo, and Knapp formations. Underlies Arkwright group (new). Chautauquan series. Upper Devonian.

L. V. Rickard, 1957, New York Geol. Assoc. Guidebook 29th Ann. Mtg., p. 17 (table 2), 19–20. Group comprises (ascending) Wolf Creek conglomerate, Cattaraugus shale, and Oswayo shale. Overlies Chadakoin group; underlies Lower Mississippian Knapp "formation." Approximately same as Venango group (Carll, 1880).

Named for exposures in valley walls and uplands bordering Conewango Creek, south of New York boundary.

Coney Limestone (in Bluefield Formation)[1]

Mississippian: Southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Mercer, Monroe, and Summers Counties, p. 298, 379.

Type locality: In vicinity of Avis, just opposite Coney Island, Summers County.

Coney 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. 298, 380.

Type locality: On east side of New River, just east of Avis and just opposite Coney Island, Summers County. Also exposed in Mercer and Monroe Counties, W. Va., and in Giles and Tazewell Counties, Va.

Confederate Limestone (in Hoxbar Group or Deese Group)

Confederate Limestone Member (of Hoxbar Formation)[1]

Pennsylvanian: Central southern Oklahoma.

Original reference: C. W. Tomlinson, 1928, Oklahoma Geol. Survey Bull. 40Z, p. 15.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, p. 697, chart 6 (column 37). Reallocated to Deese group and given formational status. Base of Hoxbar is drawn above the Confederate limestone, rather than just below it, as the boundary between Desmoinesian and Missourian deposits preferably should coincide with the Deese-Hoxbar contact.

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). Formation at base of Hoxbar group, Missouri series. At type locality, the Confederate comprises 30 feet of finely crystalline limestone varying from thin bedded to massive and from cream to dark tan in color; overlying 10 feet of calcareous shale with 2 feet or more of dense gray limestone at base. Crinerville beds (or member) occur 400 to 500 feet above base of Hoxbar.

B. H. Harlton, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 2, p. 221. In Cement Pool area, Caddo and Grady Counties, the Confederate overlies West Arm formation (new) of Deese group.

Named because it is well exposed a short distance west of Oklahoma Confederate Veterans Home, in SE¼ sec. 36, T. 4 S., R. 1 E., on southwest outskirts of Ardmore, Carter County.

†Congaree Clay Member[1] (of McBean Formation)

Eocene, upper: Eastern Georgia.

Original references: J. O. Veatch and L. W. Stephenson, 1911, Georgia Geol. Survey Bull. 26, p. 267; 1915, U.S. Geol. Survey Water-Supply Paper 341, p. 77, 268.

Named for Congaree, Richland County, S.C.

Congaree Formation

†Congaree Shales[1] or phase[1]

Eocene, middle: Central southern South Dakota.

Original references: E. Sloan, 1905, South Carolina Geol. Survey geognostic map of South Carolina, advance copies; published 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), 21–23. Though Sloan's Congaree phase was vaguely defined, he evidently intended to include in it clay, sand, and buhrstone of early Claiborne age. Veatch and Stephenson (1911, Georgia Geol. Survey Bull. 26) accepted Congaree in this sense for use in Georgia and described Congaree clay as basal member of McBean formation, oldest formation of Claiborne age known to them there. How much of their Congaree is Claiborne is still uncertain. Cooke and Shearer (1918, U.S. Geol. Survey Prof. Paper 120–C) supposed that all their Congaree was Jackson and transferred it to Barnwell formation under name of Twiggs clay member. Later Cooke (1943, U.S. Geol. Survey Bull. 941) restored that facies consisting of thin-bedded or laminated sand and clay to McBean formation. It now appears that deposits of Claiborne and Jackson age have never been properly delimited in either Georgia or South Carolina. A large part of the deposits in Georgia mapped as Barnwell is of Claiborne age. This includes much of Twiggs clay member of Barnwell of eastern Georgia. Name Congaree is here revived and deemed of formational rank because it is equivalent to the Tallahatta formation of Mississippi and Alabama. Term formation is preferred to clay or shale because much sand as well as clay and shale are included. At designated typical exposure, formation is 21 feet thick and unconformably underlies Warley Hill marl. Overlies Black Mingo formation. Included in lower Claiborne.

Typical exposure: Section in roadcut west of Halfway Swamp one-half mile east of Creston, Calhoun County, S.C. Name derived from Congaree River.

Conglomerate Point Breccia

Pliocene: Northwestern Washington.

R. S. Yeats, 1958, Dissert. Abs., v. 19, no. 4, p. 775. In a deeply eroded volcanic neck which intruded the Grotto batholith.

In Skykomish area in northwestern Cascade Mountains, 45 miles east of Seattle.

Congo Cay Limestone Member (of Tutu Formation)

Upper Cretaceous: Virgin Islands.

T. W. Donnelley, 1960, Dissert. Abs., v. 20, no. 7, p. 2756; 1960, Caribbean 2d Geol. Conf. Trans., Mayagüez, Puerto Rico, p. 153. Thickness 100 to

300 feet. Occurs near top of formation. Virgin Island group considered of Cenomanian age.

Report discusses geology of St. Thomas and St. John Islands.

Conneaut Group[1] or Formation

Conneaut Stage

Upper Devonian: Northeastern Ohio, southwestern New York, and northwestern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 136.

G. H. Chadwick, 1936, New York State Mus. Bull. 307, p. 78, 96. Group includes Cotton formation (new).

K. E. Caster, 1938, Jour. Paleontology, v. 12, no. 1, p. 44. Referred to as Conneaut stage of Chautauquan series.

J. G. Woodruff, 1942, New York State Mus. Bull. 326, p. 27–50. Group, in Wellsville quadrangle, comprises (ascending) Wellsville formation (new), Hinsdale sandstone, Whitesville formation (new), "Catskill" sedimentation, and Germania formation (new). Embraces strata between Cuba formation of Canadaway group below and Cattaraugus formation above.

I. H. Tesmer, 1955, New York State Mus. Sci. Service Circ. 42, p. 11-12. In Cherry Creek quadrangle, Chadakoin formation contains about 420 feet of siltstone and shales which lie between top of Northeast shale member of Canadaway formation and base of Panama conglomerate member of Cattaraugus formation. These strata are equivalent to Conneaut group of Caster (1934). As Chadakoin formation is here assigned to Arkwright group, term "Conneaut group" has no status.

Hugo Greiner, 1957, Yale Univ. Peabody Mus. Nat. History Bull. 11, p. 9 (table), 10, 54–55. Discussion of evolution and paleoecology of *Spirifer disjunctus* in Catskill delta. Collections were made from Conneaut stage which according to table includes Cuba standstone, Volusia (Girard) shale, Lillibridge sandstone, Dexterville shale, Hinsdale sandstone, Ellicott shale, and "Chadakoin" formation.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Conneaut group, as mapped, consists of alternating gray, brown, greenish, and purplish shales and siltstones; includes "pink rock" of drillers and "Chemung" and "Girard" formations of northwestern Pennsylvania.

Named for exposures on Conneaut Creek in Ohio and Pennsylvania.

†Conneaut limestone member[1]

Mississippian: Northwestern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, table opposite p. 61.

Connell Sandstone Member (of Oil Creek Formation)

Middle Ordovician: Western Texas (subsurface).

R. H. Schweers, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 12, p. 2029–2036. Medium- to coarse-grained sandstone at base of Oil Creek formation. Thickness 40 feet at type locality.

Type locality: Texas Co. W. E. Connell No. 33 in NE¼NE¼ sec. 1, Block B–22, Public School Land Survey, Jordan area, Ector County, between 8,822 and 8,862 feet.

Connellsville Member (in Conemaugh Formation)[1]

Pennsylvanian: Western Pennsylvania.

Original reference: M. E. Johnson, 1929, Pennsylvania Topog. and Geol. Atlas 27, p. 31.

Pittsburgh area.

Connellsville Red Bed (in Conemaugh Formation)[1]

Connellsville redbed member

Pennsylvanian: Western Pennsylvania, southeastern Ohio, and northern West Virginia.

Original reference: C. K. Swartz, 1922, Maryland Geol. Survey, v. 11, pl. 6.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 94 (table 11), 154. Referred to as Connellsville redbed member of Little Waynesburg cyclothem in report on Athens County. At places, the interval between the Little Clarksburg and Pittsburgh coals is occupied almost entirely by redbeds. The lowermost of these is Connellsville redbed. whose position is equivalent to upper part of Connellsville sandstone. Average thickness 8 feet.

Name probably derived from Connellsville, Fayette County, Pa.

Connellsville Sandstone Member (of Conemaugh Formation)[1]

Connellsville sandstone and shale member

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

Original reference: F. Platt, 1876, Pennsylvania 2d Geol. Survey Rept. L.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 60–61, geol. map. In Morgan County, Connellsville sandstone and shale member of Conemaugh series occupies interval between Clarksburg coal and Lower Pittsburgh limestone. Predominantly gray to tan, micaceous, sandy shales with beds of shaly, thin to platy bedded sandstones; rapid facies changes occur in interval so that local areas consist of erratic developments of thick sequences of sandstones separated by sandy shales. Thickness 20 to 40 feet. In most of county, base of member can be placed only approximately; top of member is indefinite because of rapid changes in character of Lower Pittsburgh interval.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 153–154. Referred to as shale and sandstone member of Lower Little Pittsburgh cyclothem in report on Athens County.

Well exposed in town of Connellsville, Fayette County, Pa. Also caps hills in Ligonier Valley, southwestern Pennsylvania.

Connelly Conglomerate

Connelly Conglomerate (in Oriskany Group)[1]

Lower Devonian: Southeastern New York.

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

A. J. Boucot, 1959, Jour. Paleontology, v. 33, no. 5, p. 730–732. Thickness 45½ feet at Highland Mills, N.Y. Overlies Central Valley sandstone (new); underlies Highland Mills member (new) of Esopus formation. Oriskany age. [Oriskany group not used in this report.]

Typically exposed on hill above South Rondout (Connelly post office), Rhinebeck quadrangle, Ulster County, and in creek bank opposite.

Conner facies (of Dunham Dolomite)

Lower Cambrian: Northwestern Vermont.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, pl. 1. Named used only on correlation chart. Underlies Mallett facies of Dunham dolomite; overlies Gilman quartzite. Refers to Shaw (unpub. thesis, 1949).

Connoquenessing Formation (in Pottsville Group)

Connoquenessing Sandstone Member (of Pottsville Formation)[1]

Connoquenessing Sandstone

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

Original reference: I. C. White, 1878, Pennsylvania 2d Geol. Survey Rept. Q.

M. N. Shaffner, 1952, Pennsylvania Geol. Survey, 4th ser., Prog. Rept. 151. Columnar section, Donegal quadrangle, shows Connoquenessing sandstone, Pottsville series, underlying the Mercer and overlying Mauch Chunk.

R. E. Lamborn, 1954, Ohio Geol. Survey Bull. 53, p. 43–46, geol. map. Eastward from Stark County, the Massillon (Conoquenessing) sandstone is well developed on outcrop in Ohio and western Pennsylvania. In Beaver County, Pa., it was described as Connoquenessing sandstone by White (1878) and divided into Upper and Lower Connoquenessing sandstone with Quakertown coal between. Southwest from Stark County, the Massillon is irregularly present but found close above the Quakertown coal and thus corresponds in position to the Connoquenessing sandstone of Pennsylvania.

R. R. Dutcher and others, 1959, Geol. Soc. America Guidebook for Field Trips Pittsburgh Mtg., p. 68–71. Formation in Pottsville group. Underlies Mercer formation. The Connoquenessing, where most complete, is about 175 feet thick and consists of two sandstones, the Upper and Lower Connoquenessing separated, by Quakertown coal and shales.

Exposed along bed of Connoquenessing Creek, Lawrence County, Pa.

Conococheague Group

Conococheague Limestone[1] (in Knox Group)

Upper Cambrian: Central southern Pennsylvania, western Maryland, Tennessee, and northwestern Virginia.

Original reference: G. W. Stose, 1908, Jour. Geology, v. 16, p. 701.

C. R. L. Oder, 1934, Jour. Geology, v. 42, no. 5, p. 478–479, 492, 493, 496. Conococheague-Copper Ridge formation in eastern Tennessee contains Morristown below and Bloomingdale members. Overlies Maynardville limestone; underlies Chepultepec formation.

B. N. Cooper, 1936, Virginia Geol. Survey Bull. 46–L, p. 136–137, pl. 14. Referred to as formation in Marion area where it consists chiefly of thick-bedded coarsely crystalline gray cherty dolomite but contains characteristic beds of limestone, sandstone, and edgewise conglomerate. Thickness about 1,200 feet. Unconformably overlies Nolichucky formation; conformably underlies Chepultepec formation. Ozarkian.

B. N. Cooper, 1939, Virginia Geol. Survey Bull. 55, p. 13–17, pls. 1, 3. Formation described in Draper Mountain area where it is about 1,500 feet thick. Overlies Elbrook formation; underlies Nittany dolomite. Cambrian. Virginia Geological Survey has discontinued use of Ozarkian as systematic term.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 86–90. In Virginia, the Conococheague limestone includes all strata between Elbrook dolomite or Nolichucky below and Chepultepec limestone above. Predominant characteristic is thick-bedded blue limestone which forms about 75 percent of formation. Thickness 2,013 feet in Washington County. Conococheague of Virginia is correlated with that of Pennsylvania and Tennessee and with Gatesburg dolomite of central Pennsylvania. Conococheague is correlated with Copper Ridge dolomite of northwestern belts of Appalachian Valley in Virginia.

H. P. Woodward, 1949, West Virginia Geol. Survey, v. 20, p. 169–190. Conococheague limestone described in West Virginia where it crops out in Berkeley and Jefferson Counties. Overlies Elbrook limestone; underlies Chepultepec-Stonehenge limestone. Thickness 1,800 to 2,000 feet.

P. B. King, 1950, U.S. Geol. Survey Prof. Paper 230, p. 33–34, pl. 1. In Elkton area, Virginia, overlies Elbrook dolomite and underlies Beekmantown dolomite (including Chepultepec limestone). Thickness about 2,000 feet.

Ernst Cloos, 1951, Maryland Dept. Geology, Mines and Water Resources Washington County Rept. 14, p. 45–57. Conococheague limestone described in Washington County, where it is as much as 1,913 feet thick. Includes Big Spring member (new) in lower part. Overlies Elbrook formation; underlies Beekmantown limestone.

J. L. Wilson, 1952, Geol. Soc. America Bull., v. 63, no. 3, p. 305–316. Discussion of Conococheague formation in Shenandoah-Cumberland Valley of Virginia, West Virginia, Maryland, and Pennsylvania. Includes Big Spring Station member (replaces term Big Spring member) in lower part in Maryland and Pennsylvania. A section of the formation, 1,650 feet thick, measured by Stose just west of village of Scotland on Conococheague Creek, 3 miles northeast of Chambersburg, Pa., became unofficially the type section, although the section is incomplete and its lower part is structurally distorted. Minor anticlinal axis passes through the village exposing lower part of Conococheague on both its flanks. Beds across axis are covered, and section cannot be traced across it at Scotland. Stose overestimated height of fold, believing that underlying Elbrook formation was exposed along it south of Scotland (1909, map). Fossils of Trempealeauian age (high in Conococheague) discovered within this supposed Elbrook inlier 1½ miles north of Stonehenge village indicate that structure is relatively small. Therefore, on west limb of this minor fold at Scotland, less of lower Conococheague is repeated than Stose believed and his estimated total thickness is too small. About 500 feet of lower Conococheague (a part of Big Spring Station member at base) is present on east flank of fold at Musser Farm, on east edge of Scotland village. These beds are not present in Stose's section. Big Spring Station section of this report is almost complete and is about 1,900 feet thick. General facies change from west to east from arenaceous dolomite (Gatesburg formation) to silt-laminated limestone (Conococheague formation) is indicated in geosyncline. Trilobites identified from Warrior, upper Elbrook, and lowest Conococheague formations, indicate Dresbachian age for these beds. Trilobites of Franconian age from middle Gatesburg and lower Conococheague show more complex relationships. Trempealeauian trilobites are identified from upper Conococheague.

G. W. Stose, 1953, Geology of the Carlisle quadrangle, Pennsylvania: U.S. Geol. Survey Geol. Quad. Map [GQ–28]. Conococheague limestone crops out in irregular belt that extends entirely across north-central part of quadrangle, bordering the belt of Elbrook limestone on north. Distinctive feature of Conococheague is occurrence of Cryptozoon beds, made up of rather pure blue limestone, up to 4 or 6 inches thick, showing concentric layers, convex upward. Partial section exposed at Bonnybrook about 784 feet. Map legend gives thickness about 2,000 feet. Underlies Beekmantown limestone; overlies Elbrook limestone. Upper Cambrian.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, p. 61–63, pls. As mapped in southeastern Tennessee, about 1,100 feet or more thick. Included in Knox group. Underlies Jonesboro limestone; overlies Maynardville limestone. Corresponds roughly to Copper Ridge dolomite to northwest.

Josiah Bridge, 1956, U.S. Geol. Survey Prof. Paper 277, p. 33. Oder's (1934) Morristown seems to correspond to entire Copper Ridge as herein delimited, and his Bloomingdale is now thought to belong to lower part of Chepultepec dolomite as now recognized. Limestone facies of the Copper Ridge is commonly known as the Conococheague limestone, which name has been extended from Pennsylvania into Virginia and Tennessee.

W. J. Sando, 1958, Geol. Soc. America Bull., v. 69, no. 7, p. 838 (fig. 2), 839. Formation, in vicinity of Chambersburg, Pa., stratigraphically restricted at top to exclude beds previously referred to as "upper member of Conococheague;" these beds are herein named Stoufferstown member of Stonehenge.

Carlyle Gray, A. R. Geyer, and D. B. McLaughlin, 1958, Pennsylvania Geol. Survey, 4th ser., Atlas 167–D. In Richland and adjacent quadrangles, formation is subdivided into (ascending) Buffalo Springs, Snitz Creek, Schaefferstown, Millbach, and Richland members (all new). Underlies Stonehenge formation of Beekmantown group. Base of Cambrian not exposed in Richland quadrangle.

Carlyle Gray and D. M. Lapham, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 148–151. Formation divided into five members (ascending): Buffalo Springs, Snitz Creek, Schaefferstown, Millbach, and Richland. Not certain that all of these members belong with Conococheague as defined by Stose (1908). At Cornwall iron mines, south of Lebanon, the Conococheague contains two units known locally as Mill Hill slate and Blue conglomerate.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Mapped as Conococheague group. Includes Buffalo Springs, Snitz Creek, Schaefferstown, Millbach, and Richland formations.

P. B. King and H. W. Ferguson, 1960, U.S. Geol. Survey Prof. Paper 311, p. 28 (table), 55–56, 126, pl. 1. Included in Knox group. Thickness in Denton Valley, Va., 2,200 feet. Underlies Jonesboro limestone; overlies Conasauga group. Mapped in northeastern Tennessee.

Named for Conococheague Creek in Scotland, Franklin County, Pa.

Conover Slate[1]

Precambrian (upper Huronian): Northeastern Wisconsin.

Original reference: R. C. Allen and L. P. Barrett, 1915, Michigan Geol. and Biol. Suvey Pub. 18, geol. ser. 15, p. 123–129.

Conover district, Vilas County.

Conowingo Breccia

Age not stated: Northeastern Maryland.

O. P. Bricker and others, 1960, Pennsylvania Geologists Guidebook 25th Ann. Field Conf., p. 8, 11. Mentioned in road log (stop 2). Occurs at contact zone with Port Deposit granodiorite.

Occurs near Conowingo Dam on Susquehanna River, Cecil County, Md.

Conquista Clay Member (of McElroy Formation)

Eocene: South-central Texas.

D. H. Eargle, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 11, p. 2626 (table 1), 2631. Substituted for preempted Falls City shales (Ellisor, 1933). At type locality, consists of about 70 feet of pale-yellowish-brown to chocolate bentonitic clay. Overlies Dilworth sandstone member; underlies Stones Switch sandstone member of Whitsett formation.

Type locality: Bluff adjoining historic Conquista Crossing on San Antonio River 3¾ miles southwest of Falls City, Karnes County. This is same type locality as Falls City shales.

Conshohocken Clay[1]

Ordovician(?), or Cretaceous(?): Southeastern Pennsylvania.

Original references: T. C. Hopkins, 1899, Am. Geologist, v. 23, p. 102; 1899, Science, new ser., v. 9, p. 139; 1900, Geol. Soc. America Bull., v. 10, p. 480–482; 1900, Pennsylvania State Coll. Ann. Rept. 1899–1900.

Occurs on hill north of Conshohocken, Montgomery County.

Contadero Formation

Upper Devonian: Central 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. Series of carbonaceous shales and limestones. Basal gray limestone beds conformably overlie Sly Gap formation, and gray calcareous shales comprising top beds of formation unconformably underlie Caballero formation. Possibly a different facies of Ready Pay member (new) of Percha shale.

F. V. Stevenson, 1945, Jour. Geology, v. 53, no. 4, p. 239–241, fig. 2. Thickness at type section 66½ feet. Type section location further described. In a north-south cross section, formation roughly resembles shape of shallow bowl. Upper Devonian.

L. R. Laudon and A. L. Bowsher, 1949, Geol. Soc. America Bull., v. 60, no. 1, p. 35 (fig. 16), 53, 55 (fig. 25). Underlies Alamogordo formation and Andrecito member (new) of Lake Valley formation in parts of San Andres Mountains.

F. E. Kottlowski and others, 1956, New Mexico Bur. Mines Mineral Resources Mem. 1, p. 30–31. Type Contadero formation revised to exclude upper beds containing Percha fauna and to include at base barren silty shales that locally exhibit sharp contact with underlying Sly Gap formation.

At Rhodes Canyon, 45 feet of section measured. Formation thins to the north and south, pinching out north of Sly Gap and south of Dead Man Canyon.

Type section: In S½ sec. 8, T. 13 S., R. 4 E., on north slope of Rhodes Canyon, near an abandoned mining claim. Noted only in central part of San Andres Mountains.

Contention Series[1]

Lower Cretaceous(?): Southeastern Arizona.

Original reference: W. P. Blake, 1902, Tombstone and its mines.

Tombstone district. Derivation of name not stated.

Continental Peak Formation

Eocene, upper(?): West-central Wyoming.

R. L. Nace, 1939, Wyoming Geol. Survey Bull. 27, p. 11 (chart), 21–25, pl. 1. Reddish-brown, gray, and green fine- to medium-grained thin- to thick-bedded and massive, blocky, and crossbedded tuff and tuffaceous sandstone. Thickness 145 to 250 feet. Disconformably overlies Bridger formation; disconformably underlies Beaver Divide conglomerate member (new) of Chadron formation.

Type section: West side of Continental Peak near center sec. 35, T. 27 N., R. 101 W., Fremont County.

Contra Costa Group

Miocene, upper, to Pliocene, middle: Northern California.

C. R. Ham, 1952, California Div. Mines Spec. Rept. 22, p. 6 (fig. 3), 14–15. Lawson (1914) mapped and described continental deposits within Las Trampas Ridge area as Orinda formation. Lawson and Palache (1902) designated lower Pliocene silt, sandstone, and conglomerate in Berkeley Hills as type Orinda. Subsequent work to the east by D. E. Savage and others (unpub. rept.) [1951, (abs.) Geol. Soc. America Bull., v. 62, no. 12, pt. 2] has shown need for revision of terminology. They suggest term Contra Costa group to include five formations, the Orinda being at base. Within Las Trampas Ridge area only two of the five formations, Orinda and Mulholland, are recognized, the Grizzly Peak, Siesta, and Bald Peak formations being absent. Overlies San Pablo group.

Type locality not stated.

Contra Costa Lake Bed[1]

Pliocene: Western California.

Original reference: J. G. Cooper, 1894, California Acad. Sci. Proc., 2d ser., v. 4, p. 169.

Exposed on northeast slope of hills west of San Pablo Creek, forming body between Contra Costa and Alameda Counties in that part of its course about 4½ miles northeast of State University, San Francisco Bay region.

Converse Formation (in Wilcox Group)

Paleocene, middle: West-central Louisiana.

H. V. Andersen, 1960, Louisiana Dept. Conserv., Geol. Bull. 34, p. 55–58. Consists of fine- to medium-grained sand which can be either massive, thin, or crossbedded. Contains lenses of clay or silt sufficiently calcareous locally to produce caliche. Thickness at least 155 feet in vicinity of Converse (100 feet plus in water wells and at least 55 feet along State Highway 174); traced in subsurface as far as Negreet, where it attains thickness of 232 feet. Overlies Cow Bayou formation; underlies Lime Hill formation.

H. V. Andersen, ed., 1960, Type localities project unit 1: Baton Rouge, La., Soc. Econ Paleontologists and Mineralogists, Gulf Coast Sec., p. [14–15]. Middle Paleocene.

Type locality: Series of outcrops along State Highway 174 starting at city limits of Converse, 0.55 mile west of K.C.S. Railroad crossing and extending westward for a distance of 1.7 miles. This includes three major outcrops in secs. 8 and 9, T. 9 N., R. 13 W., Sabine Parish.

Conway Formation

Conway Schist[1]

Ordovician and Silurian(?): Western Massachusetts, southwestern New Hampshire, and southeastern Vermont.

Original reference: B. K. Emerson, 1898, U.S. Geol. Survey Geol. Atlas, Folio 50; 1898, Mon. 29, p. 183–225.

M. E. Willard, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–85. Redefined as a formation containing four lithologic members, in order of decreasing age: schist-quartzite, schist-marble, amphibolite, and phyllite members. Detailed lithologic descriptions. Ordovician and Silurian(?).

Named for development along the rivers in Conway and Deerfield, Franklin County, Mass.

Conway Granite[1] (in White Mountain Plutonic-Volcanic Series)

Mississippian(?): Northern and central New Hampshire.

Original references: C. H. Hitchcock, 1874, The geology of New Hampshire, pt. 1, p. 508–545; 1877, pt. 2, p. 142–143.

M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000): U.S. Geol. Survey. Belongs to White Mountain plutonic-volcanic series of Mississippian(?) age.

Named for town of Conway, Carroll County.

Conway Cut Siltstone Member (of Brodhead Formation)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 76, 169–170, pl. 15. Massive siltstone 75 feet thick. Basal member of Brodhead formation, Irvine facies (new). Underlies Combs Mountain siltstone member (new); overlies New Providence formation, Boone Gap facies (new).

Name derived from Conway Cut of Louisville and Nashville Railroad, just south of Conway, northern Rockcastle County. Unit is well exposed at Boone Gap on Rockcastle-Madison County line, where it forms the cliff rock and hillside above cut for U.S. Highway 25.

Cooda Sandstone

See Coody Sandstone.

Coody Sandstone Member (of Atoka Formation)[1]

Middle Pennsylvanian: Eastern Oklahoma.

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

C. W. Wilson, Jr., and N. D. Newell, 1937, Oklahoma Geol. Survey Bull. 57, p. 27–28. Basal member of Atoka formation. Thickness 15 to 115 feet. Separated from overlying Pope Chapel sandstone member by unnamed shale 35 to 72 feet thick. Unconformable with underlying Morrow group.

Named for exposures along Coody (Coata) Creek in secs. 34 and 35, T. 15 N., R. 19 E., Muskogee County.

Cooke Grainite[1]

Precambrian: Central southern Montana.

Original reference: T. S. Lovering, 1930, U.S. Geol. Survey Bull. 811–A, p. 17.

W. H. Parsons and E. L. Bryden, 1952, Michigan Acad. Sci., Arts and Letters, Papers, v. 37, p. 253. Cited as Cooke City granite, a pinkish rock with no gneissic structure.

Well exposed near Cooke in southeastern corner of Park County.

Cooke City Granite

See **Cooke Granite.**

Cook Inlet Gravels[1]

Pleistocene: Central southern Alaska.

Original reference: J. E. Spurr, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 174–175.

Extends from Cook Inlet along drainage basin of Skwentna River as far as Tordrillo Mountain, Cook Inlet region.

Cook Mountain Formation (in Claiborne Group)[1]

Eocene, middle: Southern and eastern Texas, northwestern Louisiana, and eastern Mississippi.

Original reference: W. Kennedy, 1892, Texas Geol. Survey 3d Ann. Rept., p. 54–57.

J. Huner, Jr., 1939, Louisiana Geol. Survey Bull. 15, p. 84–110. In Caldwell and Winn Parishes, La., divided into (ascending) Dodson (new), Milams, Saline Bayou, and Little Natches (new) members. Thickness 99 to 185 feet. Overlies Sparta sand; underlies Cockfield formation.

H. B. Stenzel, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 9, p. 1663–1675. Cook Mountain formation replaces term Crockett formation. Name Cook Mountain believed to be preferable because of more extensive usage in Texas and Louisiana. Wheelock marl, Landrum shale, Spiller sand, and Mount Tabor shale, previously defined as members of Crockett, are here reallocated to Cook Mountain formation.

J. M. Patterson, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 2, p. 259 (fig. 2), 261–263. In south Texas, divided into (ascending) Garceno sandstone, Veleno, and Falcon sandstone members (all new). Thickness 1,700 feet. Overlies Mount Selman formation; underlies La Perla shale member (new) of Yegua formation.

W. E. Belt and others, 1945, Geologic map of Mississippi (1:500,000): Mississippi Geol. Survey. As mapped, overlies Sparta sand and underlies Cockfield formation.

F. S. MacNeil, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 29. Correlation chart shows that Cook Mountain in Mississippi includes (ascending) Archusa marl, Potterchitto sand, and Gordon Creek shale members. Overlies Sparta sand; underlies Cockfield formation. Mississippi

Geological Survey uses Wautubbee formation instead of Cook Mountain and Kosciusko sand instead of Sparta sand.

Named for Cook Mountain, Houston County, Tex.

Cook Ranch Formation[1]

Oligocene, middle: Southwestern Montana.

Original reference: A. E. Wood, 1933, Jour. Mammalogy, v. 14, no. 2, p. 134–135.

Jean Hough, 1955, Jour. Paleontology, v. 29, no. 1, p. 26–28. Cook Ranch formation of Wood is included in Sage Creek formation as redefined in this paper.

Robert Scholten, K. A. Keenmon, and W. O. Kupsch, 1955, Geol. Soc. America Bull., v. 66, no. 4, p. 373, 374, pl. 1. Rhyolitic lava flows and volcanic tuff and breccia associated with Cook Ranch formation are here named Cook Ranch rhyolites and Cook Ranch volcanics, respectively.

First described from locality near Cook Sheep Co., Home Ranch, 8.1 miles north and east of Dell Railroad station, T. 12 S., R. 33 E., secs. 27 and 34, Beaverhead County.

Cook Ranch Rhyolites

Oligocene, middle: Southwestern Montana.

Robert Scholten, K. A. Keenmon, and W. O. Kupsch, 1955, Geol. Soc. America Bull., v. 66, no. 4, p. 373, pl. 1. Pink and buff rhyolitic lava flows that are intercalated between pyroclastic deposits that have been correlated with the Cook Ranch formation.

Exposed on the southwest side of the Blacktail Range, Beaverhead County.

Cook Ranch Volcanics

Oligocene, middle: Southwestern Montana.

Robert Scholten, K. A. Keenmon, and W. O. Kupsch, 1955, Geol. Soc. America Bull., v. 66, no. 4, p. 374, pl. 1. Named for beds of volcanic tuff and white acidic volcanic breccia associated with sediments of Cook Ranch formation. Some volcanic ash present at type locality. Northward, the ash content increases, and the formation grades into interbedded tuffs, volcanic breccias, and agglomerates at the foot, on the slopes, and near the crest of the Blacktail Range.

Type locality: At south end of Red Rock Mountains. [The compiler notes that the unit is not mapped at the south end of Red Rock Mountains but that it is mapped around the southern end of the Blacktail Range]. These rocks probably once covered entire southeastern end of the Blacktail Range, Beaverhead County.

Cooks Canyon Agglomerate[1]

Upper Jurassic: Northern California.

Original reference: C. H. Crickmay, 1933, Geol. Soc. America Bull., v. 44, no. 1, p. 81.

Type locality: Ridge between Cooks Canyon and Lights Creek, Mount Jura.

Cooks Peak Granodiorite Porphyry

Tertiary: Southwestern New Mexico.

H. L. Jicha, Jr., 1954, New Mexico Bur. Mines Mineral Resources Bull. 37, pl. 1. Name appears on explanation of map.

W. E. Elston, 1957, New Mexico Bur. Mines Mineral Resources Bull. 38

p. 39. Described as porphyritic andesine and green hornblende partly altered to biotite and chlorite. Groundmass consists of andesine, quartz, orthoclase, and magnetite. Younger than Colorado shale and older than Rubio Peak volcanic rocks.

Mapped on flanks of Cooks Peak, Cooks Range, Lake Valley quadrangle.

Cool Creek Formation[1] (in Arbuckle Group)

Lower Ordovician: Southern Oklahoma.

Original reference: E. O. Ulrich, 1933, Geol. Soc. America Bull., v. 44, no. 1, p. 105.

C. E. Decker, 1933, Tulsa Geol. Soc. Digest, p. 55, 56. Included in Arbuckle group. Occurs above Wolf Creek dolomite and below Alden limestone.

C. E. Decker, 1939, Oklahoma Geol. Survey Circ. 22, p. 16 (table 1), 25, measured sections; 1939, Geol. Soc. America Bull., v. 50, no. 7, p. 1319–1320, table 1. Consists primarily of thin beds of limestone, some of which are shaly and sandy. Thickness 1,513 to 1,687 feet in Arbuckles; 1,015 feet in Wichitas. Underlies Kindblade formation (new). Overlies Strange formation (new) or where Strange is absent, the McKenzie Hill. Type locality and derivation of name given.

Type section: Sec. 18, T. 2 S., R. 2 E., along U.S. Highway 77 about 4 miles north of Springer. Named for Cool Creek, headwaters of which flow across the formation about 6 miles north of Springer, Carter County.

Cooledge Chalk[1]

Upper Cretaceous: Eastern Texas.

Original reference: J. A. Waters and W. A. Reiter, 1930, Am. Assoc. Petroleum Geologists Bull., v. 14, p. 322–323.

Well exposed 3 miles northwest of Cooledge, on main road to Hubbard, Limestone County.

Coombs Limestone Member (of Islesboro Formation)[1]

Cambrian(?): Central southern Maine.

Original reference: G. O. Smith, E. S. Bastin, and C. W. Brown, 1907, U.S. Geol. Survey Geol. Atlas, Folio 149, p. 2–3.

H. W. Allen, 1951, Maine State Geologist Rept. 1949–1950, p. 79. Sequence of metamorphosed sedimentary rocks in area of Rockland quadrangle, Knox County, is (ascending) Islesboro formation containing Coombs limestone member at top; Battie quartzite; Penobscot formation; and Rockland formation consisting of Weskeag quartzite member at base, a siliceous limestone member above the quartzite, and Rockport limestone member at top.

Named for exposures near Coombs Point, on northeastern shore of Islesboro, Waldo County.

Coon Creek Tongue (of Ripley Formation)[1]

Upper Cretaceous: Western Tennessee and northern Mississippi.

Original reference: B. Wade, 1917, Johns Hopkins Univ. Circ., new ser., Whole No. 293, p. 74, 101.

L. W. Stephenson and others, 1942, Geol. Soc. America Bull., v. 53, no. 3, chart 9. Correlation chart shows Coon Creek tongue as occurring in Tennessee and Mississippi.

N. F. Sohl, 1960, U.S. Geol. Survey Prof. Paper 331–A, p. 13–15. Wade (1917) recognized two divisions of Ripley formation below McNairy sand member in southern Tennessee: "Ferruginous clay horizon" immediately below the NcNairy and a "Coon Creek horizon" immediately above the Selma chalk. Wade (1926 U.S. Geol. Survey Prof. Paper 137) lumped these two horizons into Coon Creek tongue. Wade stated that Coon Creek tongue thinned northward but was recognizable at Kentucky line and that the ferruginous clay merged north into the McNairy. Whitlach (1940, Tennessee Div. Geology Bull. 49) misinterpreted this statement and assumed Wade to mean the whole of the Coon Creek was lost northward. The ferruginous clay appears to be merely a transition zone between typical Coon Creek tongue and McNairy sand member and, as treated in this report, is included in McNairy sand from which it becomes indistinguishable both to the north and to the south. At type locality Coon Creek tongue is typified by massive dark- to bluish-gray micaceous glauconitic calcareous fossiliferous silty sand beds which some authors have called "marls." Lower part of unit is gradational into transitional clay in lower part of Ripley and thin interbeds of sand and sandy clay are common. At top of tongue, generally unfossiliferous noncalcareous thin-bedded sand is common. Coon Creek varies in age along outcrop belt; at type locality, sand contains *Exogyra cancellata* Stephenson; in Mississippi, a few miles south of State line, member lies entirely above that zone. Sand of Coon Creek grades upward through thinner bedded lighter colored sand and clay beds into McNairy sand member. Thickness as much as 60 feet.

Named for exposures along Coon Creek, McNairy County, Tenn.

Coonewah Bed (in Annona Chalk)

Upper Cretaceous: Northern Mississippi.

F. F. Mellen, 1958, Mississippi Geol. Survey Bull. 85, p. 29-40. Name applied to a 2-foot bed of relatively pure chalk near top of the Annona.

Type locality: West valley wall of Coonewah Creek approximately at the SE cor. SW¼ sec. 22, T. 10 S., R. 5 E., Lee County, 2½ miles west of Verona.

Cooney Quartz Latite[1]

Tertiary: New Mexico.

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

Named for exposures in canyon of Mineral Creek near old mining camp of Cooney, Mogollon district.

Coon Mountain Sandstone Member (of Pueblo Formation)[1]

Coon Mountain Sandstone Member (of Stockwether Formation)

Permian (Wolfcamp Series): Central 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). Reallocated to Stockwether, which is here given formational status in Pueblo group (redefined) and assigned to the Permian.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 75, 76. Member of Pueblo formation in report on Brown and Coleman Counties where it is placed above Camp Creek shale member and below Stockwether limestone member. In northern Brown County, extensive channel erosion has removed Saddle Creek limestone member in many places, especially over wide area on Coon Mountain. In places, channel erosion has cut down to within about 50 feet of Chaffin limestone member of Thrifty formation. The sandstone and conglomerate deposited in these channels was called Coon Mountain bed by Drake (1893). Plummer and Moore (1921, Texas Univ. Bull. 2132) considered it of Cretaceous age. As the unit was not extensively exposed in area mapped by Moore (1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80), he did not use the name. Exact relations of Coon Mountain sandstone member to beds surrounding it are only partially known. The thick body may be a complex of two or more channels, the later one or ones superposed on the earlier in the outcrop area. The member is tentatively placed in the section where Drake placed it until future detailed work explains its relations more exactly.

Named for Coon Mountain, Brown County.

Cooper Limestone[1]

Middle Devonian: Central and northeastern Missouri.

Original reference: G. C. Swallow, 1855, Missouri Geol. Survey 2d Ann. Rept., pt. 1, p. 108, 196.

E. B. Branson, 1944, Missouri Univ. Studies, v. 19, no. 3, p. 136–138. Thickness as much as 30 feet, rarely more than 20; average less than 15. Formation not continuous but represents erosional remnants. Unconformable on Jefferson City over most of its extent in central Missouri, though locally rests on St. Peter sandstone; in northeastern Missouri, unconformable on Kimmswick and Maquoketa and locally unconformable below Ashland formation; unconformably underlies Callaway limestone in Boone and Cooper Counties but westward it is unconformable below Bushberg sandstone.

Named for exposures in Cooper County.

Cooper Marl[1]

Oligocene: Eastern South Carolina and eastern Georgia.

Original reference: M. Tuomey, 1848, South Carolina Agr. Survey 1st Rept., p. 162–169, 190, 211.

C. W. Cooke, 1943, U.S. Geol. Survey Bull. 941, p. 40 (chart), 74–76. Geographically extended into Georgia where thickness is about 33 feet. Thickness in South Carolina 76 feet. Unconformably underlies Flint River formation; overlies Ocala formation with apparent conformity; contact with Barnwell formation not observed, but presumably is younger than Sandersville member (new) and perhaps conformable with it.

F. S. MacNeil, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 29. Shown on correlation chart in upper part of Jackson group in Georgia. Eocene.

C. W. Cooke and F. S. MacNeil, 1952, U.S. Geol. Survey Prof. Paper 243–B, p. 27–28. Cooper marl, currently referred to late Eocene (Jackson), is reassigned to early Oligocene(?) on basis of its mollusks, foraminifers, and cetaceans. In some areas, unconformably overlies Castle Hayne limestone.

L. N. Smith and H. S. Johnson, 1958, Carolina Geol. Soc. Guidebook, p. [5]. Shown on correlation chart as Eocene (Jackson).

H. E. Malde, 1959, U.S. Geol. Survey Bull. 1079, p. 7–26, pl. 1. Cooper marl, oldest exposed formation in Charleston phosphate area, South

Carolina, is a soft, very fine grained, impure carbonate deposit. Dips southward from 8 to 14 feet per mile and overlies beds of Eocene age upturned on the north. Thickness 200 feet near Charleston; thins and pinches out 20 miles north; thickens southwestward to at least 280 feet. Unconformably underlies Ladson formation (new); in other areas, underlies Duplin marl, unnamed lower Miocene(?) sandy limestone, or Hawthorn(?) formation. Paleontologic evidence indicates that Cooper marl is of Oligocene age, basal beds exposed inland at Harleyville being early Oligocene and higher beds nearer the coast late Oligocene.

Named for exposures along Cooper River, S.C.

Cooper Creek Limestone (in Henrietta Group)

Cooper Creek Limestone (in Marmaton Group)

Pennsylvanian (Des Moines Series): Iowa and northern Missouri.

L. M. Cline, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 27 (fig. 2), 62, 65, 69. Proposed for Bain's (1896, Iowa Geol. Survey, v. 5) "Floating rock." Consists of light-gray fragmental nodular limestone admixed with green clay; algal. Separated from underlying Worland limestone and overlying Exline limestone (new) by intervals containing clay and shale. Thickness 2 to 4 feet in Appanoose County, Iowa. Not well developed in Putnam County, Mo., and, if present, represented only by nodular limestone. Included in Henrietta group.

W. B. Howe, 1953, Missouri Geol. Survey and Water Resources Rept. Inv. 9, p. 14. Sni Mills limestone is correlated with Cooper Creek limestone of southern Iowa on basis of lithologic similarity and position in stratigraphic succession. Cooper Creek (in Marmaton group) has been correlated with Lonsdale limestone of western Illinois. These correlations extend recognition of upper member of Lenapah (Sni Mills limestone) into Iowa and probably Illinois. Name Sni Mills has priority over Cooper Creek, and name Cooper Creek should be suppressed.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 30, fig. 5. Lenapah limestone is represented in Iowa by Cooper Creek limestone (Sni Mills in Missouri). Thickness 3 to 5 feet, Madison County; 7 feet, Appanoose County.

Named for occurrence along tributary ravines of Cooper Creek, in pastures in vicinity of Centerville, Appanoose County, Iowa.

Cooper Peak Dolomite

Lower Devonian: Northeastern Nevada.

C. W. Merriam, 1940, Geol. Soc. America Spec. Paper 25, p. 35–36, pl. 1. Name applied to dolomite in Cooper Peak structural unit in Roberts Mountains. Similar to dolomites of Lone Mountain formation. At Cooper Peak, light-gray dolomites are thrust over lower Nevada formation along Cooper Peak thrust. No fossils found at Cooper Peak, but 2½ miles west in same ridge a well-preserved fauna indicates Lower Devonian age, not far from Oriskany stage, but possibly as old as Helderberg.

Roberts Mountains, Eureka County.

Coopers Lake Limestone Member[1] (of Jefferson Limestone)

Upper Devonian: Northwestern Montana.

Original reference: C. F. Deiss, 1933, Montana Bur. Mines and Geology Mem. 6, p. 43.

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

Type locality: On southeast slope of southwestern peak of White Ridge, in SW¼ sec. 16, T. 22 N., R. 11 W. Named for the fact that it forms a large part of Jefferson limestone over northeastern part of Coopers Lake quadrangle, especially in Powell County.

Coos Conglomerate[1]

Coos Conglomerate Lentil (in Empire Formation)

Pliocene, lower: Southwestern Oregon.

Original reference: W. H. Dall, 1897, U.S. Geol. Survey 18th Rept., pt. 2, p. 336–343.

C. E. Weaver and others, 1944, Geol. Soc. America Bull., v. 55, no. 5, chart 11. Coos conglomerate considered a lens in Empire formation.

Exposed at Fossil Point, Coos Bay region, Coos County.

Coos Group[1] or Quartzite[1]

Paleozoic(?): Northern New Hampshire.

Original reference: C. H. Hitchcock, 1870, 2d Ann. Rept. Geol. and Min. New Hampshire, p. 34, map.

Extends over large part of Coos County and southwestward across western part of New Hampshire to Massachusetts line.

†Coosa Shale[1]

Middle and Upper Cambrian: Western Georgia and eastern Alabama.

Original reference: E. A. Smith, 1890, Alabama Geol. Survey Rept. on Cahaba coal field, p. 148, map, structure sec. facing p. 162.

Named for Coosa Valley, between Rome, Ga., and Gadsden, Ala.

†Coosa Valley[1] (Shales and Sandstones)

Lower, Middle, and Upper Cambrian: Eastern Alabama.

Original reference: E. A. Smith, 1888, Alabama Geol. Survey Rept. Prog. 1884–1888, geog. map of Alabama.

Named for Coosa Valley.

Copake Limestone[1]

Lower Ordovician: Southeastern New York.

Original reference: J. D. Dana, 1879, Am. Jour. Sci., 3d, v. 1, p. 376–383.

J. D. Weaver, 1957, Geol. Soc. America Bull., v. 68, no. 6, p. 734–736, pl. 1. Described in area of type section. Owing to structural complexity and to absence of diagnostic fossils, accurate stratigraphic definition of term is difficult, but Copake limestone may be defined as series of dolomitic limestones with about 90 feet of irregularly crossbedded sandy dolomites at its base and containing worm borings and a planispiral gastropod resembling *Ophileta*. Thickness at type section 212 feet; top not exposed. Younger than Pine Plains formation.

Type section: On southern end of Tom Hill, northeast of Copake, Columbia County. Upper part of section is well exposed in small quarry near junction of Route 22 and road leading to town; base of section is in a series of small cliffs about 500 feet west of main quarry.

†Copan Formation[1]

Pennsylvanian: Northeastern and central Oklahoma.

Original reference: D. W. Ohern, 1910, Oklahoma State Univ. Research Bull. 4, p. 29.

Named for Copan, Washington County.

Copco Basalts

Recent: Northern California.

Howel Williams, 1949, California Div. Mines Bull. 151, p. 48. Name applied to basalts erupted in vicinity of present Copco Lake. Basalts are characterized by abundant clusters of large olivine and plagioclase crystals. Otherwise essentially similar to Plutos Cave, Butte Creek, and Butte Valley basalts (all new).

Copco Lake is in northwestern part of Macdoel quadrangle, Siskiyou County.

Copeland Formation

Age not stated: Eastern Maine.

L. A. Wing, 1957, Maine Geol. Survey GP. and G. Survey 1, sheet 1. Whitish gray muscovite quartz schist with interbedded quartzite; locally may contain minor biotite and chlorite. Name credited to J. M. Trefethen (1950, Preliminary map of Bucksport area, Maine: Maine Univ.). [Compiler was unable to locate this reference.]

Report covers parts of Hancock and Penobscot Counties.

Copenhagen Formation

Middle Ordovician: Northeastern Nevada.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 28. Overlies Antelope Valley limestone (new) in Antelope Valley, Nev. Name credited to C. W. Merriam (unpub. ms.).

G. W. Webb, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 10, p. 2339–2340. Underlies Eureka quartzite. Thickness about 600 feet; no completely exposed section found. Localities and fossils noted.

Probably named for occurrence in Copenhagen Canyon, in Monitor Range, Eureka County. Well exposed on west face of Antelope Range, across valley and on the east, and about seven-eighths of a mile south of Eureka County line.

Coplay Limestone[1]

Lower and Middle Ordovician: Southeastern Pennsylvania.

Original reference: E. T. Wherry, 1909, Science, new ser., v. 30, p. 416.

Bradford Willard, 1958, Pennsylvania Acad. Sci., v. 32, p. 177, 179–182. Proposed to reinstate Coplay formation for Lower and lower Middle Ordovician beds between Upper Cambrian Allentown and Middle Ordovician Jacksonburg formations. Name Beekmantown, as applied to these beds, is inappropriate because of lack of correlation with type Beekmantown and because of presence of post-Beekmantown fossils. Coplay is a high-magnesium carbonate rock; colors vary through blue, medium to light gray, rarely dark gray, black or pinkish; beds range from dense through arenaceous; many strata are crystalline or marbloid; commonly massive bedded. No known section is complete; at type locality, calculated thickness about 1,500 feet.

Type locality: Along west bank of Lehigh River in vicinity of towns of Coplay and West Catasauqua, Lehigh County. Formation crosses central Northampton and Lehigh Counties in broad east-west belt which separates underlying Allentown (south) from overlying Jacksonburg (north).

Copley Greenstone

Copley Meta-Andesite[1]

Copley Metavolcanics

Devonian(?): Northern California.

Original reference: J. S. Diller, 1906, U.S. Geol. Survey Geol. Atlas, Folio 138.

A. R. Kinkel, Jr., and J. P. Albers, 1951, California Div. Mines Spec. Rept. 14, p. 4. Named Copley meta-andesite by Diller (1906) unit is renamed Copley greenstone because it is a greenish metamorphosed rock in which primary ferromagnesian minerals have been altered to chlorite and epidote.

A. R. Kinkel, Jr., W. E. Hall, and J. P. Albers, 1956, U.S. Geol. Survey Prof. Paper 285, p. 1, 9–17, pl. 1. Composed of volcanic flows, volcanic breccia, and tuff of intermediate and basic composition, and a few beds of shale and rhyolitic tuff; lower part of formation contains massive flows, and upper part contains much pillow lava and pyroclastic material. Thickness at least 3,700 feet; base not exposed in mapped area (Shasta County). Conformably underlies Balaklala and in some areas interfingers with it.

I. E. Klein, 1960, Sacramento Geol. Soc. [Guidebook] Field Trip June 3, 4, and 5, p. 11. Intruded by Mule Mountain granite (new).

Named for occurrence in vicinity of Copley, Redding quadrangle.

Copperas Creek Sandstone Member (of Carbondale Formation)

Copperas Creek Sandstone (in McLeansboro Group)

Copperas Creek Shale and Sandstone (in McLeansboro Formation)[1]

Pennsylvanian: Western and central 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. 50 (fig. 22), 112, 114, 194. Savage applied name Copperas Creek to shale and overlying sandstone; Copperas Creek is herein restricted to the sandstone unit, and name Sheffield applied to the shale. The sandstone is light olive green to brownish gray; commonly has brown limonitic specks, is massive and locally, crossbedded; and has channel and nonchannel phases. Thickness 3 to 27 feet; it is thickest where it cuts out Sheffield shale, Brereton limestone, and dark shale and rests directly on Herrin (No. 6) coal. Included in Sparland cyclothem, near base. McLeansboro group.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 35, 48 (table 1), 65, pl. 1. Reallocated to member status in Carbondale formation (redefined). Stratigraphically below Danville (No. 7) coal member and above Pokeberry limestone member. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: Along Copperas Creek, Glasford quadrangle, Fulton County.

Copper Belle Monzonite Porphyry

Triassic or Jurassic: Southeastern Arizona.

James Gilluly, 1956, U.S. Geol. Survey Prof. Paper 281, p. 8, 60–63, pl. 5. Hand specimens of the monozonite porphyry differ greatly owing to diversity of metamorphism. Ranges from light gray through buff to dark greenish gray, or even uniform pink; texture, however, remains remarkably constant in all varieties, being characterized by conspicuous phenocrysts of feldspar (1 to 10 millimeters in length). Groundmass everywhere clearly crystalline but aphanitic. Most exposed bedrock contacts are with Escabrosa limestone. All exposed contacts in Gleeson district are faults.

Named for exposures on and near the Copper Belle claim, on west slope of Gleeson Ridge in Gleeson district, central Cochise County. Outcrops form nearly complete elliptical ring on lower slopes of Gleeson Ridge. Smaller outcrops in alluvial areas to east and northeast, and considerable body exposed in Courtland district near and east of abandoned post office. Other smaller bodies exposed in the county.

Copper City 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 of exceptional thickness, about 500 feet. Overlies St. Louis conglomerate.

J. C. Wright and H. R. Cornwall, 1954, Bedrock geology of the Bruneau Creek quadrangle, Michigan: U.S. Geol. Survey Geol. Quad. Map [GQ–35]. Ophitic basalt flow with numerous pegmatitic layers in the upper half in Bruneau Creek quadrangle.

Mapped in vicinity of Copper City, Ahmeek quadrangle, Houghton County.

Cooper Creek Beds[1]

Precambrian (upper Keweenawan): Northwestern Wisconsin.

Original reference: F. T. Thwaites, 1912, Wisconsin Geol. Nat. History Survey Bull. 25, p. 42, 43, 44, 67.

Named for exposures on Copper Creek, Douglas County.

Copper Creek Member (of Muldoon Formation)

Lower Mississippian: Central and eastern Idaho.

M. R. Thomasson, 1959, Dissert. Abs., v. 20, no. 3, p. 999. Basal member of formation consisting of clastics. Thickness 860 feet. Underlies Garfield member (new); overlies Milligen formation.

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

Copper Harbor Conglomerate

Copper Harbor Group[1]

Precambrian (upper Keweenawan): Northwestern Michigan.

Original reference: A. C. Lane and A. E. Seaman, 1907, Jour. Geology, v. 15, p. 680, 690.

W. S. White, 1952, Jour. Sed. Petrology, v. 22, no. 4, p. 190. Conglomerate about 4,000 feet thick; contains a few lava flows. Overlies newly defined Portage Lake lava series; underlies younger shales and sandstones of the Keweenawan series.

W. S. White, H. R. Cornwall, and R. W. Swanson, 1953, U.S. Geol. Survey Geol. Quad. Map GQ-27 [1954]. Red to brown boulder conglomerate with subordinate amounts of pebble conglomerate and beds of coarse arkosic sandstone; most of the detrital material is rhyolitic in composition; three units of mafic flows distinguished. Underlies Nonesuch shale. Designated as upper Keweenawan.

Named for exposures around Copper Harbor, Keweenaw County.

Copperhill Formation (in Great Smoky Group)

Precambrian: Southeastern Tennessee, central northern Georgia, and southwestern North Carolina.

V. J. Hurst, 1955, Georgia Geol. Survey Bull. 63, p. 9–21, pl. 1, map. Consists of massive beds of metagraywacke or biotite gneiss, mica schist, metaconglomerate, micaceous quartzite, metaarkose, and occasional dark slates: includes epidote-amphibolite sill. Estimated thickness 2,000 to 5,000 feet; base not exposed. Underlies Hughes Gap formation (new), transition zone a few hundred feet thick.

Named after town of Copperhill, Polk County, Tenn., in vicinity of which formation is well exposed.

Copper Mountain Greenstone or Amphibolite Schist[1]

Age(?): Southeastern Alaska.

Original reference: F. C. Schrader, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 414–415.

Copper Mountain, Prince William Sound region.

†Copper Mountain Porphyry[1]

Eocene: Colorado.

Original reference: S. F. Emmons, 1898, U.S. Geol. Survey Geol. Atlas, Spec. Folio 48.

On Copper Mountain, Tenmile district.

Copper Queen Limestone[1]

Upper Cambrian: Southeastern Arizona.

Original reference: A. A. Stoyanow, 1936, Geol. Soc. America Bull., v. 47, no. 4, p. 469–471, 480–482.

F. W. Galbraith and W. B. Loring, 1951, Arizona Bur. Mines Bull. 158, Geol. Ser. 19, p. 30. Thickness in Swisshelm district 175 feet.

Named for Copper Queen mining area of Bisbee, where it is a good horizon.

Copper Ridge Dolomite[1] (in Knox Group)

Upper Cambrian: Eastern Tennessee, Alabama, northwestern Georgia, and southwestern Virginia.

Original reference: E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, p. 548, 635–636, pl. 27.

C. R. L. Oder, 1934, Jour. Geology, v. 42, no. 5, p. 476–479. Discussion of subdivision of Knox dolomite in east Tennessee. Conococheague-Copper Ridge formation, which overlies Maynardville limestone (new), is subdivided into Morristown dolomite and Bloomingdale limestone members (both new).

Charles Butts, 1940, U.S. Geol. Survey Geol. Atlas, Folio 226. Described in Montevallo-Columbiana quadrangles, Alabama, where it is 1,750 feet thick, overlies Ketona dolomite (Bibb dolomite absent in this area), and underlies Chepultepec dolomite.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 90–95. Copper Ridge overlies Nolichucky shale and extends upward to Chepultepec limestone. Northwest of Greendale syncline, Washington County, the Copper Ridge and Beekmantown form continuous vertical mass 2,400 feet thick with no recognizable break between them. Occurrence of Chepultepec fossils at or very near middle of similar section in Tennessee, 3½ miles southeast of Cumberland Gap, proves mass is about equally Copper Ridge and Beekmantown. Equivalent to Conococheague.

R. L. Miller and J. O. 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. 17–20, pl. 1, geol. sections. Basal formation of Knox group. In Lee County, Va., underlies Chepultepec dolomite; overlies Chances Branch dolomite member (new) of Maynardville limestone. Thickness 840 feet. Upper Cambrian.

John Rodgers and D. F. Kent, 1948, Tennessee Div. Geology Bull. 55, p. 3, 14–19. Stratigraphic section at Lee Valley, Hawkins County. This section is compared with Thorn Hill section (which includes type locality of Copper Ridge) as measured by Hall and Amick (1934, Tennessee Acad. Sci. Jour., v. 9). Thickness of Copper Ridge 925 feet. Underlies Chepultepec dolomite; overlies Maynardville member of Nolichucky shale.

Josiah Bridge, 1956, U.S. Geol. Survey Prof. Paper 227, p. 25–29, chart 1, pl. 1. Described in Mascot-Jefferson City zinc district, Tennessee, where it is 943 feet thick; overlies Maynardville limestone member of Nolichucky shale and underlies Chepultepec dolomite. As thus defined, the formation in the type section is specifically units 203 to 304 of Hall and Amick's (1934) section. Unit could be logically divided into two members: a thick lower member composed mainly of dark thick-bedded cherty dolomite and an upper member consisting of light-colored thinner bedded dolomite, also chert-bearing and containing many arenaceous beds. If such a division were made, break would come within unit 282 in Thorn Hill section and at base of unit 148 in Lee Valley section (Rodgers and Kent, 1948). Oder (1934) divided Copper Ridge into two members, Morristown and Bloomingdale. Oder's Morristown seems to correspond approximately to entire Copper Ridge as here delimited. Bloomingdale member is now thought to belong to lower part of Chepultepec dolomite as now recognized. Copper Ridge is dolomite in type area, and this dolomitic phase extends along western side of Appalachian Valley in East Tennessee and southeastward into and across Mascot-Jefferson City district. To southeast of this area, beds of limestone wedge into section and on eastern side of Appalachian Valley, particularly in belts southeast of Bays Mountain syncline, entire formation is slightly magnesian limestone. This limestone extends northeastward along eastern side of Appalachian Valley into Virginia, and in the central and northern parts of that State it extends progressively into western belts as well until, in northern Virginia, Maryland, and southern Pennsylvania, the limestone phase extends almost entirely across the Appalachian Valley. This limestone facies is commonly known as Conococheague limestone. and that name has been extended from Pennsylvania into Virginia and Tennessee. Ulrich recognized presence of Conococheague limestone in these areas but contended it was older than Copper Ridge dolomite and that it thinned westward and was overlapped unconformably by the Copper Ridge. Historical summary of usage of name and notes on type locality. Ulrich proposed term Copper Ridge chert for his second division of Knox dolomite of eastern Tennessee and southwestern Virginia. Name was taken from Copper Ridge, the long, narrow, monoclinal ridge at northwest base of Clinch Mountain, recognizable as distinct topographic feature from Russell County, Va., to a few miles west of Knoxville. East of gap at Speers Ferry, Va., where Troublesome Creek cuts through ridge to join Clinch River, the ridge is known as Moccasin Ridge, and name Copper Ridge is transferred to next structural belt to northwest (see Estillville 30 minute quadrangle and Clinchport and Duffield 7½-minute quadrangles). Type locality is along "the road from Bean Station to Evans Ferry, on Clinch River" (Ulrich, 1911, p. 636), now U.S. Highway 25-E. It is shown on Morristown folio (Keith, 1896) and on Avondale 7½-minute quadrangle sheet of TVA series. Wilmarth, 1938 (U.S. Geol. Survey Bull. 896) states formation was "named for Copper Ridge, northeast of Knoxville, Tenn.," and Resser (1938, Geol. Soc. America Bull. Spec. Paper 15) says that "type locality for Copper Ridge formation is on Copper Ridge, Knox County, Tenn., (Ulrich, 1911)." Cooper (1944, Virginia Geol. Survey Bull. 60) makes similar statement. The only section of formation on Copper Ridge mentioned by Ulrich in his original description is the one in Grainger County, discussed in this report. Ulrich stated to writer [Bridge] on several occasions that this is section to which he was referring in the "Revision" and that he regarded it as type section.

Type locality (Butts. 1940): Gorge of Forked Deer Creek through Copper Ridge, 1 mile northwest of Thorn Hill, Grainger County, Tenn., and 13 miles northwest of Morristown.

Type locality (Bridge, 1956): Along road from Bean Station to Evans Ferry, on Clinch River (Ulrich, 1911), now U.S. Highway 25-E. This locality is now submerged by Cherokee Lake, and Bean Station is a new location, more than 1 mile to the west.

Ulrich (1911, p. 635, 636) states "The resistant character and finally great abundance of this chert [Copper Ridge] almost invariably gives rise to broad and long ridges, among which that known as Copper Ridge, in northeast Tennessee, is the excellent example chosen to supply the name and type of the member or formation. The road from Beans Station to Evans Ferry, on Clinch River (see Morristown quadrangle), follows Indian Creek, where it cuts through Copper Ridge, Tenn."

Copper River Silts and Gravels[1]

Pleistocene: Southeastern Alaska.

Original reference: F. C. Schrader, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 410-412.

Along Copper River above Taral and on tributaries of that part of river, Copper River region.

Copps Formation

Copps Group[1]

Precambrian: Northwestern Wisconsin and northwestern Michigan.

Original reference: R. C. Allen and L. P. Barrett, 1915, Jour. Geology, v. 23, p. 697.

G. I. Atwater, 1938, Geol. Soc. America Bull., v. 49, no. 2, p. 171-179. Referred to as a formation made up of graywacke and gray slate with Copps conglomerate at base.

Named for Copps mine, sec. 15, T. 47 N., R. 43 W., Wisconsin.

Coqui Limestone[1]

Age(?): Puerto Rico.

Original reference: C. P. Berkey, 1915, New York Acad. Sci. Annals, v. 26, p. 29.

J. D. Weaver *in* R. Hoffstetter and others, 1956, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2b, p. 322. Berkey suggested name for limestone occurring near Coqui, but term has not been used since.

Coquille Formation

Pleistocene: Southwestern Oregon.

E. M. Baldwin, 1945, Jour. Geology, v. 53, no. 1, p. 39–42. Name proposed for estuarine deposits which unconformably underlie Elk River beds (restricted) just north of mount of Coquille River. Formation consists of conglomerate, sand, and thin-bedded sandy clay; stumps, logs, peat, and other woody material common. Total exposed thickness probably more than 200 feet; measured section 93 feet; dip as high as 25°. At mouth of Whiskey Run, the Coquille unconformably overlies Umpqua formation and unconformably underlies Elk River beds.

P. D. Snavely, Jr., and H. E. Vokes, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 97. Crops out along sea cliff near Cape Kiwanda where it consists of poorly sorted coarse sand and gravel, together with peat, carbonaceous shale, and clay. Minimum thickness about 30 feet. Rests with angular unconformity upon mudstone of Oligocene age. Also occsurs near Nestucca Bay in a sea cave cut in basaltic sandstone of Nestucca formation (new). Formation is a Pleistocene estuarine fill.

Named for exposures between Whiskey Run and Cut Creek just north of mouth of Coquille River, Coos County.

Coralline Falls Limestone[1]

Devonian: Kentucky.

Original reference: D. D. Owen, 1856, Kentucky Geol. Survey, v. 1, p. 95–97.

Coral Ridge Member (of New Providence Formation)

Lower Mississsippian: Northern Kentucky and southern Indiana.

J. E. Conkin, 1957, Bulls. Am. Paleontology, v. 38, no. 168, p. 114–116, 119–120, 152. Basal member of New Providence formation, Silver Hills facies. Divisible into two parts, lower and upper, on basis of fauna. Consists largely of green- to blue-gray shales; ironstone lenses, ironstone cone-in-cones, and ironstone nodules common in upper part but virtually lacking in lower part. Thickness as much as 52 feet. Underlies Button Mold Knob member (new); overlies Underwood-Falling Run formations.

Type locality: East quarry of Coral Ridge Brick and Tile Co., Coral Ridge, Jefferson County, Ky. Base not exposed at type section.

Coralville Limestone[1]

Coralville Limestone Member (of Cedar Valley Formation)

Upper Devonian: Central eastern Iowa.

Original references: C. 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, chart 4. Shown on correlation chart as uppermost member of Cedar Valley formation. Overlies Rapid limestone member. Correlated with Callaway limestone of Missouri. Middle Devonian. Age of entire Cedar Valley is difficult to establish, and dating of some of its parts presents problems.

M. A. Stainbrook, 1944, Illinois Geol. Survey Bull. 68, p. 182 (chart), 185. Three members of the Cedar Valley are recognized: Linwood, Littleton, and Coralville.

M. 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, the Cedar Valley is Upper Devonian in age and post-Independence.

Typically exposed in quarries about 1 mile northeast of Coralville, Johnson County.

Corbett Sandstone (in Bisbee Group)

Lower Cretaceous: Southwestern New Mexico.

S. G. Lasky, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 5, p. 533–534, figs. 2, 4; 1947, U.S. Geol. Survey Prof. Paper 208, p. 23–24, pl. 1. Chiefly sandstone, in part quartzitic and massive, and variably black, brown, and white in color. Ripple marks and crossbedding common. In part, the formation contains beds of shale that alternate with the sand and range from 1 to 15 feet in thickness. Includes several limestone members in eastern part of Eureka section. Thickness is 4,000 feet in Sylvanite section, where full original thickness is present, and ranges from 1,500 to 3,000 feet in Eureka section. Disconformably underlies Playas Peak formation (new) and conformably overlies Howells Ridge formation (new). Trinity age.

Named from Corbett Ranch at Granite Pass, Sylvanite district, in Little Hatchet Mountains.

Corbin Conglomerate (in Briceville Formation)

Corbin Conglomerate Lentil[1] or Member (of Lee Formation)

Pennsylvanian: Central Kentucky and northern Tennessee.

Original reference: M. R. Campbell, 1898, U.S. Geol. Survey Geol. Atlas, Folio 46, p. 3.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, p. 686, chart 6 (column 18). Corbin conglomerate, prominent in Kentucky, extends into northern Tennessee, where it is included in basal part of Briceville formation.

Named for Corbin, Whitley County, Ky.

Corbin Granite[1]

Precambrian: Northwestern Georgia.

Original reference: C. W. Hayes, 1901, Am. Inst. Mining Engineers Trans., v. 30, p. 406–410.

A. S. Furcron and K. H. Teague, 1947, Georgia Geol. Survey Bull. 53, p. 12–14, pl. 1. Intrudes Cohutta schist and Fort Mountain gneiss.

G. W. Stose and A. J. Stose, 1949, Geol. Soc. America Bull., v. 60, no. 2, p. 277. Corbin granite is exposed southwest of Salem Church granite and just east of the Cartersville overthrust, along which the Corbin granite is sheared to an augen gneiss and some layers to a seritic or graphitic schist; basal beds of Pine Log conglomerate rest on that granite which is brought up in an anticline. Salem Church granite resembles phases of Corbin granite and, because of this similarity, has been called Corbin granite (Furcon and Teague, 1945, Georgia Geol. Survey Bull. 51). The Corbin is here considered a hybrid rock and regarded as part of injection complex that occurs below Hurricane graywacke (new).

G. W. Crickmay, 1952, Georgia Geol. Survey Bull. 58, p. 41. Strongly gneissic aggregate of feldspar, smoky-blue quartz, biotite, augite, and garnet. Intrusive into Talladega series.

Named for development around Corbin, Bartow County.

Corbin City Limestone[1] Member (of Drum Limestone)

Pennsylvanian (Missouri Series): Eastern Kansas and northwestern Missouri.

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

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2030; 1949, Kansas Geol. Survey Bull. 83, p. 99–100. Predominantly a crossbedded oolite locally 40 feet or more thick. Disconformably overlies Dewey limestone member; underlies Chanute formation.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 37. Type locality stated. Unit absent in Nebraska.

Type locality: Corbin City, 2 miles south of Cherryvale, Montgomery County, Kans.

Corbin Ranch Formation (in Simpson Group)

Middle Ordovician: Southern Oklahoma.

R. W. Harris, 1957, Oklahoma Geol. Survey Bull. 75, p. 7, 55, 94–101, fig. 1. Cooper (1956) subdivided the Bromide into Mountain Lake and overlying Pooleville members. Mountain Lake is essentially Ulrich's Cool Creek; Pooleville appears to be essentially Ulrich's Criner formation plus his Webster (name preempted). Corbin Ranch formation is erected to include topmost Simpson dense limestone (with shale breaks) in stratigraphic position between underlying Bromide Pooleville member and overlying Viola limestone. Appears to be exact equivalent of Edson's (1935, Kansas Geol. Soc. Guidebook 9th Ann. Field Conf.) unnamed formation of lower Prosser age; it is topmost limestone of Ulrich's Webster; comprises topmost 15 to 20 feet of Cooper's Pooleville member. Thickness at type locality 19 feet; 24 feet on Colbert Creek, southwest of Davis. Disconformable relationship with underlying Bromide Pooleville and overlying Viola limestone.

Type section: On Carleton W. Corbin Ranch, on west side of Oklahoma Highway 99, 3 miles south of Fittstown, Pontotoc County.

Corcoran Clay Member (of Tulare Formation)

Pliocene, upper, and Pleistocene(?): Southern California (subsurface).

J. W. Frink and Harry A. Kues, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 11, p. 2357–2371. Massive greenish-gray silty clay, highly diatomaceous. Thickness 50 to 120 feet. Lies 200 to 800 feet beneath the surface and extends over an area greater than 4,000 square miles.

U.S. Geological Survey currently classifies the Corcoran Clay as a member of Tulare Formation on the basis of a study now in progress.

Type section: W½ cor. sec. 15, T. 15 S., R. 14 E., U.S. Bureau of Reclamation test hole. Named for town of Corcoran, Kings County, near which it was first recognized.

Corcoran Member (of Price River Formation)

Upper Cretaceous (Montana): Central western Colorado.

R. G. Young, 1955, Geol. Soc. America Bull., v. 66, no. 2, p. 188, 190–191, fig. 2. Unit of littoral marine sandstone and associated coal-bearing rocks which lies above Sego member and is separated from it by thin tongue of Mancos shale with disconformity at its base; underlies Cozzette member (new) and is separated from it by tongue of Mancos shale. Average thickness about 100 feet. At the base, a massive littoral marine sandstone tongue grades downward and eastward into Mancos; first appears near Big Salt Wash and is traceable eastward into Grand Mesa where it disappears; where overlain by coal measures, commonly pure white, and miners call it the "White Pioneer." Series of offshore bar sandstones appears above it near Watson Creek in Grand Mesa and forms eastern limit of the 50 feet or so of coal-bearing rocks. Erdmann (1934, U.S. Geol. Survey Bull. 851) described main coal zone of member as series of overlapping and isolated lenses of coal in thick deposit of carbonaceous shale and called it the Palisade coal. In Neslen facies.

Named from exposures near old Corcoran mine north of Palisade, Mesa County. In Book Cliffs.

Cordell Dolomite or Formation (in Manistique Group)

Cordell Member[1] (of Manistique Formation)

Middle Silurian (Niagaran): Northern Michigan and eastern Wisconsin, and Ontario, Canada.

Original reference: R. B. Newcombe, 1933, Michigan Geol. Survey Pub. 38, p. 23, 37.

R. R. Shrock, 1940, Wisconsin Acad. Sci., Arts, and Letters, Trans., v. 32, p. 207–208, pl. 3. Geographically extended into eastern Wisconsin. Dark-gray thin- and uneven-bedded somewhat saccharoidal dolomite; silicified fossils; chert nodules and lenses common in lower half. Thickness about 45 feet. Overlies Schoolcraft member; underlies Racine dolomite.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, p. 536, chart 3. Cordell dolomite and Schoolcraft dolomite replace term Waukesha in eastern Wisconsin.

G. M. Ehlers, 1957, Michigan Geol. Soc. [Guidebook] Ann. Geol. Excursion, p. 2 (chart), p. 19–20, 21–22, 28. Rank raised to formation in Manistique group. Thickness at type section (herein designated) about 77 feet. Overlies Schoolcraft dolomite; underlies Engadine dolomite. Traced from northeastern Wisconsin to region of Owen Sound, Ontario.

Type section: Abandoned quarry of Scott Quarry Co., excavated in north side of outlier of formation in SW¼ sec. 29, T. 44 N., R. 4 W., about 1 mile southeast of Cordell, Chippewa County, Mich.

Cordito Member (of Los Pinos Formation)

Pliocene: Central northern New Mexico.

Fred Barker, 1958, New Mexico Bur. Mines Mineral Resources Bull. 45, p. 38, 48–50, pl. 1. Rhyolite-fragment conglomerate, tuff, and sandstone with minor rhyolite flows. Maximum thickness about 600 feet. Unconformably underlies Cisneros (new) and Dorado (new) basalts; disconformably overlies Jarita basalt (new) and Biscara (new) and Biscara-Esquibel (new) members of Los Pinos formation. Name credited to Butler (unpub. dissert.).

Named from exposures in Canyon de Cordito, 4 miles south of Tres Piedras, Las Tablas quadrangle.

Cordova Dolomite

Silurian (Niagaran): Northwestern Illinois and northeastern Iowa.

T. E. Savage, *in* C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, p. 537, chart 3. Proposed for beds formerly called Waukesha dolomite in northwestern Illinois and Iowa. Underlies Port Byron dolomite; overlies Joliet dolomite (restricted).

Well exposed in quarry of U.S. Gypsum Co., 1½ miles south of Cordova, Rock Island Ill.

Corduroy Member (of Supai Formation)

[Permian]: Central Arizona.

R. L. Jackson, 1951, Plateau, v. 24, no. 2, p. 86–88. Uppermost member of Supai in Fossil Creek and Fort Apache areas. Overlies Apache [Fort Apache] member. Name credited to S. S. Winters (unpub. thesis).

Type locality and derivation of name not stated. Winters (1951, Plateau, v. 24, no. 1) described, but did not name, an uppermost member of Supai exposed west of Corduroy Creek, Fort Apache Indian Reservation.

Coriba formation[1]

Miocene: Central northern Oregon and southern Washington.

Original reference: E. T. Hodge, 1931, Geol. Soc. America Bull., v. 42, p. 991, footnote.

Corinth Sandstone (in Conemaugh Formation)[1]

Pennsylvanian: Northern West Virginia and western Maryland.

Original reference: C. K. Swartz, W. A. Price, and H. Bassler, 1919, Geol. Soc. America Bull., v. 30, p. 574.

Named for exposures at east end of cut on Baltimore & Ohio Railroad at Corinth, W. Va.

Cork Hill Gneiss

Precambrian: Northern New Jersey.

J. M. Hague and others, 1956, Geol. Soc. America Bull., v. 67, no. 4, p. 468, 469, fig. 18. Graphitic gneiss, garnet gneiss, and pyroxene gneiss at Mount Eve. Light pyroxene gneiss north of McAfee. Thickness, 500 feet at Glenwood, 1,000 feet at Franklin, 800 feet at Sterling, and 1,900 feet at Limecrest. Underlies Wildcat marble (new); overlies Franklin marble.

In Franklin-Sterling area.

Corliss Conglomerate[1]

Corliss Conglomerate Member (of Morses Line Slate)

Corliss Limestone Breccia

Lower Ordovician: Northwestern Vermont.

Original reference: Arthur Keith, 1932, Washington Acad. Sci. Jour., v. 22, p. 360, 377.

Charles Schuchert, 1937, Geol. Soc. America Bull., v. 48, no. 7, p. 1015, 1021, 1045, 1074–1075. Described as a limestone breccia. Name should not be applied to depositional basal breccias in other areas; applicable only at type locality. Thickness about 30 feet. Presumably underlain by Highgate slate and overlain by a dark slate, which may be Grandge formation (new).

A. B. Shaw, 1951, Jour. Paleontology, v. 25, no. 1, p. 98. Corliss breccia abandoned as a formation. Included in Morses Line slate as a local lens.

A. B. Shaw, 1958, Geol. Soc. America Bull., v. 69, no. 5, p. 523 (table 1), 532 (fig. 5), 553, pl. 1. Member of Morses Line slate. Middle(?) Ordovician.

Type locality: Corliss Ledge, 5 miles northeast of St. Albans, Franklin County.

Corn Creek Limestone (of Placid Formation)

Pennsylvanian (Canyon): North-central Texas.

D. H. Eargle, 1958, San Angelo Geol. Soc. Guidebook, Apr. 17–19, p. 51 (columnar section). Incidental mention. Name credited to W. A. Jenkins, Jr. (unpub. thesis).

Section is of Permian rocks along Colorado River.

Cornelia Quartz Monzonite

Tertiary, lower (?): Southwestern Arizona.

James Gilluly, 1937, Arizona Bur. Mines Bull. 141, Geol. Ser. 9 p. 15 (table 1), 32–38, pl. 1; 1946, U.S. Geol. Survey Prof. Paper 209, p. 25–33, pl. 3 [1947]. Made up of several varieties of rocks that range from fine-grained equigranular quartz diorite through equigranular quartz monzonite and porphyritic quartz monzonite to aplite and pegmatite. Has dioritic border facies. Contacts between monzonite and diorite nearly everywhere sharp and clean cut and are easier to draw than those between keratophyre and diorite. The equigranular facies of quartz monzonite, which is preponderant, commonly is light pinkish gray but ranges from white, chalky varieties to green-gray rocks. Intrudes Concentrator volcanics (new) in neighborhood of the New Cornelia mine; farther west invades Cardigan gneiss (new), and 1½ miles above Tule well the border facies cuts the Chico Shunie quartz monzonite (new). Unconformably underlies Locomotive fanglomerate (new), Daniels conglomerate (new), and probably the Sneed andesite (new).

Exposed over area of about 6 square miles, embracing much of the Little Ajo Mountains, Ajo quadrangle, Pima County. Most easterly exposure is at southeast end of the New Cornelia mine, south of Ajo.

Cornell Member[1] (of Portage Formation)

Cornell Shale and Sandstone

Upper Devonian: Central New York.

Original reference: Burnett Smith, 1935, New York State Mus. Bull. 300, p. 10, 57–62.

G. A. Cooper and others, 1942, Geols. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Shown as shale and sandstone; above Sherburne sandstone and below Ithaca shale.

Type locality: On south side of Fall Creek Gorge, not far from Cornell University campus, Ithaca. Named from outcrops at foot of Ithaca Falls near mouth of gorge.

Cornell Ranch 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), 159–161, 163. Comprises up to 80 feet of silty to sandy, clayey, cherty limestones, dolomitic claystones, and dark-gray calcareous clayey shales; at base is a soft green shale, locally pyritic and glauconitic, that lies with apparent conformity on Woodford formation. Above green shale is a series of gray silty, clayey dolomitic limestones that are locally glauconitic. Remainder of member consists of alternating beds of dark-gray calcareous shales and silty, clayey limestones; it is in this sequence that bulk of chert in Sycamore occurs. Underlies Worthey member (new).

Type section: On Cornell Ranch, SE¼SE¼SE¼ sec. 25, T. 2 S., R. 1 E., 2 miles north of Springer, Carter County.

Cornett Basalt Member (of Flat Ridge Formation)

Precambrian: Southwestern Virginia.

A. J. Stose and G. W. Stose, 1957, Virginia Div. Mineral Resources Bull. 72, p. 48, 49, 50, 51, pls. 1, 60. Green amygdaloidal basalt flow, or series of flows, whose vesicles are filled by quartz and epidote. In some places, a few feet of green quartzite occur at base. West of Cornett Store, member contains beds of purple and green tuffaceous slate. Generally occurs at base of formation.

Name from Cornett Store (erroneously named Cornell Store on Mouth of Wilson quadrangle) 3 miles southwest of Cinnamon Ridge. Mapped in extreme western part of Gossan Lead district.

Cornfield Series[1]

Tertiary or Pleistocene: Northeastern Arizona.

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

Cornfield Harbor Clays[1]

Pleistocene: Eastern Maryland.

Original references: W. H. Dall, 1897, 55th Cong., 2d sess., H. Doc. 5; 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 2, p. 336, table opposite p. 334.

Cornfield Harbor, near Federalsburg, Caroline County.

Cornfield Springs Formation[1]

Upper Cambrian: Southeastern California and southeastern Nevada.

Original reference: J. C. Hazzard and J. F. Mason, 1936, Geol. Soc. America Bull., v. 47, no. 2, p. 229–240.

J. C. Hazzard, 1937, California Jour. Mines and Geology, v. 33, no. 4, p. 318–320, p. 277 (fig. 3C). Extended into Nopah and Resting Springs area, Inyo County, Calif. Thickness 2,957 feet. Overlies Bonanza King formation; underlies Nopah formation (new).

J. C. Hazzard and J. F. Mason, 1953, Am. Jour. Sci., v. 251, no. 9, p. 643–655. Geographically extended into Goodsprings area, Nevada, where it lies within Goodsprings dolomite of Hewett (1931).

A. R. Palmer and J. C. Hazzard, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2494–2499. On basis of paleontological data, age of Cornfield Springs formation at its type locality is designated as Upper Cambrian. On basis of this evidence, name Cornfield Springs was misapplied in Nopah area. Unit designated Cornfield Springs in Nopah area should now be considered an unnamed division in upper part of Bonanza King formation.

Named for good exposures east of Cornfield Springs, Providence Mountains, San Bernardino County, Calif.

Corning Creek zone (in Negaunee Formation)[1]

Precambrian (middle Huronian) : Northern Michigan.

Original reference: J. L. Adler, 1935, Jour. Geology, v. 43, no. 2, p. 113–132.

Type locality not stated. Map shows Corning Creek and West Corning Creek, Marquette County.

Cornish sandstone member[1]

Permian: Central southern Oklahoma.

Original reference: C. W. Tomlinson, 1928, Oklahoma Geol. Survey Bull. 40Z, p. 18.

Named for occurrence in vicinity of Cornish, Jefferson County.

Cornishville Formation

Cornishville Limestone Member (of Perryville Formation)[1]

Middle Ordovician: Central Kentucky.

Original reference: A. F. Foerste, 1912, Denison Univ. Sci. Lab. Bull. 17, p. 23, 31, 33, 36, 132, 133.

A. C. McFarlan and W. H. White, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1635–1636. The Cornishville with its supposedly recurrent upper Benson fauna is actually uppermost Benson and the entire Perryville is a Benson facies.

J. A. Stokley and F. H. Walker, 1953, Kentucky Geol. Survey, ser. 9, Rept. Inv. 8, p. 44–45. At Harrodsburg, Mercer County, the Cornishville formation is 6 feet thick; overlies Salvisa formation.

Named for Cornishville, Mercer County.

†Cornwall Limestones[1]

Silurian and Devonian: Southeastern New York.

Original reference: E. C. Eckel, 1902, New York State Geologist 20th Ann. Rept., p. 148.

Name probably taken from some one of the places in Orange County that bears the name Cornwall.

Cornwall Shale[1]

Cornwall Shale (in Onondaga Formation or Group)

Middle Devonian: Southeastern New York, and northern New Jersey.

Original reference: C. A. Hartnagel, 1907, New York State Mus. Bull. 107, p. 39–54.

Bradford Willard, 1937, Am. Jour. Sci., v. 33, no. 196, p. 271, 272. In proposed succession in Green Pond Mountain area, New Jersey, Cornwall shale is assigned to Onondaga formation. Overlies Kanouse sandstone and conglomerate.

Bradford Willard, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 138. Referred to as Cornwall member of Onondaga group.

G. A. Cooper, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Correlation chart shows age as Lower or Middle Devonian.

Named for occurrence at Cornwall, Orange County, N.Y.

†Cornwall Slates[1]

Upper Cambrian: Southeastern Pennsylvania.

Original reference: J. P. Lesley and E. V. d'Invilliers, 1886, Pennsylvania 2d Geol. Survey Rept. 1885, p. 526.

Exposed in railroad cut at Cornwall Station, Lebanon County.

Coronado Quartzite[1]

Upper Cambrian: Central eastern Arizona.

Original reference: W. Lindgren, 1905, U.S. Geol. Survey Prof. Paper 43, p. 59.

A. A. Stoyanow, 1936, Geol. Soc. America Bull., v. 47, no. 4, p. 478. Fossil evidence may suggest a Middle Cambrian age for the unit.

Several areas of this formation crown summit and westerly slope of Coronado Mountain, northwest of Morenci, Greenlee County.

Corough Sandstone Member (of Catahoula Formation)

Miocene (?): East-central Texas.

W. L. Russell, 1957, Gulf Coast Assoc. Geol. Soc. Trans., v. 7, p. 68, fig. 3. Name applied to sandstone occurring roughly 175 feet above base of Catahoula. Thickness 0 to 40 feet.

Type locality: Where a road crosses member about 2½ miles west-southwest of Erwin, Grimes County. Name derived from land survey at type locality.

Corozal Limestone[1]

Paleocene or Eocene: Puerto Rico.

Original reference: C. P. Berkey, 1915, New York Acad. Sci. Annals, v. 26, p. 23.

R. C. Mitchell, 1954, Puerto Rico Univ. Agr. Expt. Sta. Tech. Paper 13, p. 36 (table 2), 47, 48 (table 4). Upper Cretaceous.

R. C. Mitchell, 1956, Am. Assoc. Petroleum Geologists Bul., v. 50, 12, p. 2971. Upper Paleocene or lower Eocene. This age determination credited to Kaye (1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 1) who described limestone section at Corozal.

Present in San Juan district.

†Corral Sandstone (in Cheyenne Sandstone)[1]

Lower Cretaceous (Comanche): Central southern Kansas.

Original reference: F. W. Cragin, 1895, Am. Geologist, v. 16, p. 361, 366.

Named for the natural corral, a short box canyon on Lanphier claim, in southeastern corner of Kiowa County.

Corral Creek Glacial Substage

Pleistocene (Wisconsin): Southern Rocky Mountains.

L. L. Ray, 1938, (abs.) Geol. Soc. America Proc. 1937, p. 314. Two stages of glaciation believed to be of Wisconsin age recognized along northern Front Range. Younger is termed Corral Creek, and older Home.

L. L. Ray, 1939, (abs.) Geol. Soc. America Bull., v. 50, no. 12, pt. 2, p. 2007; Kirk Bryan and L. L. Ray, 1940, Smithsonian Misc. Colln., v. 99, no. 2, p. 33–34; L. L. Ray, 1940, Geol. Soc. America Bull., v. 51, no. 12, pt. 1, 1860–

1862. Represents third of five substages in southern Rocky Mountains. Preceded by Home substage and followed by Long Draw substage.

Named for moraine in valley of Corral Creek, Cache la Poudre Valley.

Corral Hollow Shales[1] (in Franciscan Formation)

Jurassic(?): Western California.

Original reference: C. F. Tolman, Jr., 1915, Nature and science on Pacific coast: San Francisco, Elder and Co., p. 45.

M. D. Crittenden, Jr., 1951, California Div. Mines Bull. 157, p. 15. Incidental mention in discussion of Franciscan formation in San Jose-Mount Hamilton area.

First described in Alameda County [near Livermore].

Correo Sandstone Member (of Chinle Formation)

Upper Triassic: West-central New Mexico.

V. C. Kelley and G. H. Wood, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 47. Dark-brown and buff medium to massive crossbedded standstone, 90 to 120 feet thick. Overlies unnamed red shale member; disconformably underlies Wingate sandstone.

Caswell Silver, 1948, Am. Assoc. Petroleum Geologist Bull., v. 32, no. 1, p. 72, 73, fig. 2. Interbedded sandstone and conglomerate. Unevenly and irregularly crossbedded. Pinches out westward. Derivation of name given.

Named from exposures 1 mile north of settlement of Correo, Valencia County. Crops out along lower bench at south edge of Mesa Gigante, north of Correo.

†Corrigan Formation[1]

Lower Devonian: Western Maryland.

Original reference: A. W. Grabau, 1910, Michigan Geol. and Biol. Survey Pub. 2, geol. ser. 1, p. 231, 234.

Named for occurrence at Corriganville, Allegany County.

Corrigan Formation[1]

Oligocene and Miocene(?): Eastern Texas.

Original reference: E. T. Dumble, 1911, Texas Acad. Sci., v. 11, p. 51.

J. W. Stovall, 1948, Am. Jour. Sci., v. 246, no. 1, p. 84. At least a part of the Corrigan beds were deposited in Oligocene seas.

Named for Corrigan, Polk County.

Corry Sandstone[1]

Corry Formation (in Pocono Group)

Mississippian: Northwestern Pennsylvania.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. Q_4, p. 92–94.

Wallace de Witt, Jr., 1951, Geol. Soc. America Bull., v. 62, no. 11, p. 1347–1369; J. F. Pepper, Wallace de Witt, Jr., and D. F. Demarest, 1954, U.S. Geol. Survey Prof. Paper 259, p. 40. At type locality, consists of about 20 feet of gray and white siltstone and some interbedded fine-grained sandstone. At many places, the Corry can be separated into three units: lower of massively bedded siltstones and fine-grained sandstones; medial of thinner bedded siltstones intercalated in silty mudrock and silty shale; and upper of massive siltstones separated by some thin shaly partings.

Westward from type locality, the Corry thins and, in area between Riceville and Strand School, grades laterally into Shellhammer Hollow formation (new). Throughout most of outcrop, overlies Riceville shale; contact conformable. Underlies Orangeville shale (Hungry Run sandstone member, new, or Bartholomew siltstone member, new). The Corry can be considered an eastward facies of Berea sandstone.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey. Mapped in Pocono group.

Type locality: Colgrove quarry (now abandoned), 1 mile south of Corry, Erie County.

Corryville Shale Member (of McMillan Formation)[1]

Corryville Formation (in Maysville Group)

Upper Ordovician: Southwestern Ohio, southeastern Indiana, and northern Kentucky.

Original reference: J. M. Nickles, 1902, Cincinnati Soc. Nat. History Jour., v. 20, p. 75, 83.

A. C. McFarlan, 1943, Geology of Kentucky: Lexington Ky., Kentucky Univ., p. 11. Corryville listed with formations exposed in northern Kentucky.

J. B. Patton, T. G. Perry, and W. J. Wayne, 1953, Indiana Geol. Survey Field Conf., Guidebook 6, pl. 1. Shown on chart of Ordovician rocks exposed in Jefferson and Switzerland Counties as Corryville formation in Maysville group. Blue dense to crystalline limestone beds and blue-gray soft gray clay shale; fossiliferous. Thickness 20 to 45 feet. Underlies Mount Auburn formation; overlies Bellevue formation.

Named for Corryville, near Cincinnati, Ohio.

Corset Spring Shale

Upper Cambrian: East-central Nevada and western Utah.

Harald Drewes and A. R. Palmer, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 1, p. 106 (fig. 2), 108 (fig. 3), 115–116, 117. A 65-foot unit of olive-gray predominantly clay shale with characteristic pencil fracture that overlies Johns Wash limestone (new); near middle of formation, 5 to 15 feet of medium-gray thick-bedded medium-coarse, crystalline, and clastic limestones separate a lower shale unit from an upper one. Distribution irregular because thrust fault commonly follows unit. Undisturbed sections show sharp lower contact and a gradational upper contact with overlying (unnamed) cherty limestone. Upper contact is placed at highest shale in a sequence of alternating shale and limestone lenses.

Harald Drewes, 1958, Geol. Soc. America Bull., v. 69, no. 2, p. 224 (fig. 2), 226–227, pl. 1. Trilobite assemblage indicates early Trempealeau age. Formation probably correlative of part of Dunderberg shale of Eureka district and part of Mendha formation of Pioche district.

C. B. Bentley, 1958, Brigham Young Univ. Research Studies, Geology Ser., v. 5, no. 6, p. 21–22. Dunderberg shale is basal Franconian and is equivalent to a sandstone, shale, and limestone unit about 600 feet above base of Mendha limestone at Pioche, Nev. Dunderberg is present in Snake Range, Nev., where Drewes and Palmer (1957) called it Corset Spring shale. Although they correlated it with Dunderberg shale of Eureka, Nev., and found basal Franconian fossils, they designated it as

Trempealeauan (Drews, 1958). Underlying Corset Spring shale is 228 feet of limestone designated by Drewes and Palmer the Johns Wash limestone, supposedly of upper Franconian and basal Trempealeauan age. Present writer [Bentley] does not agree with this dating or with nomenclature involved. Formation names used by Drewes and Palmer, at least those for Upper Cambrian, should be suppressed, and section renamed with either Eureka district or House Range terminology.

A. R. Palmer, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B289–B290. Unit that has been called "Dunderberg shale" by Bentley and by those who have studied it in western Utah is not equivalent to whole of Dunderberg shale exposed near Eureka and Cherry Creek, Nev. Evidence indicates that name "Dunderberg shale" should no longer be used for a thin unit of interbedded limestones and shales occurring in western Utah and containing *Elvinia* zone trilobites. This unit is better named Corset Spring shale. Bentley has pointed out correctly that the Corset Spring shale, which occurs in Snake Range just west of Nevada-Utah line, is equivalent to his "Dunderberg shale." Name Corset Spring extended into Deep Creek Range, where it occurs above Hicks formation and below Chokecherry dolomite.

Type section: Segment B of measured section (fig. 2), southern Snake Range, Nev. No suitable geographic name near this section but there is alternate section at elevation 10,500 above Corset Spring on northeast flank of peak 11,064, two miles east of Lincoln Peak, and shale is named for that spring.

Corsicana Marl (in Navarro Group)[1]

Upper Cretaceous (Gulf Series): Northeastern Texas.

Original reference: R. T. Hill, 1901, U.S. Geol. Survey 21st Ann. Rept., pt. 7, p. 342–343.

D. L. Frizzell, 1954, Texas Bur. Econ. Geology Rept. Inv. 22, p. 51–52, pls. Overlies Nacatoch sand; underlies Kemp clay. Foraminifera described.

Type locality: Pit Corsicana Brick Co., 2 miles south of courthouse at Corsicana, Navarro County.

Corson diabase[1]

Precambrian: Southeastern South Dakota(?) and northwestern Iowa.

Original references: C. R. Keyes, 1914, Iowa Acad. Sci. Proc., v. 21, p. 187; 1914, Science, new ser., v. 40, p. 144.

Probably named for Corson, Minnehaha County, S. Dak.

Corta Sandstone (in Joserita Member of Lowell Formation)

Lower Cretaceous: Southeastern Arizona.

A. A. Stoyanow, 1949, Geol. Soc. America Mem. 38, p. 11. Hard-cross-bedded partly quartzitic and partly calcareous reddish-brown and in places whitish sandstone. Thickness 35 feet. Underlies Quimbo dolomite (new); overlies Espinal grit (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.

Cortado Formation

Pennsylvanian (Des Moines): Northern New Mexico.

J. A. Young, Jr., 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1247. Arkose, arkosic sandstone, arenaceous, carbonaceous, and calcareous shale, and a few thin beds of limestone. Thickness over 3,300 feet. Overlies Whiskey Canyon limestone.

Arthur Montgomery, 1953, New Mexico Bur. Mines Mineral Resources Bull. 30, p. 51. Presentation of better locality data (from unpub. thesis of Young).

First described from occurrence near mouth of Rio Grande del Rancho Canyon, northern Sangre de Cristo Mountains, Taos County.

Cortlandt Complex

Cortland Series[1]

Age undetermined: Eastern New York.

Original references: J. D. Dana, 1880, Am. Jour. Sci., 3d, v. 20, p. 194–220; 1881, Am. Jour. Sci., v. 22, p. 103–119.

G. P. Woollard, 1948, Am. Geophys. Union Trans., v.. 29, no. 3, p. 316. Referred to as Cortlandt complex, a norite intrusive.

N. C. Steenland and G. P. Woollard, 1952, Geol. Soc. America Bull., v. 63, no. 11, p. 1075–1104. Cortlandt complex is a body of igneous rocks, composed of norite, diorite, and pyroxenite. Outstanding features are: (1) unusual suite of basic rocks; (2) systematic zoning of rock types; (3) conspicuous banding in parts of complex; and (4) funnel shape for complex as a whole and similar shape for some of its constituent parts. Report is based on 185 gravity and magnetic stations established over complex and contiguous areas. Complex is in region of granitic rocks and lower Paleozoic sediments.

First described in township of Cortlandt, northwestern part of Westchester County, between Croton River on south and parallel of Peekskill on north. Covers area of about 24 square miles.

Corwin Formation[1] (in Nanushuk Group)

Lower and Upper Cretaceous: Northwestern Alaska.

Original reference: F. C. Schrader, 1902, Geol. Soc. America Bull., v. 13, p. 244.

E. G. Sable, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 11, p. 2641–2643, fig. 3. Restricted in Utukok-Corwin area to the predominantly nonmarine facies of Nanushuk group which overlies and intertongues with Kukpowruk formation (new) and underlies Prince Creek formation of Colville group. Upper contact with Prince Creek formation not exposed but may represent an unconformity. Thickness at type section about 15,500 feet; thins northeastward to about 4,500 feet on lower Utukok River. Age redesignated at late Early and Late Cretaceous, not older than middle Albian. Type locality given.

R. M. Chapman and E. G. Sable, 1960, U.S. Geol. Survey Prof. Paper 303–C, p. 101–125, pls. Formation described in Utukok-Corwin region. Consists predominantly of nonmarine rocks (coastal facies with possibly some inland facies); intertongues with and overlies Kukpowruk formation. Shale, siltstone, claystone, sandstone, coal, conglomerate, ironstone, clay, and bentonitic clay are commonest rock types. Thins eastward in northern part of region and also thins northward from more than 15,400 feet near Corwin Bluff to about 4,500 feet along lower Utukok River.

Type locality: Corwin Bluff vicinity in sea cliffs from 0.6 mile west of Thetis Creek and west for 11 miles, thence 0.3 mile upstream along small creek which enters the ocean at this point; Cape Lisburne region.

Coso Formation

Pliocene, upper, or Pleistocene, lower: Eastern California.

J. R. Schultz, 1937, Carnegie Inst. Washington Pub. 487, p. 79. Alluvial gravels, tuffs, and lake beds that form a unit sharply differentiated from other rock types in region. Conformably overlain by basaltic lava; overlies granite. Thickness about 300 feet.

R. H. Hopper, 1947, Geol. Soc. America Bull., v. 58, no. 5, p. 415, 416, pl. 1. Thickness about 500 feet. Basal material consists of reddish arkose and buff gravel, sandstone, and shale; above is about 200 feet of well-stratified thin-bedded white and light-buff lake beds, with interbedded white rhyolite tuffs. Alluvial fan material below tuffs has yielded vertebrate fauna. Rests on erosion surface cut in granitic rocks; overlain without angular discordance by flows of basaltic lava.

Exposed on west, north, and east flanks of Coso Range, Inyo County.

Coso Granodiorite

Upper Mesozoic: Southern California.

V. C. Kelley, 1937, Econ. Geology, v. 32, no. 8, p. 993, 994 (fig. 2), 996 (fig. 4). Mentioned as lobe of Coso batholith. Intrusive into Pennsylvanian limestone.

V. C. Kelley, 1938, California Jour. Mines and Geology, v. 34, no. 4, p. 514, pl. 7. Megascopically a coarse-grained light-colored granitoid rock in which the principal minerals are quartz, feldspar, and green hornblende,

Occurs in Darwin silver-lead district in the Coso Range, Inyo County. Batholithic in extent and underlies most of plateau south and west of Darwin Hills.

Cosumnes Formation (in Amador Group)

Middle (?) and Upper Jurassic: East-central California.

N. L. Taliaferro, 1943, California Div. Mines Bull. 125, p. 283. Basal formation of Amador group at its northern section. Basal beds consist of alternate sandstones and conglomerates 1,200 feet in thickness; these pass upward into sheared arkosic sandstones and dark clay-slate which, in turn, grade upward into thin-bedded tuffs and fine sediments; basic flows and red and green cherts locally present in upper part. Thickness 4,400 feet to east of Calaveras anticline; thicker on west owing to presence of rhyolite flows and agglomerates. Underlies Logtown Ridge agglomerates (new); unconformably overlies the Calaveras (Clipper Gap formation).

J. H. Eric, A. A. Stromquist, and C. M. Swinney, 1955, California Div. Mines Spec. Rept. 41, p. 10–11, pls. 1, 2. Described in Angels Camp and Sonora quadrangles, Calaveras and Tuolumne Counties, where maximum thickness is about 1,500 feet, base not exposed. Consists of metavolcanics, chiefly thin-bedded tuff, with minor slate; dark-gray to black slate, quartzite, chert, and minor conglomerates. Unconformably underlies Logtown Ridge formation; unconformably overlies Calaveras formation. Age considered to be Middle or Late Jurassic. Perisphinctid ammonite collected from unit.

Type locality: At northern type section of Amador group on Cosumnes River, Eldorado and Amador Counties.

Cottage Grove Sandstone[1] Member (of Chanute Shale)

Pennsylvanian (Missouri Series): Southeastern Kansas and northeastern Oklahoma.

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. 61 (fig. 6), 63–64. Described in Washington County where it is 6 to 50 feet thick. Occurs above unit referred to as Thayer coal member and below unnamed carbonaceous shale member.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 84. Yellowish-brown or tan thin-bedded to massive sandstone; comprises upper one-third to one-half of Chanute shale in southeastern Kansas; occurs only locally in northeastern Kansas. Thickness featheredge to 60 feet.

Named for Cottage Grove Township in Allen County, Kans.

Cotter Dolomite[1]

Lower Ordovician: Northern Arkansas, southern Missouri, and Oklahoma.

Original reference: A. H. Purdue and H. D. Miser, 1916, U.S. Geol. Survey Geol. Atlas, Folio 202.

J. G. Grohskopf, E. L. Clark, and S. P. Ellison, 1943, Missouri Geol. Survey and Water Resources 62d Bienn. Rept., app. 4, p. 7–9. Underlies Fortune formation (new).

J. S. Cullison, 1944, Missouri Univ. School Mines and Metallurgy Bull., Tech. Ser., v. 15, no. 2, p. 15, 32–39, pls. Predominantly cherty dolomite varying from gray to buff; fine-grained to coarse-grained; thin to massive bedded. Thickness 340 feet in vicinity of Cotter. Includes Crooked Creek chert bed (new) in lower part and Jenkins Branch chert bed (new) near middle. Underlies Powell dolomite; unconformably overlies Theodosia formation (new) of Jefferson City group. As used in this report, term Cotter is restricted to those beds which crop out in vicinity of type area. Type section designated. Lower half of what Weller and St. Clair (1928, Missouri Bur. Geology and Mines, v. 22, 2d ser.) called Cotter is here included in Theodosia formation.

G. G. Huffman, 1953, Oklahoma Geol. Survey Guide Book 1, p. 5, 7. Unconformably overlies Precambrian Spavinaw granite. Where exposed near Qualls, Cherokee County, is succeeded by Burgen sandstone.

Josiah Bridge, 1956, U.S. Geol. Survey Prof. Paper 277, p. 23. In Mascot-Jefferson City zinc district, Tennessee, names Kingsport and Mascot (both new) replace terms Jefferson City formation and Cotter-Powell beds. There is no possibility that these formations can ever be traced into Appalachian Valley. Kingsport limestone corresponds to some part of Jefferson City formation of Ozark region, and Mascot dolomite corresponds to some part of the Cotter, but there is n evidence to indicate that Jefferson City-Cotter boundary is same as Kingsport-Mascot boundary.

Type section: Starting at valley bottom just upstream from west end of White River bridge at Cotter and extending to top of hill westward along U.S. Highway 62, Baxter County, Ark.

Cotton Formation (in Conneaut Group)

Upper Devonian: North-central Pennsylvania and central New York.

G. H. Chadwick, 1936, New York State Mus. Bull. 307, p. 78, 96. Name proposed for mass of continental strata. Briefly mentioned in discussion in which a number of beds loosely termed "Catskill" are reassigned.

G. A. Cooper and others, 1942. Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Geographically extended into New York.

Named from Cotton Creek in Bingham and Genesee Townships, Potter County, Pa.

†Cottondale Formation (in Tuscaloosa Group)

Upper Cretaceous: West-central Alabama.

L. C. Conant and W. H. Monroe, 1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 37. Comprises the apparently nonmarine gravelly sand and carbonaceous clay which lie between the Paleozoic basement and the overlying marine Eoline formation (new). Sand and clay members vary in thickness though most outcrops show 25 to 50 feet of gravelly sand overlain by a few feet of carbonaceous clay. Sand is cross bedded, coarse to fine grained; gravel present in lower half, chiefly as thin stringers, but toward base is abundant enough to form beds; clay typically forms one or two layers at top, but locally occupies entire thickness of formation; upper part of clay locally lignitic. Thickness 30 to 100 feet; topographic irregularities on Paleozoic floor cause corresponding differences in thickness of formation. Upper contact of formation locally sharp but in some places appears to be gradational. Flora indicates Upper Cretaceous age.

W. H. Monroe, L. C. Conant, and D. H. Eargle, 1946, Am. Assoc. Petroleum Geologists Bull, v. 30, no. 2, p. 192–194. Commonly 25 to 75 feet of cross-bedded slightly micaceous sand, which is coarser or even gravelly at base and is overlain by 2 to 8 feet of carbonaceous or lignitic clay; at many places dark-gray and purple clays are interbedded with the sand; at some places, entire interval is represented by dark-gray to purple clay as much as 50 to 60 feet thick. Type locality designated.

C. W. Drennen, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 3, p. 528. Name abandoned. Sediments heretofore designated Cottondale are included in the Eoline, which is here reduced to member status in the Coker formation (revised).

Type locality: East of Cottondale in sec. 25, T. 21 S., R. 9 W., Tuscaloosa County. Named for Cottondale, about 6 miles east of Tuscaloosa, where several exposures are present along Southern Railway and nearby county roads.

Cotton Valley Formation or **Group**

Upper Jurassic: Subsurface in northern Louisiana, southern Arkansas, western Mississippi, and eastern Texas.

H. K. Shearer, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 6, p. 722, 723, 724–725. Dominantly marine beds, made up of various types of shale, sand, and limestone, underlying Travis Peak red beds; includes Schuler facies (or limestone). Thickness about 3,240 feet at Rodessa, La. Name approved by Shreveport Geological Society.

W. B. Weeks, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 8, p. 966. Geographically extended into Arkansas where it overlies the Smackover limestone and Bucker anhydrite.

R. W. Imlay, 1940, Arkansas Geol. Survey Inf. Circ. 12, p. 25–27. Further desribed in Arkansas where it underlies Hosston formation (new). Jurassic age favored on basis of fossils.

F. M. Swain, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 5, p. 578 (table 1), 579–582. Rank raised to group. Includes rocks between base of Hosston formation (Travis Peak of East Texas petroleum geologists) and top of Buckner formation, or top of Smackover formation in areas where Buckner is not recognizable. Consists of Schuler formation above and Boosier formation below.

T. H. Philpott and R. T. Hazzard, 1949, *in* Shreveport Geol. Soc. Guidebook 17th Ann. Field Trip, fig. 5 (correlation chart); L. A. Goebel, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 10, p. 1978–1979. Proposed that Cotton Valley as a formation be restricted to the gray sands and shales above a major unconformity that exists within the formation and that Haynesville formation be used for the red sands, shales, and anhydrite below unconformity.

Type locality: Cotton Valley field, Webster Parish, La.

Cottonwood Beds[1]

Miocene: North-central Oregon.

Original reference: W. D. Matthew, 1900, Am. Mus. Nat. History Bull., v. 12, p. 23.

Rattlesnake Creek, near Cottonwood, John Day region.

Cottonwood Beds (in Horsetown Group)

Lower Cretaceous (Shasta Series): Northern California.

F. M. Anderson, 1938, Geol. Soc. America Spec. Paper 16, p. 32 (fig. 1), 38 (table 1), 63–67, table 2. Name applied to lower part of Horsetown group. Beds, which vary in thickness from 3,480 feet on North fork of Cottonwood River to 8,400 feet on Dry Creek, contain a succession of distinctive faunal zones. Consist of sandstone and conglomerate in lower part with shales in upper part. Underlie Hulen beds (new) though the boundary is more one of paleontological distinction; overlie Shasta group.

Type area: Along Cottonwood River [Shasta County]. Beds form a belt 2½ miles broad, crossing North and Middle forks of Cottonwood River; from the latter stream, belt extends in southwest course by Dry Creek, northern Tehama County, and thus across the delta area.

†Cottonwood Formation (in Council Grove Group)[1]

Permian: Eastern Kansas.

Original reference: C. S. Prosser, 1894, Geol. Soc. America Bull., v. 6, p. 37–41.

Named for Cottonwood Valley, Chase and Lyon Counties.

Cottonwood Limestone (in Council Grove Group)[1]

Cottonwood Limestone Member (of Beattie Limestone)

Permian: Eastern Kansas, southeastern Nebraska, and north-central Oklahoma.

Original reference: E. Haworth and M. Z. Kirk, 1894, Kansas Univ. Quart., v. 2, p. 112–114.

G. E. Condra and C. E. Busby, 1933, Nebraska Geol. Survey Paper 1, p. 13. Beattie formation (new) comprises (descending) Morrill limestone, Florena shale, and Cottonwood limestone members.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 47. Member of Beattie limestone. Underlies Florena shale member; overlies Eskridge shale. Thickness about 6 feet. Wolfcamp.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Cottonwood limestone in Council Grove group mapped in Oklahoma.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 101–103. In Pawnee County, classed as limestone in Council Grove group. Overlies Eskridge shale and underlies Garrison shale. As currently classified in Nebraska, Kansas, and north-central Oklahoma, the Cottonwood is basal member of Beattie formation overlain in turn by Florena shale and Morrill limestone members. Members of Beattie can be identified in Pawnee County just south of Arkansas River in two northernmost outliers of Cottonwood limestone. Only Cottonwood member is traceable for any distance across county. Accordingly, Beattie formation has been ignored in subdividing Council Grove group for this report. Maximum development is along Arkansas River where Cottonwood occurs as single resistant bed of light-greenish-gray limestone 2.2 feet thick. Wolfcamp series.

Named for Cottonwood Falls, Chase County, Kans.

Cottonwood Quartzite

Precambrian: Northern Utah.

N. E. A. Hinds, 1938, Am. Jour. Sci., 5th, v. 35, no. 210, 445. Cottonwood quartzite over 10,000 feet thick, mentioned in discussion of Precambrian Arizonan revolution in western North America.

This may or may not be same unit referred to as Cottonwood schists and gneisses.

Present in Wasatch, Uinta, and other ranges of northern Utah.

Cottonwood Rhyolite[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. 37.

Occurs about headwaters of Cottonwood Canyon, Oatman district.

Cottonwood Schists and Gneisses[1]

A name that has been rather loosely applied to the Precambrian schists and gneisses of Cottonwood Creek region, central Wasatch Mountains, Utah.

†Cottonwood Shales (in Council Grove Group)[1]

Permian: Eastern Kansas.

Original reference: C. S. Prosser, 1894, Geol. Soc. America Bull., v. 6, p. 38–39.

In Cottonwood Valley and at Manhattan and vicinity, Riley County.

Cottonwood white layer[1]

Eocene, middle: Wyoming.

Original reference: W. D. Matthew and W. Granger, 1909, Am. Mus. Nat. History Mem., v. 9, p. 295.

Bridger Basin.

Cottonwood 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, 382.

D. A. Zimmerman and G. D. Glover, 1956, Soc. Econ. Paleontologists and Mineralogists, Permian Basin Sec., [Guidebook] Spring Mtg., May 11–12, p. 72. Chiefly white friable sandstone, 300 feet thick. Underlies Hanna Valley bed; overlies Spring 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 Cottonwood Creek, San Saba County.

Cottonwood Creek Formation

Miocene, middle to upper: Southern California.

Otto Hackel and K. F. Krammes, 1958, San Joaquin Geol. Soc. [Guidebook] Spring Field Trip May 17, p. 4, road log (p. 6), geol. map. Series of light-colored coarse sands and conglomerates. Unconformably overlies Round Mountain silt; unconformably underlies Kern River formation. Can be traced north and west into Mon Bluff formation (new).

Type locality: Near Round Mountain, Kern County.

Cottonwood Draw banded layers[1] (in Wind River Formation)

Eocene, lower: Wyoming.

Original reference: W. Granger, 1910, Am. Mus. Nat. History Bull., v 28, p. 244.

Along Cottonwood Creek, near Lost Cabin, northeast corner of Fremont County.

†Cottonwood Falls Limestone[1]

Permian: Eastern Kansas.

Original reference: E. Haworth and M. Z. Kirk, 1894, Kansas Univ. Quart., v. 2, p. 112–114.

Named for Cottonwood Falls, Chase County.

Cottonwood Spring Basalt (in Buck Hill Volcanic Series)

Cottonwood Spring Basalt (in Green Valley Volcanic Series)

Oligocene and younger(?): Western Texas.

S. S. Goldich and M. A. Elms, 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1197. Green Valley volcanic series is divided into (ascending) Pruett formation, Cottonwood Spring basalts, and Duff tuff. Consists of basaltic lava flows up to 325 feet thick.

S. S. Goldich and G. L. Seward, 1948, West Texas Geol. Soc. [Guidebook] Oct. 29–31, p. 14 (table 1), 17 (fig. 3), 20. Included in Buck Hill volcanic series. [Authors made no reference to previous use of Green Valley volcanic series.] Derivation of name given.

S. S. Goldich and M. A. Elms, 1949, Geol. Soc. America Bull., v. 60, no. 7, p. 1138 (table 1), 1144 (fig. 3), 1156–1159, 1171 (fig. 6), 1179, (measured section 5, type section), pl. 1. Dense to vesicular and amygdaloidal flows; trachyandesite to olivine basalt. Flows vary in number and in thickness. Maximum thickness 325 feet in area west of Whirlwind Spring; in type section, flows aggregate 300 feet, and lowermost flow, 40 to 50 feet thick, rests on Pruett formation; on Potato Hill, total thickness of 166 feet includes six flows. On Crossen Mesa, Cottonwood Spring basalt rests on tuff deposited on weathered surface of Potato Hill andesite. Age Eocene(?).

W. N. McAnulty, 1955, Geol. Soc. America Bull., v. 66, no. 5, p. 536 (table 1), 550–551, pl. 1. Traced across Cathedral Mountain quadrangle, Cottonwood Spring basalt flows occupy position between Potato Hill andesite and Duff formation, a relationship which is maintained across the south-north length of Alpine quadrangle. Thickness 220 to 332 feet. Top of Eocene is placed at disconformity between Crossen trachyte and Sheep Canyon basalt; suggested that overlying lava and tuff layers are Oligocene and younger(?), and map bracket shows this age for Cottonwood Spring basalt.

Type section: In vicinity of elevation 4,054 feet, south of Cottonwood Spring, Buck Hill quadrangle, Brewster County.

Cotui Limestone

Cotui Limestone Member (of San Germán Formation)

Upper Cretaceous: Southwestern Puerto Rico.

P. H. Mattson, 1958, Dissert. Abs., v. 18, no. 1, p. 198. Massive rarely thick-bedded limestone near top of San Germán formation. Includes microcoquino and pellet limestone with some argillaceous limestone. Maximum thickness 75 meters. Stratigraphically above Cabo Rojo member. Maestrichtian.

P. H. Mattson, 1960, Geol. Soc. America Bull., v. 71, no. 3, p. 340, 341, 342, pl. 1. Cotui limestone is highest unit in San Germán except southeast of Cabo Rojo, where about 150 meters of andesitic volcanic rock, shale, and conglomerate overlie it. Mitchell (1922) used term San Germán to describe the massive limestone herein called Cotui limestone. Definition of San Germán has been expanded in present report.

E. A. Pessagno, Jr., 1960, Geology of the Ponce-Coamo area, Puerto Rico.: Puerto Rico Econ. Devel. Adm. and Princeton Univ. Dept. Geology, p. 53, 67. Referred to as Cotui limestone. Outcrops occur along western margin of Peñuelas quadrangle, where unit crops out in low hills surrounded by alluvium. In Mayagüez area, Mattson includes this limestone as a member of his San Germán formation. Relationship of the Cotui to underlying Mayagüez group could not be discerned in area of present report.

Well exposed in quarries along south edge of Guanajibo Valley, Mayagüez area.

Couch Formation

Pliocene, lower: Western Texas.

G. L. Evans, 1949, West Texas Geol. Soc. Guidebook Field Trip 2, Nov. 6–9, p. 4 (table 1), 5–6. Compact well-sorted calcareous sand and gravel; typically pinkish gray. Thickness at type locality 125 feet; thickness varies markedly with relief of underlying bedrock; maximum development in deeper pre-Cenozoic valleys; thins and wedges out against higher ridges and divides on bed rock surface. Underlies Bridwell formation (new); unconformably overlies Triassic and Cretaceous rocks.

D. C. Van Siclen, 1957, Jour. Geology, v. 65, no. 1, p. 49 (fig. 2), 51, 52. Thickness 200 feet. Stratigraphic section lists formation under Pliocene (Miocene?).

Type locality: About 7 miles east of Crosbyton, Crosby County. Named for Couch Ranch, in Blanco Canyon. Extends northward into Texas panhandle.

Coudersport Member (of Cattaraugus Formation)[1]

Upper Devonian: North-central Pennsylvania.

Original reference: Bradford Willard, 1936, Geol. Soc. America Bull., v. 47, no. 4, p. 581.

Bradford Willard, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 287–288. Green standstone 10 to 20 feet thick, about 100 feet below [above] base of Cattaraugus. Persists into Potter, Tioga, and probably McKean Counties and perhaps as far as Cameron, Clinton, Lycoming, and Sullivan Counties. Not to be confused with Oswayo which it closely resembles.

Named for Coudersport, Potter County, where it occurs in quarries along west side of town.

†Coulters Ferry Sands[1]

Upper Cretaceous: Northeastern Mississippi.

Original reference: E. W. Hilgard, 1860, Mississippi Geol. and Agric. Rept., p. 66, 67, 73.

Named for exposures at Coulter's Ferry, on Old Town Creek, near its confluence with the Tombigbee, sec. 34, T. 10, R. 7 E., Monroe County.

Council Grove Group[1]

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

Original reference: C. S. Prosser, 1902, Jour. Geology, v. 10, p. 709.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 45–49. As defined in Kansas, includes (ascending) Foraker limestone, Johnson shale, Red Eagle limestone, Roca shale, Grenola limestone, Eskridge shale, Beattie limestone, Stearns shale, Bader limestone, Easly Creek shale, Crouse limestone, Blue Rapids shale, Funston limestone, and Speiser shale. Thickness 310 to 330 feet. Overlies Admire group; underlies Chase group.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. As mapped, includes only Cottonwood limestone, Neva limestone, and Red Eagle limestone.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 73 (table 3), 77–105. As presently applied, group includes beds from base of Americus limestone upward to base of Wreford limestone. Lies with apparent conformity between underlying Admire group and overlying Chase group. Thickness increases from 321 feet in Kansas to about 480 feet in Pawnee County. In southwest part of T. 22 N., R. 4 E., Wreford limestone, base of which defines upper limit of group, loses its identity; farther south, therefore, Council Grove and overlying Chase groups cannot be differentiated. They grade laterally into Konawa-Asher sequence of central Oklahoma. Group subdivided into limestone and shale-sandstone units of equal rank. Where applicable, names from Kansas section have been used, but rank of these names in Kansas classification has been discarded. In Pawnee County, includes (ascending) Foraker limestone with Americus limestone, Hughes Creek shale, and Long Creek limestone members, Johnson shale, Red Eagle limestone, Roca shale, Neva limestone, Eskridge shale, Cottonwood limestone, and Garrison shale. Wolfcamp series.

Named for Council Grove, Morris County, Kans.

Council Spring Limestone (in Veredas Group)

Pennsylvanian (Missouri series) : Central New Mexico.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 27 (table 2), 58 (fig. 6), 59, 62–63. Proposed for uppermost formation of Veredas group (new). Overlies Adobe formation and underlies Burrego formation (both new). Limestone is light gray to white, coarsely crystalline to fine grained, and massive to massively bedded. Thickness at type locality 18 feet.

Type locality: Northwest face of Oscura Mountains in eastern part of SE¼ sec. 36, T. 5 S., 5 E., Socorro County. Name derived from Council Spring near top of Oscura Mountains, about 5 miles south of north end of mountains.

†Courtland Quartzite[1]

Precambrian (Huronian) : Central southern Minnesota.

Original reference: C. W. Hall, 1899, U.S. Geol. Survey Bull. 157. p. 20–25.

Redstone, in Courtland Township, midway between towns of New Ulm and Courtland, Nicollet County.

Courtney Granite[1]

Mesozoic: Northern California.

Original reference: O. H. Hershey, 1900, Science, new ser., v. 11, p. 130–132.

Mount Courtney batholith, Trinity County.

†Coutchiching Series[1]

Precambrian: Northern Minnesota, and Ontario, Canada.

Original reference: A. C. Lawson, 1887, Am. Jour. Sci., 3d ser., v. 33, p. 473–480.

F. F. Grout and others, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 1020–1022. No Coutchiching recognized in Minnesota.

Rainy Lake region, Minnesota.

Covada Group[1]

Probably Devonian, Carboniferous, or Mesozoic: Northeastern Washington.

Original reference: C. E. Weaver, 1913, Washington Geol. Survey Bull. 16, p. 20–30.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 75a), Correlation chart shows age Mississippian to Permian.

Washington [State] Division of Mines and Geology, 1960, Washington Div. Mines and Geology Rept. Inv. 20, p. 5. Intruded by Scatter Creek rhyodacite (new). Has been mapped as greenstone and limestone. Greenstone includes greenstone, graywacke, graywacke conglomerate, quartzite, argillite, chert, and phyllite; limestone is lenticular; some is Permian in age and some Triassic.

Named for Covada, Ferry County.

†Cove Limestone[1]

Ordovician: Appalachian region.

Original reference: H. D. Rogers, 1836, Pennsylvania Geol. Survey 1st Ann. Rept., p. 12–22.

Name probably derived from Cove Mountain, Franklin County, Pa.

Cove Quartz Monzonite

Jurassic: California.

O. P. Jenkins, 1938, Geologic map of California (1:500,000): California Div. Mines, sheet 4. Shown on map legend.

†Cove Slate[1]

Ordovician: Appalachian region.

Original reference: H. D. Rogers, 1836, Pennsylvania Geol. Survey 1st Ann. Rept., p. 12–22.

Name probably derived from Cove Mountain, Franklin County, Pa.

†Cove Creek Limestone[1]

Mississippian: Southwestern Virginia.

Original reference: C. Butts, 1927, Virginia Geol. Survey Bull. 27, p. 16.

R. H. Wilpolt and D. W. Marden, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 38, sheet 1. Abandoned on basis of this report. Replaced by Bluefield formation.

D. B. Reger, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 9, p. 1911. Butts (1927) ignored Reger's 1926 terminology and used names "Cove Creek" limestone and "Fido" sandstone for certain stages of the Mauch Chunk and assigned everything between the Gasper (Upper Union) and St. Louis (Hillsdale) to the Ste. Genevieve. This assignment of certain lower rocks to the Ste. Genevieve was merely an avoidance of Pickaway, Taggard, Patton, and Sinks Grove. Continued use of Butts' illogical Ste. Genevieve column has led to confusion. [See Denmar formation.]

Well exposed along Cove Creek, Scott County.

Cove Fort Quartzite

Upper Devonian(?): Southwestern Utah.

G. W. Crosby, 1959, Brigham Young Univ. Research Studies, Geology Ser., v. 6, no. 3, p. 20–21, 52, pl. 11. Proposed for cream-colored vitreous quartzite formation unconformably overlying Guilmette formation. Consists of three units: lower, which is thickest, is white to cream, highly indurated, clean quartz sand; middle, gray limestone intraformational breccia with large amount of sand; upper, reddish-gray poorly sorted quartzite with calcareous cement. Thickness about 85 feet. Disconformably underlies Redwall limestone.

Occurs in south end of Pavant Mountains. Measured section is in sec. 16, T. 24 S., R. 6 W., [Millard County] at southeast corner of White Sage Flat. Exposed in overturned limb of asymmetrial syncline resting in thrust relationship on Triassic beds. Cove Fort is in southeastern corner Millard County.

Covel Conglomerate Member (of Carbondale Formation)

Covel Conglomerate (in Carbondale Group)

Pennsylvanian: Northern Illinois.

H. B. Willman, 1939, Illinois Acad. Sci. Trans., v. 32, no. 2, p. 174–176. Proposed for a thin limestone conglomerate that occurs at top of Summum cyclothem a short distance below No. 5 coal in overlying St. David cyclothem. Notably lenticular so that it is discontinuous in almost every outcrop. Thickness varies from a trace to about 1 foot but is usually ½ to 2 inches thick. In upper Illinois Valley, underlain by a light-greenish-gray calcareous clay and overlain by 4 to 6 inches of dark-gray thin-bedded shale.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 35, 47 (table 1), pl. 1. Rank reduced to member status in Carbondale formation (redefined). Stratigraphically above Hanover limestone member and below Springfield (No. 5) coal member. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: SE¼SW¼ sec. 26, T. 33 N., R. 3 E., La Salle County. Named for exposures along Covel Creek south of Ottawa.

Cove Mountain Formation

Tertiary: Eastern Nevada and southwestern Utah.

E. F. Cook, 1960, Utah Geol. and Mineralog. Survey Bull. 70, p. 18 (fig. 1), 44, maps 1 and 2. Consists of four members (ascending) Willow Spring, Racer Canyon tuff, Pilot Creek basalt, and Cedar Spring. Thickness as much as 2,000 feet. Stratigraphically above Maple Ridge porphyry (new). Underlies Ox Valley tuff (new). Name credited to H. R. Blank (unpub. thesis).

Type locality and derivation of name not stated. Cove Mountain is in Bull Valley area, Washington County, Utah.

Cove Mountain Member (of Pocono Formation)

Lower Mississippian: Central Pennsylvania.

Bradford Willard, 1938, Pennsylvania Geol. Survey, 4th ser., Bull. G–8, p. 18. Name proposed for uppermost division of formation in south-central Pennsylvania. Consists of gray sandstone and pebble beds; lithologically similar to Second Mountain member at base of formation, but distinguished by presence of several coal beds. Conformably overlies Peters Mountain member; underlies Mauch Chunk red beds. Has been termed Burgoon, but question of precise correlation with that unit occurring in areas to the west warrants introduction of new name.

Type locality: In highway cuts at Cove Mountain, Perry County, south of Duncannon.

Coventry Conglomerate[1]

Lower Ordovician: Northeastern Vermont.

Original reference: C. H. Richardson, 1919, Vermont State Geologist 11th Rept., p. 47.

Located about 10 miles north of Craftsbury, and on main road from Newport to South Troy, and crosses northern part of Coventry Township, Orleans County.

Coventry Limestone[1]

Coventry phase (of Waits River Limestone)[1]

Ordovician: Northeastern Vermont.

Original reference: C. H. Richardson, 1908, Vermont State Geologist 6th Rept., p. 265-291.

Type locality: Coventry, Irasburg quadrangle, Orleans County.

†Covington Group[1]

Covington Subseries

Upper Ordovician (Cincinnatian Series): North-central Kentucky and southwestern Ohio.

Original reference: R. S. Bassler, 1906, U.S. Natl. Mus. Proc., v. 30, p. 9.

R. H. Flower, 1946, Bulls. Am. Paleontology, v. 29, no. 116, p. 107-112. Referred to as Covington subseries of Cincinnatian series. Below Richmond subseries. Includes Eden and Maysville groups.

W. C. Sweet and others, 1959, Jour. Paleontology, v. 33, no. 6, p. 1029-1032. Group comprises (ascending) Eden, Fairview, and McMillan formations. Cincinnatian series. Group contains standard sections of Eden and Maysville stages.

Named for Covington, Ky.

Cowaselon Clay[1]

Pleistocene: Southeastern New York.

Original reference: B. Smith, 1914, Am. Jour. Sci., 4th, v. 38, p. 463.

Named for Cowaselon Creek, Madison County.

Cow Bayou Formation (in Wilcox Group)

Cow Bayou Member (of Logansport Formation)

Paleocene: Northwestern Louisiana and northeastern Texas.

D. P. Meagher and L. C. Aycock, 1942, Louisiana Dept. Conserv. Geol. Pamph. 3, p. 13, 14. Named in a stratigraphic summary of Louisiana lignite district. Name credited to G. Murray, Jr.

G. E. Murray, Jr., and E. P. Thomas, 1945, Am. Assoc. Pertoleum Geologists Bull., v. 29, no. 1, p. 48 (fig. 2), 57. Consists of carbonaceous to lignitic shale of a cyclic pattern; typical facies best developed in and around type locality. Average thickness 75 to 100 feet. Underlies Lime Hill member; overlies Dolet Hills member; both upper and lower contacts are transitional, the transition taking place through 5 to 15 feet of section. Paleocene. Type locality designated.

G. E. Murray, 1948, Louisiana Dept. Conserv. Geol. Bull. 25, p. 110-116, pl. 10. Consists of two facies Benson (lower) and Lulu. Geographically extended into Panola County, Tex.

H. V. Andersen, 1960, Louisiana Dept. Conserv. Geol. Bull. 34, p. 54-55. Formation, in Sabine Parish [this report], consists of interbedded silts, shales, and fine-grained sands. Present only in subsurface. Overlies Dolet Hills formation. Underlies Converse formation (new) which includes sand occupying valleys of Pleasant Hill oil field mapped by Murray (1948) as Cow Bayou member of Logansport. Term Logansport eliminated as members are given formational rank. Wilcox group.

Type locality: Along Cow Bayou in SE¼ sec. 9 and NW¼ sec. 16, T. 10 N., R. 14 W., De Soto Parish, La., approximately 3 miles southeast of Hunter on road to Converse.

Cow Creek Granodiorite

Jurassic–Cretaceous: Central California.

D. C. Ross, 1958, California Div. Mines Spec. Rept. 53, p. 11, pl. 1. Leucocratic granodiorite; light gray and finer grained than rocks of Giant Forest pluton. Relation to other named plutonic rocks in area not determined.

Named from exposures along Cow Creek along west side of mapped area, Sequoia National Park.

Cow Creek Limestone Member (of Pearsall Formation)

Cow Creek Limestone Member (of Travis Peak Formation)

Cow Creek Beds (in Travis Peak Formation)[1]

Cow Creek Formation

Lower Cretaceous: Texas.

Original reference: R. T. Hill, 1901, U.S. Geol. Survey 21st Rept., pt. 7, p. 141–143.

R. H. Cuyler, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 5, p. 632–633. Referred to as member of Travis Peak formation.

R. W. Imlay, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 3. Middle member at type section of Pearsall formation (new) in subsurface. Thickness about 85 feet. Consists of black, gray, and light-brown hard dense to finely crystalline limestone. Overlies Pine Island member; underlies Hensell shale member. Occupies same stratigraphic position as Cow Creek limestone member of Travis Peak formation of outcrop and as James limestone of Arkansas-Louisiana-east Texas area.

P. E. Cloud, Jr., and V. E. Barnes, 1948, Texas Univ. Bur. Econ. Geology Pub. 4621, p. 318, 319 [1946]. In outcrops, overlies Sycamore sand member and underlies Hensell sand member. Overlaps top of Honeycut formation and all of Carboniferous within map area of this report. A fossil coquina in which fossils are bonded into massive limestone bed.

V. E. Barnes, 1948, Texas Univ. Bur. Econ. Geology Rept. Inv. 2, p. 5, 6–7 (fig. 1), 8. Upper member of Travis Peak formation (restricted). Thickness 10 to 30 feet. Underlies Hensell sand member reallocated to member status in Shingle Hills formation (new).

F. E. Lozo and F. L. Stricklin, Jr., 1956, Gulf Coast Assoc. Geol. Soc. Trans., v. 6, p. 69, 70, figs. In subsurface and outcrop, formation overlies Hammett shale (new). Hammet was originally included in Hill's Cow Creek beds.

Named for Cow Creek, Burnet County.

Cowdren Anhydrite Member (of Salado Formation)

Permian (Ochoa): Subsurface in West Texas and southeastern New Mexico.

G. A. Kroenlein, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 11, p. 1689. Anhydrite bed at base of a 200-foot zone of alternating halite and anhydrite beds. Above a basal 150-foot halite zone. Name credited to Giesey and Fulk (unpub. ms.).

S. G. Giesey and F. F. Fulk, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 4, p. 603. Mainly white crystalline anhydrite in type locality well, whereas 70 miles to north bed is composed of brown earthy dolomitic anhydrite. Also becomes considerably dolomitic southward.

Thickness in type section 15 feet; in other localtities 10 to 50 feet. Lowermost anhydrite bed in Salado, occurring from 150 to 200 feet above base of formation. Type section designated.

Type locality well: Between depths of 2,590 and 2,605 feet in Southern Crude Oil Purchasing Co. J. M. Cowden No. 1, located 2,310 feet from north and 330 feet from west lines of sec. 26, Blk. 43, T. 1 N., T. & P., Ector County, Tex.

Cowesett Granite (in East Greenwich Group)

Mississippian(?): Central Rhode Island.

A. W. Quinn, 1952, Bedrock geology of the East Greenwich quadrangle, Rhode Island: U.S. Geol. Survey Geol. Quad. Map [GQ–17]. Gray to pink medium-grained granite which is subporphyritic, mostly massive, and foliated near the contacts. Underlies Pennsylvanian sedimentary rocks unconformably. Intrusive into Westboro(?) quartzite, Spencer Hill volcanics (new), an unnamed metadiorite, and Maskerchugg granite (new). Intruded by a dark fine-grained granite dike. Included in East Greenwich group.

Named for typical exposures along Cowesett Road one-half mile west of Hardig Road, Kent County.

Cowiche Gravel[1]

Pleistocene: Central Washington.

Original reference: G. O. Smith, 1903, U.S. Geol. Survey Geol. Atlas, Folio 86.

Occurs in broad terrace in valley of Cowiche Creek, Ellensburg quadrangle.

Cow Island Beds[1]

Upper Cretaceous: Central northern Montana.

Original reference: C. H. Sternberg, 1914, Science, new ser., v. 40, p. 134–135.

At Dog Creek, east of Judith River and in Fergus County.

Cowles Member (of Tererro Formation)

Lower Mississippian: Northern New Mexico.

E. H. Baltz and C. B. Read, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 11, p. 1754–1756, 1760, 1763–1768, 1769, 1770–1771, 1772, 1773. Consists of lower unit of calcarenite and upper unit, present locally, of marly quartz siltstone and intercalated limestone beds. Thickness 26 to 50 feet. Overlies Manuelitas member (new); underlies Sandia formation. Because of its unconformable relation with Manuelitas member, the Cowles may be of Late Mississippian age.

Typical section: Abandoned quarry on road to Winsor Ranch, 0.2 mile above junction with State Highway 63, 1.4 miles south of Cowles, San Miguel County. East side of Pecos River Canyon.

Cowley Formation

Upper Mississippian: Kansas (subsurface).

Wallace Lee *in* G. E. Abernathy, R. P. Keroher, and Wallace Lee, 1940, Kansas Geol. Survey Bull. 31, p. 15. Consists of silty and cherty gray or dark-gray or buff to almost black dolomite or dark dolomitic silty shale; contains glauconite, particularly in a zone a few inches to 30 or more feet thick, which forms a transgressive deposit at base of formation. Thickness as much as 300 feet. Conformably underlies Warsaw limestone; unconformably overlies rocks of Osage age.

Wallace Lee, 1940, Kansas Geol. Survey Bull. 33, p. 66–79, pl. 2. In different areas, base is in contact with Keokuk, Burlington, Reeds Spring, and St. Joe limestones of Osage age; in some areas, rests on Northview shale, Compton limestone, Chattanooga shale, and even on pre-Chattanooga rocks; at most places, unconformably overlain by Pennsylvanian rocks, but, in some places, conformably overlain by the Warsaw. Deriviation of name given.

Named for Cowley County, where in most wells, except in north-central part of county, there is a good development of the formation.

Cowley Canyon Member (of Wasatch Group)

Paleocene or Eocene, lower: Northern Utah.

J. S. Williams, 1948, Geol. Soc. America Bull., v. 59, no. 11, p. 1144–1145. Ooidal, stromatolitic ,pisolitic, or algal limestone at most outcrops with army-brown stromatolites in brownish-gray matrix of compact limestone. Locally stromatolites are missing, and rock is compact cream-colored limestone. Thickness 0 to 83 feet. Basal member of Wasatch group. Unconformably overlies Paleozoic rocks.

Good exposure on east side of Cowley Canyon in sec. 21, T. 12 N., R. 3 E., 0.9 mile above junction of Cowley Canyon and Right Fork Roads. Base of section at elevation 5,880 feet, about 100 feet above road, Logan quadrangle.

Cowlitz Formation[1]

Eocene, upper: Southwestern Washington and northwestern Oregon.

Original reference: C. E. Weaver, 1912, Washington Geol. Survey Bull. 15, p. 10–22.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 90–97. At type section, consists of massive stratified medium- to coarse-grained brownish-gray marine sandstones, shaly sandstnoes, sandy shales, and clay shales, with estuarine and fresh-water members near middle and intercalated basaltic flows near base; extreme lower part not exposed. Thickness at type section 3,745 feet.

R. S. Beck, 1943, Jour. Paleontology, v. 17, no. 6, p. 584–614. Approximately 200 feet of Eocene beds are exposed 1½ miles east of Vader, Lewis County, Wash., along west bank of Cowlitz River in E½SE¼ sec. 28, T. 11 N., R. 2 W. Weaver (1912) proposed name Cowlitz formation for the beds containing molluscan fauna at this locality. Weaver (1937) expanded type Cowlitz to include strata exposed along Olequa Creek between towns of Winlock and Vader. This emendation is undesirable because Olequa Creek section was not included in original definition and the addition would necessitate two type localities for the Cowlitz. In this report, type Cowlitz is limited to beds exposed along Cowlitz River. Foraminifera described. [Report also refers to Cowlitz River beds.]

C. E. Weaver and others, 1944, Geol. Soc. America Bull., v. 44, no. 5, p. 593, chart 11. Formation composed of about 8,000 feet of marine grayish-brown sandstone and sandy shale containing well-preserved molluscan fossils. Type section is in banks of Olequah Creek and not in banks of Cowlitz River. Best known fauna does occur in about 200 feet of strata exposed in bluffs of Cowlitz River, 1½ miles east of Vader, and corresponds to strata in middle of type section on Olequah Creek.

W. C. Warren, Hans Norbisrath, and R. M. Grivetti, 1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 42. West of Willamette River, unconformably overlies Tillamook volcanic series (new); interfingers with basal part of Goble volcanic series (new).

W. C. Warren and Hans Norbisrath, 1946, Am Assoc. Petroleum Geologists Bull., v. 30, no. 2, p. 220 (table 1), 221–225. Described in upper Nehalem River basin where it is 950 feet thick, overlies Tillamook volcanic series, and underlies Keasey formation. Upper Eocene.

D. A. Henriksen, 1954, Dissert. Abs., v. 12, p. 2315–2316; 1956, Washington Div. Mines and Geology Bull. 43, p. 16 (fig. 5), 36–66, pl. 1. Weaver's 1937 type section expanded to include strata along Stillwater Creek from its confluence with Olequa Creek westward to contact with uppermost basalt flows of Metchosin volcanic series 3 miles west of Ryderwood. Type Cowlitz, as redefined herein, consists of more than 8,000 feet of upper Eocene sediments and subordinate volcanic rocks exposed along Stillwater and Olequa Creeks as far south as Cowlitz River. Subdivided into (ascending) Stillwater Creek, Pe Ell volcanics, Olequa Creek (all new), and Goble volcanics members. Underlies undifferentiated Oligocene.

M. L. Steere, 1955, Geol. Soc. Oregon Country News Letter, v. 21, no. 10, p. 85. In Sunset Tunnel area, Columbia County, Oreg., underlies Nehalem formation (new).

M. H. Pease, Jr., and Linn Hoover, 1957, U.S. Geol. Survey Oil and Gas Inv. Map OM–188. Underlies Hatchet Mountain formation (new).

A. E. Roberts, 1958, U.S. Geol. Survey Bull. 1062, p. 12 (table), 14–19, pl. 1. In Toledo-Castle Rock coal district, Washington, unconformably overlies Northcraft formation and underlies Hatchet Mountain formation. Thickness about 2,600 feet.

Type section (Weaver, 1937): In canyon of Olequa [also spelled Olequah] Creek between towns of Winlock and Olequa, Lewis and Cowlitz Counties, Wash. Well exposed between Winlock and junction of Olequa Creek and Cowlitz River, a distance of about 14 miles.

Cowlitz River Beds

See **Cowlitz Formation.**

Cow Run Sandstone (in Conemaugh Formation)[1]

Cow Run sandstone and shale member

Pennsylvanian (Conemaugh Series): Eastern Ohio and western West Virginia.

Original reference: J. J. Stevenson, 1906, Geol. Soc. America Bull., v. 17, p. 154.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 68. 70, table 1. Member of Barton cyclothem in report on Perry County. Includes about 30 feet of shale and sandstone lying between Portersville member of Anderson cyclothem and Ewing limestone member of Barton cyclothem. Dominantly interval contains brick-red or buff shale or interbedded sandstone and shale, but massive coarse-grained sandstone is locally present. Conemaugh series.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 42–45. Name Cow Run has been applied to almost any massive sandstone in middle part of Conemaugh series. Member, as defined by Condit (1912, Ohio Geol. Survey, 4th ser., Bull. 17) and as adopted by Geological Survey of Ohio, includes an erratic sequence of sandstones and shales between the Portersville shale and limestone member below and Ewing limestone above; these latter units are not developed in many areas; hence, boundaries of Cow Run member usually are indefinite. Lithologically member varies from a massive sandstone to a series of sandstones and shales or to a sandy shale or clay shale section; facies changes are rapid. Thickness in Morgan County 30 feet.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 95 (table 11), 124–127. Sandstone member of Upper Bakerstown cyclothem in report on Athens County. Name Cow Run was originally applied to an oil-bearing sandstone in shallow wells in Lawrence Township, Washington County, Ohio. Name has been used and misused for various Pennsylvanian sandstones, and today a First Cow Run sandstone (to which name was first given and one under consideration here), lying in interval between Ames and Cambridge limestone, and a deeper Second Cow Run sandstone (Lower Freeport), lying above Middle Kittanning coal, are recognized. Cow Run member under discussion here is commonly considered to be the local massive thick sandstone lying just above Anderson cyclothem and at some places cutting out and replacing members of that cycle. Here, Cow Run will be used not only for massive sandstone but also for bedded sandstone and shale lying between Portersville and Ewing members. Average thickness about 26 feet. Conemaugh series.

Named for stream in eastern Washington County, Ohio.

Cow Springs Sandstone

Upper Jurassic: Northeastern Arizona, southwestern Colorado, northwestern New Mexico, and southeastern Utah.

E. D. McKee *in* C. R. Longwell, 1949, Geol. Soc. America Mem. 39, p. 46 (fig. 6). Name appears on cross section of north side of Black Mesa, Ariz. Name credited to J. W. Harshbarger.

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 district sand facies here named Cow Springs sandstone. Consists of greenish-gray to light-yellowish-gray fine-grained well-sorted cross-stratified well-cemented sandstone. Thickness at type locality 342 feet. Separated from overlying Dakota sandstone by erosional unconformity; thins southward to 112 feet at Coal Canyon and remains relatively thin eastward to Hopi Buttes area; 420 feet at Steamboat, Ariz.; 240 feet at Lupton, Ariz. Overlies Entrada sandstone.

J. W. Harshbarger, C. A. Repenning, and J. H. Irwin, 1957, U.S. Geol. Survey Prof. Paper 291, p. 3 (fig. 2), 48–51. Because of its intertonguing relationships with Summerville formation and lower members of Morrison formation, Cow Springs cannot be considered either a formation in San Rafael group or a member of Morrison formation. Bluff sandstone is believed to be a tongue of Cow Springs, but, because of its homogeneous and mappable character and its areal extent, it is considered a separate formation and assigned to San Rafael group.

Type locality: In cliff along north face of Black Mesa, Ariz., 4 miles east of Cow Springs along Reservation Highway 3. Section is 1¼ miles west of long 110°45′ W., and 6 miles south of lat 36°30′ N.

Cox Sandstone

Cox Sandstone (in Trinity Group)[1]

Lower Cretaceous (Comanche Series): Western Texas.

Original reference: G. B. Richardson, 1904, Texas Univ. Min. Survey Bull. 9, p. 47.

R. M. Huffington, 1943, Geol. Soc. America Bull., v. 54, no. 7, p. 992 (fig. 2), 1003. Described in northern Quitman Mountains where it is about 704 feet thick, overlies Bluff formation, and underlies Finlay formation.

Elliot Gillerman, 1953, U.S. Geol. Survey Bull. 987, p. 21–22. Described in Eagle Mountains, where it is 1,300 feet thick, underlies Finlay limestone, and overlies Bluff Mesa formation (name replaces preoccupied Bluff formation).

J. P. Brand and R. K. DeFord, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 2, p. 374 (fig. 2), 376–378. In Kent quadrangle, disconformably overlies Yearwood formation (new); underlies Finlay formation, here included in Sixshooter group (new). In eastern and northeastern parts of quadrangle, the Cox oversteps Permian Castile, Rustler, and Pierce Canyon formations. Thickness 130 feet.

R. K. DeFord and L. W. Bridges, 1959, Texas Jour. Sci., v. 11, no. 3, p. 291. In northern Rim Rock country, underlies Tarantula gravel (new).

Named for Cox Mountain, El Paso County.

Coxcomb Granodiorite

Upper Jurassic(?): Southern California.

W. J. Miller, 1944, California Jour. Mines and Geology, v. 40, no. 1, p. 64, pl. 3. Light gray; uniform in composition, structure, and texture. Cuts steeply dipping beds of McCoy Mountains formation (new).

Named for typical occurrence in middle part of Coxcomb Mountains, Riverside County, where it comprises an area of approximately 20 square miles.

Coxville Sandstone[1]

Coxville Sandstone Member (of Linton Formation)

Middle Pennsylvanian: Central western Indiana.

Original reference: G. H. Ashley, 1899, Indiana Dept. Geol. and Natl. Res. 23d Ann. Rept., p. 300–303, 385.

S. A. Friedman, 1960, Indiana Geol. Survey Prog. Rept. 23, p. 7, 23–28. Rank reduced to member status in Linton formation (Allegheny series). Thickness about 60 feet. Occurs at or near base of formation. Conformably overlain by (ascending) underclay, Coal IIIa, dark-gray and black shale, and thin limestone; underlain disconformably by shale above Coal III, by Coal III, or, where this coal has been completely eroded, by underclay or gray shale.

Named for outcrops north and east of Coxville, Parke County, approximately 15 miles north-northeast of Terre Haute.

Coyote Formation[1]

Eocene(?) : Central southern Oregon.

Original reference: W. D. Smith, 1926, Oregon Univ. Commonwealth Rev., v. 8, p. 207–214.

Type locality: Coyote Hills, near Plush, Lake County.

Coyote Sandstone Member (of Madera Limestone)[1]

Pennsylvanian: Central northern New Mexico.

Original references: C. L. Herrick, 1900, Jour. Geology, v. 8, p. 115; 1900, Am. Geologist, v. 25, p. 234–237; 1900, New Mexico Univ. Bull., v. 2, pt. 3, p. 1–14.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 21. Term poorly defined. Not possible to determine exact position of Coyote sandstone. Term should not be used.

Named for Coyote Springs, Sandia Mountains.

Coyote Butte Formation

Permian: Central Oregon.

C. W. Merriam, 1942, Jour. Paleontology, v. 16, no. 3, p. 372. Fusulinid-bearing limestones, sandy limestones, and sandstones, 900 feet thick. Unconformably underlies Triassic sandstones and conglomerates; unconformably overlies Pennsylvanian Spotted Ridge formation (new).

C. W. Merriam and S. A. Berthiaume, 1943, Geol. Soc. America Bull., v. 54, no. 2, p. 156–158. At type section, lower part of formation is light-olive-gray commonly crinoidal limestone, locally containing abundant fusulinids; higher in section, limestones become purer, finer grained, deep olive gray, and more distinctly bedded, and fusulinids become less common, brachiopods more abundant.

Type locality: Steeply dipping strata forming crest of Coyote Butte, near Paulina, Crook County.

†Coyote Mountain Clays (in Imperial Formation)[1]

Miocene, lower: Southern California.

Original reference: G. D. Hanna, 1926, California Acad. Sci. Proc., 4th ser., v. 14, no. 18, p. 435.

Type locality: In foothills bordering southeastern slopes of Coyote Mountains, Imperial County.

Coys Hill Granite[1]

Late Carboniferous or post-Carboniferous: Western central Massachusetts and southwestern New Hampshire.

Original reference: B. K. Emerson, 1898, U. S. Geol. Survey Mon. 29, p. 319–320, pl. 34, map.

Composes mass of Coys Hill, western central Massachusetts.

Cozy Dell Formation

Cozy Dell Shale Member[1] (of Tejon Formation)

Eocene, or Eocene, upper: Southern California.

Original reference: P. F. Kerr and H. G. Schenck, 1928, Geol. Soc. America Bull., v. 39, p. 1090.

T. L. Bailey, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 11, p. 1931. Upper Eocene.

T. W. Dibblee, Jr., 1950, California Div. Mines. Bull. 150, p. 27–28, 38 (fig. 2), pls. 1–6. Formation described in Santa Ynez Mountains, Santa Barbara County, as well-bedded brown clay shale lying conformably on the Matilija sandstone and grading upward through a series of thin sandstone interbeds into the overlying Sacate sandstone. Thickness 700 to 2,000 feet.

Typically exposed in Cozy Dell Canyon, on east side of Ventura River, Ventura County.

Cozzette Member (of Price River Formation)

Upper Cretaceous (Montana): Central western Colorado.

R. G. Young, 1955, Geol. Soc. America Bull., v. 66, no. 2, p. 188, 191, fig. 2. In Neslen facies. Littoral marine sandstone and associated coal-bearing rocks which overlie Corcoran member (new) and are separated from it by tongue of Mancos shale which rests disconformably on coal-bearing rocks of Corcoran member. The basal sandstone grades downward into the Mancos tongue and is composed of two units with combined thickness of about 130 feet. This massive-bedded buff sandstone begins near Hunter Canyon and extends into Grand Mesa. Upper limit of member drawn at disconformity between coal-bearing rocks and overlying tongue of Mancos shale which, in turn, underlies Cameo member (new).

Named for exposures near old Cozzette mine north of Palisade, Mesa County. In Book Cliffs.

Crabbottom Sandstone

Silurian: Northwestern Virginia, western Maryland, and eastern West Virginia.

C. K. Swartz and F. M. Swartz, 1940, (abs.) Geol. Soc. America Bull., v. 51, no. 12, pt. 2, p. 2008. Proposed for a thick-bedded, whitish sandstone at base of Wills Creek formation. Overlies McKenzie formation near Driscol and Frost, W. Va. Widespread and apparently intertongues northward with Bloomsburg beds at base of Wills Creek in western Maryland.

Well exposed near Crabbottom, Va., 6½ miles northeast of Monterey, Highland County, along road leading from Strait Creek to Crabbottom.

Crab Creek Formation

Tertiary: North-central Utah.

R. E. Metter, 1955, Dissert. Abs., v. 15, no. 6, p. 1047. A piedmont deposit which may be lateral facies of Flagstaff and Colton formations. Younger than North Horn formation.

In area of southern Wasatch Mountains and northern Cedar Hills bounded by Spanish Fork Canyon, Utah Valley, Santaquin Canyon, Gardner Hollow, and Thistle Creek.

Crab Orchard cyclothem (in Carbondale Group)

Pennsyvalnian: Southern 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. 16, 17 (fig. 3). In list of cyclothems in southern Illinois, Crab Orchard occurs between Brereton above and St. David below. Includes coal No. 5A.

C. C. Cooper, 1946, Illinois Geol. Survey Bull. 70, p. 12, 16 (fig. 2). Craborchard limestone shown on correlation chart below Herrin limestone and above Absher limestone. Text states that "Craborchard" limestone is part of a cyclothem which includes the so-called No. 5A coal; name "Craborchard" is a field term which is not proposed as a permanent stratigraphic name.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 43, 54 (table 3). Replaced by Briar Hill cyclothem (new).

Type locality and derivation of name not given.

Crab Orchard Formation

Crab Orchard Clay Shales

Crab Orchard Shale[1]

Lower and Middle Silurian: Central Kentucky and southwestern Ohio.

Original reference: W. M. Linney, 1882, Kentucky Geol. Survey Repts. on Garrard and Lincoln Counties.

J. K. Rogers, 1936, Ohio Geol. Survey, 4th ser., Bull. 38, p. 69–71, geol. map. Described in Highland County, Ohio, where it is from 30 to 95 feet thick, base not exposed. Occurs below Bisher and Lilley dolomites and above Brassfield and Dayton limestones.

Kentucky Geological Society, 1955, Kentucky Geol. Soc. Field Trip, p. 31 (fig. 11). Shown on generalized section of Serpent Mound region. Adams and Highland Counties, Ohio, as Crab Orchard clay shales; includes Estill member below and Ribolt member above. Thickness about 120 feet. Occurs below Bisher formation and above Dayton limestone.

U.S. Geological Survey currently classifies the Crab Orchard as a formation and designates the ages Lower and Middle Silurian on the basis of a study now in progress.

Named for Crab Orchard, Lincoln County, Ky.

Crab Orchard Sandstone

Pennsylvanian: Eastern Tennessee.

H. R. Wanless, 1946, Geol. Soc. America Mem. 13, p. 36–37 An interval of evenly bedded hard sandstone younger than the Rockcastle. This sandstone, which has been extensively quarried near Crossville, is known commercially as Crab Orchard sandstone. It is proposed that it be called Crossville sandstone member of Duskin Creek formation since name Crab Orchard has been previously applied to a Silurian shale in Kentucky.

Occurs in syncline in Cumberland County west of Crab Orchard Mountains. Exposed on Pigeon Ridge Road, northwest of Byrd Creek, near Cumberland Homesteads CCC camp, about 6 miles south of Crossville.

Crab Orchard Mountains Formation

Crab Orchard Mountains Group

Lower 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, 4, pls. 3, 4, 6. Includes all strata from top of Gizzard group to base of Crooked Fork group (new). At type section, approximately 640 feet thick; 300 feet in vicinity of Jamestown; 900 feet along eastern edge of Walden Ridge. Includes (ascending) Sewanee conglomerate, Whitewell shale, Newton sandstone, Vandever formation, and Rockcastle conglomerate.

U.S. Geological Survey currently classifies the Crab Orchard Mountains as a formation on the basis of a study now in progress.

Type section: (Composite) along U.S. Highway 70N and the tracks of the Tennessee Central Railway Company where they cut across the Crab Orchard Mountains of Cumberland County.

Crack Canyon Formation

Upper Jurassic[?] or Cretaceous[?]: Northern California.

J. E. Lawton, 1956, Dissert. Abs., v. 16, no. 10, p. 1885. Listed as underlying Little Valley formation (new) and overlying Sulfur Creek formation (new). Comprises Grizzly Creek member above and Blue Ridge member (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.

Craddock Clay Member (of Harpersville Formation)

Pennsylvanian (Cisco): North-central Texas.

F. B. Plummer and H. B. Bradley, 1949, Texas Univ. Bur. Econ. Geology Pub. 4915, p. 21–23, pl. 3. Black or very dark gray hard compact joint clay weathering gray and in most places oxidizing upon exposure to pink, red, or maroon. Average thickness about 8 feet. Occurs as an under clay just below the Newcastle coal bed, which is below Belknap limestone. [Member of Harpersville formation.]

Named from the Craddock Farm and Craddock Lake, 1 mile northwest of Cisco, Eastland County.

Craftsbury 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 Craftsbury Township or one of villages of that name within that Township, in unnamed quadrangle in southern part of Orleans County.

Craggy Gneiss[1]

Triassic to Cretaceous: Southwestern Oregon.

Original reference: G. M. Butler and G. J. Mitchell, 1916, Min. Res. Oregon, v. 2, no. 2.

Hewitt Wilson and R. C. Treasher, 1938, Oregon Dept. Geology and Mineral Industries Bull. 6, p. 11 (fig. 3). Triassic to Cretaceous.

Composes West Craggy, Curry County.

†Craghead Creek Shale[1]

Upper Devonian: North-central Missouri.

Original reference: D. K. Greger, 1909, Am. Jour. Sci., 4th, v. 27, p. 375.

Named for Craghead Creek, 6 miles south of Fulton, Callaway County.

Crag Mountain Formation

Middle Paleozoic: North-central Massachusetts.

Robert Balk, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–92; Map GQ–93. Name proposed for formation consisting of four unnamed members.

Basal member is coarse-grained white or yellowish hard glassy quartzite; locally conglomeratic, containing abundant quartz pebbles and fragments of black cherty rocks and schist. The quartzite is irregularly distributed along the borders of the formation and is overlain by and locally interbedded with mica schist. Mica schist member is typically dark-gray, silvery, or black lustrous phyllitic schist; beds are isoclinally folded. Metagraywacke member overlying the mica schist is a succsesion of thick-bedded gray or greenish rocks; quartzose beds are separated by thin chloritic phyllite, fine-grained dark-green amphibolite, or by layers composed of quartz, garnet, epidote, hornblende and chlorite. Youngest member is a dark-green or greenish-gray well-foliated amphibolite; thin veins of quartz, albite, and epidote are common. Base of amphibolite member generally rests conformably on metagraywacke; locally, lenses of one occur in the other. This amphibolite occurring near village of Erving in the Millers Falls quadrangle was called Erving hornblende schist by Emerson (1917). Quartzite member overlies Poplar Mountain gneiss on west slopes of Brush and Crag Mountains.

Named for Crag Mountain in south-central part of Massachusetts part of the Northfield quadrangle, Massachusetts-New Hampshire-Vermont.

Craig Limestone Member (of Rogersville Shale)

Middle Cambrian: Eastern Tennessee.

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. Named on map legend.

John Rodgers and D. F. Kent, 1948, Tennessee Div. Geology Bull. 55, p. 10–11. Formally proposed for members near top of Rogersville. Thickness at Craig quarry 85 feet; here member is separated from overlying Maryville limestone by 17 feet of green shale; in general, member thins to west and northwest and thickens to east and southeast; a few miles east-northeast of Lee Valley section, overlying shale thins to disappearance, and the Craig merges with the lithologically similar Maryville. Name credited to Josiah Bridge.

Named from Craig quarry in southern part of village of Rutledge, Grainger County. Quarry is about 0.15 mile south of junction of U.S. Highway 11W and State Highway 92, near sharp turn of latter.

Craig Shale[1]

Pennsylvanian: North-central Oklahoma.

Original reference: G. C. Clark and C. L. Cooper, 1927, Oklahoma Geol. Survey Bull. 40H, fig. 3.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 100. Abandoned by Oklahoma Geological Survey. Approximates pre-Warner Pennsylvanian in Craig County.

Craigsville Limestone[1]

Lower Devonian: Central western Virginia.

Original reference: R. J. Holden, 1920, Geol. Soc. America Bull., v. 31, p. 137.

Probably named for Craigsville, Augusta County.

†Crainesville horizon (in Midway Group)[1]

Eocene, lower: Southwestern Tennessee and northeastern Mississippi.

Original reference: G. D. Harris, 1896, Bulls. Am. Paleontology, v. 1, no. 4, p. 18–25.

Exposed in vicinity of Crainesville, Hardeman County, Tenn., and also identified in northern Mississippi.

Cramer Limestone Member (of Modesto Formation)

Pennsylvanian: Western and northern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 38, 49 (table 1), pl. 1. Proposed for unit formerly called Trivoli limestone. Name Turner limestone, informally used in northern Illinois, is discontinued because it is believed to be equivalent to the Cramer. Stratigraphically above Chapel (No. 8) 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: SW¼ sec. 3, T. 8 N., R. 5 E., Peoria County. Named for village of Cramer about 1⅓ miles southwest of type locality.

Cram Hill Formation

Middle Ordovician: Central Vermont.

L. W. Currier and R. H. Jahns, 1941, Geol. Soc. America Bull., v. 52, no. 9, p. 1492, 1493–1496. Gray to black slate and phyllite grading downward into quartz-chlorite-sericite schist; thin to massive quartzite beds at bottom, herein named Harlow Bridge quartzite member. Siliceous volcanics at top; greenstone dikes locally abundant. Thickness from 1,500 to 2,600 feet. Underlies Shaw Mountain formation (new); overlies unnamed Ordovician(?) schists. Equivalent to upper part of "Missisquoi" schists of Richardson (1919).

P. H. Osberg, 1952, Vermont Geol. Survey Bull. 5, p. 116. Lower Cambrian to Lower Ordovician.

W. M. Cady, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–79. Subdivision of the Missisquoi group of Richardson (1924, Vermont State Geologist Rept. 1923–1924).

Named for and well exposed on east slope of Cram Hill 3½ miles south-southeast of Roxbury, Barre quadrangle. Traced from Randolph about 27 miles north to point 2½ miles north of Montpelier.

Cranberry Gneiss

Cranberry Granite[1]

Cranberry Granite Gneiss

Precambrian: Western North Carolina and eastern Tennessee.

Original reference: A. Keith, 1903, U.S. Geol. Survey Geol. Atlas, Folio 90, p. 3.

J. L. Stuckey and S. G. Conrad, 1958, North Carolina Div. Mineral Resources Bull. 71, p. 17–18; J. L. Stuckey, 1958, Geologic map of North Carolina (1:500,000): North Carolina Div. Mineral Resources. As mapped, Cranberry granite gneiss consists essentially of Cranberry granite as named by Keith (1903) and further described by him [see bibliography of this reference]. Keith considered the Cranberry granite as igneous in origin, Archean in age, and intrusive into older formations. As considered here, the unit, whatever its origin, is essentially gneiss which grades at places into schist. Near Linville Falls, McDowell

County, it is in contact with Henderson granite gneiss, and the two units are considered to be stratigraphically equivalent. Precambrian(?).

Named for development at Cranberry in Mitchell, now Avery County, N.C. In North Carolina, occurs as strips and patches in the mountain region along northwestern border of State from near Asheville to Virginia line.

Cranberry Island Series[1]

Cranberry Island volcanic facies (of Frenchmans Bay Series)

Silurian: Southeastern Maine.

Original reference: N. S. Shaler, 1889, U.S. Geol. Survey 8th Ann. Rept., pt. 2, p. 1037, 1042–1047, 1059, 1061, and map.

G. H. Chadwick, 1942, (abs.) Geol. Soc. America Bull., v. 53, no. 12, pt. 2, p. 1797. Considered a facies of the Frenchmans Bay series (new). Interfingers with and is of same age as Bar Harbor detrital facies. Silurian.

G. H. Chadwick, 1944, New York Acad. Sci. Trans., ser. 2, v. 6, no. 6, p. 173. Volcanic facies consists of felsite (and porphyry) flows and ash beds with tuffs and amygdaloids. Developed extensively in the southern part of Mount Desert Island.

C. A. Chapman and P. S. Wingard, 1958, Geol. Soc. America Bull., v. 69, no. 9, p. 1194 (table 1). Middle or Upper Silurian.

Named for development in Great Cranberry and Little Cranberry Islands, south of Mount Desert Island, Hancock County.

Crandall Conglomerate

Eocene: Northwestern Wyoming.

W. G. Pierce, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 4, p. 592–593 (fig. 1), 609–613. Stream-channel deposit of coarse conglomerate. At northwestern end of deposits the Crandall rests on Upper Cambrian; just south of Squaw Creek, conglomerate in middle part of channel rests on Pilgrim limestone, and toward sides of channel contact rises stratigraphically until conglomerate rests on Grove Creek formation. South of Squaw Creek, maximum thickness about 350 feet.

Type locality: South side of Squaw Creek about 2 miles above its junction with Clarks Fork, Park County. Fourteen areas of outcrop are spread over a linear distance of 20 miles.

Crane Member (of Mount Simon Formation)

Upper Cambrian: Northern Illinois (subsurface).

J. S. Templeton, Jr., 1950, Illinois Acad. Sci. Trans., v. 43 p. 153 (fig. 2), 154. Name proposed for the relatively fine-grained basal member of the formation. Type section extends from depths of 3,105 to 3,845 feet. Thickness 620 to 740 feet. Overlies a 245-foot arkosic zone above Precambrian granite; underlies Kenyon member (new).

Type well: Wyman No. 1 (well 7), in NE¼NE¼SE¼ sec. 35, T. 41 N., R. 5 E., DeKalb County. Name derived from Crane School, 4 miles south of type well.

Crane Creek Gravel

Pleistocene (Yarmouth): Northeastern Montana and northwestern North Dakota.

A. D. Howard, 1958, Geol. Soc. America Bull., v. 69, no. 5, p. 580–581. Characterized by distinctive brown water-worn pebbles. Contains many glacial pebbles of northeastern origin. Caps a broad strath terrace, the Crane terrace, within the major valleys.

A. D. Howard, 1960, U. S. Geol. Survey Prof. Paper 326, p. 19 (table 3), 20 (fig. 9), 21–23, pl. 1. Gravel and interbedded sand on Missouri Plateau peneplain. Thickness about 30 feet; average 10 to 15 feet. Similar to older and higher Flaxville and Cartwright gravels.

Named after Crane Creek, a tributary of the Yellowstone River near town of Crane in southern Richland County, Mont.

Cranesville Dolomite or Formation

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

D. W. Fisher, 1954, Geol. Soc. America Bull., v. 65, no. 1, p. 76 (fig. 2), 77, 92–93. Name proposed for thin- to thick-bedded grayish-brown dolomites alternating with sandy and silty dolomites and dolomitic siltstone. Thin seams of sandy shale rare. Basal stratum invariably a feldspathic sandstone (or subgraywacke). Lower part of formation coarse-grained blue-gray variegated silty dolomite. Upper part characterized by coarse light-tan dolomarenites and dolomitic siltstone. Maximum thickness 70 feet; thins rapidly eastward and westward. Unconformably overlies Chuctanunda Creek dolomite (new).

Type locality: Along Swartztown Creek 0.6 mile east of Cushing quarry which is just east of the Niagara-Mohawk power station at Cranesville, Montgomery County.

Cranktown Sandstone[1]

Tertiary: New Mexico.

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

Named for exposures at a small group of prospectors' cabins, locally called Cranktown, on Silver Creek about 1 mile below Mogollon, Catron County.

Cranston Beds[1]

Pennsylvanian: Eastern Rhode Island.

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

Occur in southwestern part of Cranston Township, Providence County.

Crater Creek Basalt

Pleistocene or Recent: Southwestern Alaska.

F. M. Byers, Jr., and others, 1947, U.S. Geol. Survey Alaskan Volcano Inv. Rept. 2, pt. 3, p. 25–26, pl. 3. Series of basalt flows with beds of tuff and tuff-breccia, the products of explosive eruptions, making up small part of unit. Most flows massive, but a few blocky and brecciated. Top and bottom of individual flows commonly flow breccias, 5 to 20 feet thick, consisting of red oxidized lava fragments. Individual basalt flows from 10 to 70 feet thick. Flow rocks are fine-grained basalt containing few or no phenocrysts. Youngest flows display well-developed flow structure. Tuff and tuff-breccia are medium gray on fresh surfaces and weather light reddish yellow. Maximum thickness 1,300 feet. Basalt thickens away from Okmok caldera in northern part of mapped area, indicating that many flows probably emitted from vents well down the flanks of Mount Okmok. Overlies Tulik and Ashishik basalts (new); underlies Tanak volcanics (new). Mapped as Tertiary and Quaternary.

F. M. Byers, Jr., 1959, U.S. Geol. Survey Bull. 1028–L, p. 313–314, pl. 41. Youngest unit of precaldera age. Originally defined to include uppermost aphyric basalt flows on outer slopes of Okmok Volcano, but is herein restricted to sequence of basalt flows exposed in Crater Creek Gorge and in north wall of Okmok Caldera to west. Fault separates the Crater Creek in north wall from Ashishik basalt where north arcuate ridge intersects Okmok Caldera. Separated from Ashishik basalt by erosional surface. Consists of at least 15 separate flows with total exposed thickness of 500 feet. Older than Okmok volcanics. Latest Pleistocene or early Recent.

Crater Creek Gorge, on north wall of Okmok Caldera, Umnak Island.

Crater Lake dacites, lavas, flows, series.

General terms applied to rocks of Crater Lake region.

Crater Lake Pumice.

Pleistocene to Recent: Southwestern Oregon.

Howel Williams, 1942, Carnegie Inst. Washington Pub. 540, p. 68–98, 115. Map shows distribution and thickness of Crater Lake pumice. The pumice is of two kinds, pumice flows and pumice fall. Main pumice fall was part of culminating activity of Mount Mazama. Finely divided dacite pumice which was projected high above summit of volcano drifted afar and was winnowed by winds. Earlier pumice fall was followed by explosions in which pumice escaped from crater in too large a volume and too rapidly to be thrown far into air but fell en masse on upper slopes of volcano and swept downward into the canyons and across surrounding flats as glowing avalanches. Some of these flows are: Annie Creek, Sun Creek, Sand Creek, Rogue River, and Castle Creek.

I. S. Allison, 1945, Geol. Soc. America Bull., v. 56, no. 8, p. 789–808. Discussion of pumice beds at Summer Lake, Oreg. Here, section shows six beds of pumice. Four of these appear to record eruptions of Mount Mazama. On basis of lacustrine sedimentation, the first layer of Mount Mazama pumice would be a little more than 14,000 years old, and age of main Crater Lake pumice layer about 500 years less than that. These are older than eruption of Newberry pumice.

H. P. Hansen, 1946, Am. Jour. Sci., v. 244, no. 10, p. 710–734. Discussion of postglacial succession and climate in Oregon Cascades. Figure 1 is map showing distribution of Mount Mazama pumice. [This is adapted from Williams' (1942) map (fig. 16) which shows distribution and thickness of Crater Lake pumice.]

Covers area around Crater Lake.

Crater Peak Basalt Flow

Pleistocene to Recent: Southwestern Oregon.

J. S. Diller and H. B. Patton, 1902, U.S. Geol. Survey Prof. Paper 3, p. 33–34. Name applied to basalt flow on Crater Peak. [See Timber Crater Basalt Flow].

Crater Peak is south of Crater Lake.

Cravatt Formation (in Kite Group)

Cravatt Member (of Bois d'Arc Limestone)

Silurian and Devonian: South-central Oklahoma.

R. A. Maxwell, 1936, Northwestern Univ. Summ. of Doctoral Dissert., v. 4, p. 132, 134. Defined as upper part of Kite group (new). Consists of hard cherty lithographic and argillaceous limestones and slates. Average thickness 60 to 75 feet. Conformably underlies Bois d'Arc limestone; conformably, overlies Haragan formation.

T. W. Amsden, 1957, Oklahoma Geol. Survey Circ. 44, p. 4 (fig. 3), 7, 41–45, fig. 4. Rank reduced to member of Bois d'Arc formation. Overlies Haragan formation; base of Cravatt arbitrarily placed at base of lowest cherty bed of any appreciable thickness. Underlies Fittstown member (new) of Bois d'Arc limestone. Silurian and Devonian. Type locality given.

Type locality: NE¼SW¼SW¼ sec. 2, T. 2 S., R. 7 E., Pontotoc County. Name taken from original allotment owner, Katy Cravatt.

Crawford Series[1] or Subseries[1]

Mississippian: Northwestern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 40–46.

†Crawford Shale[1]

Devonian(?) and Mississippian: Northwestern Pennsylvania.

Original reference: J. F. Carll, 1879, Pennsylvania 2d Geol. Survey Rept. I_3 Atlas, pl. 11.

Named for occurrence in Crawford County.

Crazy Hollow Formation

Eocene, upper, or Oligocene, lower: Central Utah.

E. M. Spieker, 1949, Utah Geol. Soc. Guidebook 4, p. 36–37, [pl. 1]. Red and orange sandstone, siltstone, and shale, white sandstone, and pepper-and-salt sandstone. Thickness about 600 feet in Crazy Hollow. Overlies Green River formation and underlies Gray Gulch formation (new) with disconformable contacts. Age not known, but probably Eocene and may be late Eocene.

W. N. Gilliland, 1952, American Assoc. Petroleum Geologists Bull., v. 36, no. 7, p. 1461, 1464. Of late Eocene or early Oligocene age.

C. T. Hardy, 1952, Utah Geol. and Mineralog. Survey Bull. 43, p. 41 (table 1). Eocene.

Type locality: In Crazy Hollow, where it forms lower walls of the gulch beginning a short distance above its mouth and is more completely exposed than anywhere else as far as known. Crazy Hollow gulch is on south side of Salina Canyon next west of mouth of Soldier Canyon, about 2½ miles from Salina [Sevier County].

Crazy Johnson Member (of Chadron Formation)

Oligocene, lower: Southwestern South Dakota.

John Clark, 1954, Carnegie Mus. Annals, v. 33, art. 11, p. 197. Designated as middle member of formation. Underlies Peanut Peak member (new); overlies Ahearn member (new). Author previously described unit as "Middle Member" of Chadron.

Type locality: At standard section of Chadron formation in Big Badlands on south fork of Indian Creek, Pennington County, from sec. 34, T. 3 S.,

R. 12 E., to sec. 10, T. 4 S., R. 12 E. Named from prominent butte in southern part of sec. 10, T. 4 S., R. 12 E.

†Crazy Mountain Beds[1]

Upper Cretaceous and Paleocene: Montana.

Original reference: G. H. Eldridge, 1886, U.S. Tenth Census, v. 15, maps 50 to 54.

In Crazy Mountains, Little Belt Mountains quadrangle.

Crazy Mountain Granite[1]

Eocene: Central southern Montana.

Original reference: W. H. Weed, 1899, U.S. Geol. Survey Geol. Atlas, Folio 56.

Occurs over considerable area in Crazy Mountains, Little Belt Mountains quadrangle.

Creal Springs Limestone Member (of Spoon Formation)

Pennsylvanian: Southeastern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 32–33, 45 (table 1), 65, pl. 1. Proposed for limestone previously correlated with Curlew limestone but now considered to be younger. Weathers reddish buff, dense, hard, fossiliferous; thins to north. Thickness about 1½ feet. Stratigraphically above Granger sandstone member (new) and below Mount Rorah 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: NE¼SE¼SE¼ sec. 25, T. 10 S., R. 3 E., Williamson County. Exposed just above top of sandstone quarried east of Creal Springs.

Creal Springs Sandstone (in Tradewater Group)

Pennsylvanian: Southern Illinois.

W. H. Smith, 1957, Illinois Geol. Survey Circ. 228, p. 8 (fig. 2), 9. Sandstone overlying Upper New Burnside coal and immediately underlying Curlew limestone. Name credited to P. E. Potter (1957, unpub. ms.).

Exposed in vicinity of Creal Springs, T. 10 S., R. 3 E., Johnson County.

Creede Formation[1]

Tertiary, middle or upper: 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. 13, 167–172, pl. 1. Comprises two members: lower, made up entirely of fragmental material, greater part of which was deposited by water; much of material is thinly laminated white shaly tuff, part is sandy and part is breccia and conglomerate; interbedded with tuff of lower member are beds of travertine; upper member coarser than lower member and made up mainly of well-bedded breccia. No satisfactory estimate of thickness made; structure is uncertain; top of formation nowhere preserved; and base exposed only on steep sides of basin. About 500 feet of lower member exposed on both sides of Willow Creek below Creede; neither top nor base shown; east of

Creede, where top of lower member is preserved, about 900 feet are present; about 1,000 feet of upper member exposed east of Windy Gulch. Cut by and underlies Fisher quartz latite. Overlies Potosi volcanic series (Piedra rhyolite). Upper Miocene.

U.S. Geological Survey tentatively considers the Creede formation to be middle or late Tertiary in age.

Named for development on slopes of both sides of Willow Creek about town of Creede, Mineral County.

Crekola 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.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 52–53. Bedded brownish sandstone, 4 to 10 feet thick. Lies about 10 feet below Inola limestone and about 6 feet above Secor or Upper Witteville coal.

Named for village of Crekola, in E½ sec. 10, T. 14 N., R. 17 E., Muskogee County.

Creola Member (of Yegua Formation)

Eocene (Claiborne): Central Louisiana, eastern Mississippi, and eastern Texas.

H. B. Stenzel, 1939, Texas Univ. Bur. Econ. Geology Pub. 3945, pt. 2, p. 879 (fig. 133), 881. Name applied to beds of upper Yegua which contain unmistakable marine indicators, such as marine fossils, glauconite, limestone layers, or fucoids. This part of the Yegua has been referred to as a "transition zone" between the typical Yegua and typical Jackson. Thickness varies from 10 feet at Garland's Creek, Clarke County, Miss., to 40 feet at Pineland, Tex.; at type locality 32.4 feet. Bounded at top by a widespread clear-cut sharp disconformity on which the lower Jackson rests; at base, grades into typical nonmarine Yegua beds; west of Pineland, Creola outcrops become more and more nonmarine and fade into uppermost Yegua beds.

Type locality: Creole Bluff, near Montgomery, Grand Parish, La. Old town of Creola was built on the bluff in 1850.

Cresaptown Iron Sandstone[1] (in Rose Hill Formation)

Cresaptown Sandstone Member (of Clinton Shale)

Silurian (Niagaran): Western Maryland.

Original reference: C. K. Swartz, 1923, Maryland Geol. Survey, Silurian Volume, p. 28–31.

Ernst Cloos, 1951, Maryland Dept. Geology, Mines and Water Resources Washington County [Rept. 14], p. 73. Referred to as Cresaptown iron sandstone member of Clinton shale or formation.

Well exposed at Cresaptown 6 miles southwest of Cumberland, Allegany County.

Crescent Formation[1]

Eocene, lower(?) and middle: 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. 25 (table), 40–45. At time of first investigation, the occurrence of Metchosin volcanics on Vancouver Island was unknown, and stratigraphic and structural relationships of the lavas and tuff at Crescent Bay to those along north side of Lake Crescent were not understood; in original description, these basaltic lavas together with the water-laid tuff were considered as a single formation. Recent studies indicate that the marine tuffs, shales, and sandstones which rest stratigraphically upon strictly volcanic part of formation and beneath Lyre conglomerates (new) should be segregated. Contact between underlying lava flows referred to as Metchosin volcanics and overlying marine phase in which volcanic products are mainly represented by tuffs is sharp and clearly defined. It is proposed to include within Crescent formation these upper tuffs and sedimentary deposits. Thickness about 1,000 feet. Includes Boundary shale (new) in uppermost part. Unit confined to northern border of Olympic Peninsula where it is represented in northern and southern limbs of Clallam syncline.

R. D. Brown, Jr., H. D. Gower, and P. D. Snavely, Jr., 1960, U.S. Geol. Survey Oil and Gas Inv. Map OM–203. As used in this report [Port Angeles-Lake Crescent area], name Crescent formation is extended to include entire sequence of volcanic rocks of which Arnold's type locality is small but generally typical part. Volcanic rocks of formation form belt from 2 to 5 miles wide, trending about N. 80° W., that extends from near Mount Muller southeastward to Round Mountain and form high ridges along south limb of Clallam syncline. Thickness difficult to estimate; more than 10,000 feet near east end of Lake Crescent. Underlies and interfingers with Aldwell formation (new). Overlies and interfingers with argillite and graywacke. Middle and possibly early Eocene.

Named for occurrence in vicinity of Port Crescent.

Crescent City Beds[1]

Crescent City facies (of St. George Formation)[1]

Miocene and Pliocene: Northwestern California.

Original reference: J. S. Diller, 1902, U.S. Geol. Survey Bull. 196, p. 31–35.

William Back, 1957, U.S. Geol. Survey Water-Supply Paper 1254, p. 21. Facies of St. George Formation. Outcrop of Crescent City beds no longer above sand and water level.

Occurs from Smith River to 3 miles south of Crescent City, Del Norte County.

Crescent Cliffs Flow, Lava, Dacite

Cenozoic: Northern California.

Howel Williams, 1932, California Univ. Pub., Bull. Dept. Geol. Sci., v. 21, no. 8, p. 309–310, geol. map. Discussed under general heading pre-Lassen dacite flows which include Manzanita dacites, Loomis Peak flow, Black Butte flow, and other similar units.

Mapped in vicinity of Crescent Cliffs on western side of Mount Lassen.

Crescent Crater Dacites[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. 675. Cenozoic.

Occur in Lassen National Park.

Crescent Hill Basalt

Miocene and (or) Pliocene: Northwestern Wyoming.

A. D. Howard, 1937, Geol. Soc. America Spec. Paper 6, p. 17–19, 78 (table 9), pl. 4. Coarse olivine basalt. Much of the olivine has changed to serpentine, and much of the pyroxene to uralite. Varies from brown to gray, although some exposures are colored brilliant red or yellow by surface growths of minute plants. Rock is massive to platy Platy character due to closely spaced shear surfaces. Most fractures are healed with silica, which also forms regular and irregular nodules and geodes many of which contain well-developed quartz crystals. Black color of fresh surfaces and coarse texture are in contrast to color and texture of Geode Creek basalt (new). Maximum thickness of 60 to 80 feet.

Typically exposed on summit of Crescent Hill from which it takes its name; Yellowstone National Park.

Cresswell Limestone Member (of Winfield Limestone)

Cresswell 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. 51.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 44. Consists of limestone and locally shale in upper and middle parts and massive fossiliferous limestone in lower part; upper part, which has been called "Luta limestone" is thinner bedded and more shaly. Throughout a considerable distance, the lower massive ledge is almost constantly 3 feet thick. Total thickness of member commonly about 17 feet. Overlies Grant shale member; underlies Odell shale. Wolfcamp series.

Type locality: East side of golf course, in NE¼ sec. 18, T. 34 S., R. 4 E., on north side of Arkansas City, Cowley County, Kans.

Crest Hill Granite

Precambrian: Northern Virginia.

L. R. Thiesmeyer, 1938, (abs.) Geol. Soc. America Bull., v. 49, no. 12, pt. 2, p. 1963. Four major Precambrian granitic bodies, representing extensive batholiths of the western Piedmont, have been delineated; in order of intrusion, these are Lovingston gneiss, hypersthene granodiorite, Crest Hill granite, and Marshall granite (redefined).

Occurs in western Piedmont in Fauquier County.

Creston Formation

Creston Quartzite[1]

Precambrian (Belt Series): Northwestern Montana and northern Idaho, and southeastern British Columbia, Canada.

Original references: R. A. Daly, 1905, Canada Geol. Survey Summ. Rept. 1904, p. 96–100; 1905, Am. Jour. Sci., 4th ser., v. 20, p. 186.

C. P. Ross and J. D. Forrester, 1958, Idaho Bur. Mines and Geology Bull. 15, p. 6 (fig. 4). Formation shown on correlation chart for the Belt series in northern Idaho.

Named for station on Canadian Pacific Railway (in Kootenay Province, southeastern British Columbia). Occurs at international boundary, 49th parallel, in section from Port Hill, Idaho, to Gateway, Mont.

Creston [Formation]

Eocene, upper: California.

O. P. Jenkins, 1938, Geologic map of California (1:500,000): California Div. Mines, sheet 4. Shown on map legend.

Creston Red Shale

Creston Shale (in Washington Formation)[1]

Permian (Dunkard Series): Western West Virginia and southeastern Ohio.

Original reference: R. V. Hennen, 1911, West Virginia Geol. Survey Rept. Wirt, Roane, and Calhoun Counties, p. 154.

J. B. McCue and others, 1948, West Virginia Geol. Survey [Rept.], v. 18, p. 9. Creston red shale, maximum thickness 60 feet, occurs between upper and lower Marietta sandstones, about 300 feet above base of Dunkard series. Commonly contains limestone nodules and locally interstratified with sandstone.

R. L. Nace and P. P. Bieber, 1958, West Virginia Geol. Survey Bull. 14, p. 18 (table 2). Creston shale, in Washington formation, listed in stratigraphic summary of Dunkard group in Harrison County. Thickness 30 to 65 feet. Above Middle Washington limestone and below Washington "A" coal and (or) fire clay and black carbonaceous shale.

Named for occurrence at Creston Flats, 1 mile east of Creston, Wirt County, W. Va.

Crestone Conglomerate Member (of Maroon Formation)

Crestone Conglomerate Member (of Sangre de Cristo Formation)

Crestone conglomerate phase[1] (of upper Sangre de Cristo Conglomerate)

Pennsylvanian or Permian: Southern central Colorado.

Original reference: F. A. Melton, 1925, Jour. Geology, v. 33, p. 812.

John Chronic, 1958, Rocky Mountain Assoc. Geologists Symposium on Pennsylvanian rocks of Colorado and adjacent areas, p. 63. Proposed that name Sangre de Cristo be dropped and that prior name Maroon be applied to equivalent coarse redbeds, at least as far south as La Veta Pass. Conglomeratic unit in upper part of formation is about 6,000 feet thick in vicinity of Crestone, where it has been called Crestone conglomerate "phase," more appropriately member, of Sangre de Cristo formation (now Maroon formation). Very local in occurrence, disappearing both southward and northward within a distance of about 10 miles.

D. W. Bolyard, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 1903 (fig. 5), 1923, 1924–1925, 1933. Referred to as member of Sangre de Cristo formation. Overlies lower unnamed member. Formation considered to be late Pennsylvanian(?) and probably Permian (Wolfcamp).

Well exposed near Crestone, Sangre de Cristo Range.

Creta Dolomite (in Blaine Formation)[1]

Permian: Southwestern Oklahoma.

Original reference: G. G. Suffel, 1930, Oklahoma Geol. Survey Bull. 49, p. 29–40, 42, 47, 48, 63.

Named for station of Creta, in western part of Jackson County.

Crete Formation

Crete Formation (in Sanborn Group)

Crete Member (of Sanborn Formation)

Pleistocene: Nebraska and Kansas.

G. E. Condra, E. C. Reed, and E. D. Gordon, 1947, Nebraska Geol. Survey Bull. 15, p. 24–25 Name applied to unit which Lugn (1935) [1934] classified as "valley phase" of Loveland formation. A channel fill deposit which rests unconformably upon Upland formation or older Pleistocene deposits and is believed to be Illinois in age. Consists of sand, light-pinkish-brown in upper part, brownish-gray in middle, light-brownish-gray in lower part; grading from medium- to coarse-grained sand with fairly common fine to medium gravel in lower part, to fine to medium sand with rare fine gravel and fairly common silt in upper part; thin zone (1 to 2 inches) of red-brown iron-stained sand at base. Thickness 8 to 9½ feet. At type locality, underlies Loveland formation.

J. C. Frye and A. B. Leonard, 1949, Kansas Geol. Survey Bull. 81, p. 42–43; 1952, Kansas Geol. Survey Bull. 99, p. 52 (fig. 2), 110–115. Extended into Kansas where it is basal member of Sanborn formation. Underlies Loveland member.

G. E. Condra and E. C. Reed, 1950, Nebraska Geol. Survey Bull. 15–A, p. 24–25. Overlies Sappa formation which name replaces Upland formation of Lugn.

C. W. Hibbard, 1958, Am. Jour. Sci., v. 256, p. 55 (fig. 1). Formation at base of Sanborn group.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. Shown on correlation chart as Crete formation. [Kansas does not use term Sanborn group.]

Type locality: In roadcuts along State Highway 33 about 1½ miles west of main intersection at Crete, Saline County, Nebr., in NE¼ sec. 32, T. 8 N., R. 4 E.

Crevasse Canyon Formation (in Mesaverde Group)

Upper Cretaceous: Northwestern New Mexico.

J. E. Allen and Robert Balk, 1954, New Mexico Bur. Mines Mineral Resources Bull. 36, p. 91–92, pls. 1, 11. Name applied to sedimentary units which lie between top of Gallup sandstone and base of Point Lookout sandstone. Thickness 420 to 620 feet in northern sections; thickens to south of Crevasse Canyon, as it replaces rapidly thinning Point Lookout, to about 700 feet at type section. Includes three members: Dilco, Dalton sandstone (tongue), and lower Gibson.

E. C. Beaumont, C. H. Dane, and J. D. Sears, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2149, 2156–2157. In revised nomenclature of Mesaverde group in San Juan Basin, Crevasse Canyon formation is accepted for that part of group between Gallup and Point Lookout sandstones, with Gibson coal member (restricted) at its top; also includes Dilco coal, Dalton sandstone, and Bartlett barren members. For purposes of New Mexico State geologic map and other regional geologic maps now in preparation, contact between Crevasse Canyon and Menefee formations is arbitrarily shown at top of undivided Gibson and Cleary coal members in area of outcrop in which Point Lookout sandstone is missing.

C. H. Dane, A. A. Wanek, and J. B. Reeside, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 2, p. 181, 188 (fig. 2), 191, 195. Winchester's (1920) Bell Mountain sandstone member at top of his Miguel formation in Alamosa Creek Valley area, Socorro and Catron Counties, is upfaulted duplication of his Gallego sandstone member, from which it had been supposed to be separated by nearly 1,000 feet of beds. Winchester's names Miguel formation, Chamiso formation, and Bell Mountain sandstone are abandoned and stratigraphic names in use in San Juan Basin are extended to units recognized in Alamosa Creek area. Winchester's Chamiso formation was properly defined and as it included only that part of the Mesaverde rocks above his Bell Mountain sandstone, it was not involved in duplication of section that requires abandonment of Miguel formation. Most of it, however, represents the Crevasse Canyon formation, including Dilco coal member at base and representatives or equivalents of Mulatto tongue of Mancos, overlying Dalton sandstone member, and Gibson coal member. Chamiso is abandoned in favor of Crevasse Canyon for Alamosa Creek area even though overlying Point Lookout sandstone or its equivalent has not been positively identified.

W. H. Tonking, 1957, New Mexico Bur. Mines Mineral Resources Bull. 41, p. 7 (fig. 2), 18, 20, 22, 23, pl. 1. In Puertecito quadrangle, overlies La Cruz Peak formation (new) and underlies Baca formation.

Type locality: Exposures north of Catron Creek, about 3 miles southwest of mouth of Crevasse Canyon, Tohatchi quadrangle.

Crill terrane[1]

Upper Cretaceous: Northwestern Iowa.

Original reference: C. R. Keyes, 1912, Iowa Acad. Sci. Proc., v. 19, p. 148, 150.

Named for old site of Crill mill, on Sioux River, Sioux City, Woodbury County.

Criner Formation[1]

Middle Ordovician: Central southern Oklahoma.

Original reference: E. O. Ulrich, 1930, U.S. Nat. Mus. Proc., v. 76, art. 21, p. 73.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 100. Abandoned by Oklahoma Geological Survey. Unit may be the Corbin Ranch formation of Harris (1957) and may include the Pooleville member of the Bromide formation (Cooper, 1956).

Named for exposures at south end of Criner Hills, south of Overbrook, Love County.

Crinerville Limestone (in Hoxbar Group)

Crinerville Limestone Member (of Hoxbar Formation)[1]

Pennsylvanian (Missouri Series): Southern Oklahoma.

Original reference: C. W. Tomlinson, 1928, Oklahoma Geol. Survey Bull. 40Z, p 15.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 37). Shown on chart as limestone in Hoxbar group.

C. W. Tomlinson and William McBee, Jr., 1959, *in* Ardmore Geol. Soc., Petroleum geology of southern Oklahoma—a symposium, v. 2: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 6 (fig. 2), 41–42. Crinerville beds (or member) of Hoxbar group comprise a basal buff sandstone, a calcareous shale, and a limestone at top, each with maximum thickness of at least 30 feet. Crinerville beds are 400 to 500 feet above base of Hoxbar group and 400 to 500 feet below Anadarche beds or member. Confederate limestone is at base of Hoxbar.

Type locality: Near center of W½ sec. 28, T. 5 S., R. 1 E., near Crinerville Schoolhouse, Carter County.

†Cripple Creek Breccia[1]

Tertiary: Central Colorado.

Original reference: W. Cross, 1896, Colorado Sci. Soc. Proc., v. 5, p. 30.

Cripple Creek district, Teller County.

Cripple Creek Granite[1]

Precambrian: Eastern Colorado.

Original reference: E. B. Mathews, 1900, Jour. Geology, v. 8, p. 214–240.

T. S. Lovering and E. N. Goddard, 1950, U.S. Geol. Survey Prof. Paper 223, p. 29. As used in this report, Cripple Creek granite of Pikes Peak quadrangle is included in Silver Plume granite.

Characteristically developed in area to west of line drawn from Lake George to town of Cripple Creek and thence in a somewhat sinuous line to waters of Oil Creek, Pikes Peak region.

Cripple Deer Sandstone Member (of Alsobrook Formation)[1]

Upper Mississippian: Northwestern Alabama and northeastern Mississippi.

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. Included in Tanyard Branch member of Pride Mountain formation (both new). Alsobrook stratigraphically restricted above and reduced to member status in Pride Mountain formation.

Type locality: Along highway on north side of Cripple Deer Valley, Colbert County, Ala.

Crisfield Sandstone Member (of Salt Plain Formation)

Permian: Southern Kansas.

G. H. Norton, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 12, p. 1788; R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, p. 159. Sandstone about 29 feet thick occurring about 115 feet below top of formation. Name credited to G. L. Knight.

Outcrops in Harper and Barber Counties.

Cristobal limestone[1]

Ordovician: Southern 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, 6.

In Franklin, Caballos, Fra Cristobal, and Mimbres Ranges.

Critzer Limestone[1] (in Swope Limestone)

Critzer Limestone Member (of Hertha Limestone)

Pennsylvanian (Missouri Series): Eastern Kansas and western Missouri.

Original references: J. M. Jewett, 1932, Kansas Geol. Soc. 6th Ann. Field Conf. Guidebook, p. 99, 100, 103; R. C. Moore, 1932, Kansas Geol. Soc. 6th Ann. Field Conf. Guidebook, p. 90, 97.

J. M. Jewett, 1940, Kansas Geol. Survey Bull. 30, p. 9. Reallocated to member status in Hertha limestone.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 11. The Hertha differs from previous usage of Missouri Survey by inclusion of Critzer limestone and Mound City shale members.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 90. Consists of massive brownish-gray granular partly algal limestone and thin wavy-bedded gray limestone. Thickness ranges from featheredge to about 11 feet. Basal member of Hertha. Underlies Mound City shale member; overlies Pleasanton group.

Type locality: In sec. 17, T. 22 S., R. 23 E., south of Critzer, Linn County, Kans.

Croasdale Quartzite[1]

Silurian: Northeastern Pennsylvania.

Original reference: A. W. Grabau, 1913, Geol. Soc. America Bull., v. 24, p. 479.

Kittatinny Valley, Delaware Water Gap region.

Croatan Sand[1]

Croatan Formation

Pliocene, lower: Eastern North Carolina.

Original reference: W. H. Dall, 1892, Wagner Free Inst. Sci. Trans., v. 3, pt. 2, p. 209, 213–216.

F. S. MacNeil, 1938, U.S. Geol. Survey Prof. Paper 189–A, p. 19. Croatan sand of U.S. Geological Survey usage is of Pliocene age. Dall's original material from "Croatan beds" is mixture of Pliocene and Pleistocene and was probably collected along river for a distance of several miles. No Pliocene is exposed in bluffs of Neuse River nearest Croatan itself, so that type section for Croatan sand cannot be recognized there. Best section of Pliocene in region is exposed on property of Mr. Hastings on right bank of Neuse River, 2 miles below James City, Craven County, and this might be regarded as type section of Croatan sand.

R. F. Flint, 1948, Geol. Soc. America Bull., v. 59, no. 6, p. 543. In places along coast from the Carolinas to Florida are marine deposits of undoubted Pliocene date, with faunas that imply relatively warm water temperatures. These include the Croatan, Waccamaw, Charlton, and Caloosahatchie formations.

Type section (MacNeil): On property of Mr. Hastings on right bank of Neuse River, 2 miles below James City, Craven County. Named for exposures around Croatan. near Neuse River, Craven County.

Crockett Formation (in Claiborne group)

Crockett Member (of Claiborne Formation)[1]

Eocene: Eastern Texas and northwestern Louisiana.

Original reference: A. C. Ellisor, 1929, Am. Assoc. Petroleum Geologists Bull., v. 13, p. 1339–1346.

H. B. Stenzel, 1938, Texas Univ. Bur. Econ. Geology Pub. 3818, p. 20 (table), 124–158 [1939]. Formation described in Leon County where it includes (ascending) Wheelock marl, Landrum shale, Spiller sand, and Mount Tabor members (all new). Overlies Stone City formation; underlies Yegua formation. Thickness about 385 feet. Middle Eocene.

H. B. Stenzel, 1939, Texas Univ. Bur. Econ Geology Pub. 3945, p. 847–904. Yegua-Crockett boundary discussed.

H. B. Stenzel, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 9, p. 1663. Crockett formation replaced by term Cook Mountain formation.

G. D. Harris, 1941, Texas Univ. Bur. Econ. Geology Mineral Resources Survey Circ. 33, p. 13–20. In Leon County, formation includes (ascending) Stone City, Wheelock, Two Mile (new), and [Mount] Tabor members.

Type locality: Vicinity of Crockett, Houston County, Tex.

Croghan Syenite Granite Complex[1]

Precambrian: Northwestern New York.

Original reference: A. F. Buddington, 1919, New York State Mus. Bull. 207, 208, p. 102–110, map.

Probably named for village of Croghan, Lewis County.

Croixan[1] or Croixian[1] Series
See **St. Croixan Series.**

Crook Formation

Upper Devonian: Central Arizona.

E. N. Harshman *in* M. N. Short and others, 1943, Arizona Bur. Mines Bull. 151, Geol. Ser. 16, p. 27. As originally described by Ransome, Martin limestone in Bisbee area contained a fauna similar to that of Hackberry shale of Iowa. Stoyanow noted that in Superior area a section of Upper Devonian limestone with interbedded clastic sediments is present below the true Martin limestone. These beds contain invertebrate fauna similar to that of Cedar Valley limestone. This lower part of Martin limestone section is here termed Crook formation.

Named after its locality in the Crook National Forest, Superior mining area.

Crooked Creek Chert Bed (in Cotter Dolomite)

Lower Ordovician: Northern Arkansas.

J. S. Cullison, 1944, Missouri Univ. School Mines and Metallurgy Bull., Tech. Ser., v. 15, no. 2, p. 35, pls. 2, 9. Interbedded chert and dolomite; chert is very dark bluish gray, almost black, and occurs in three layers. Occurs near top of lower half of formation and stratigraphically below Jenkins Branch chert bed (new).

Well exposed on Arkansas State Highway 101 just above the north approach to the bridge at Crooked Creek, 2½ miles southwest of Cotter, Baxter County.

Crooked Creek Formation

Lower Cretaceous: Central southern Montana and central northern Wyoming.

R. M. Moberly, Jr., 1958, Dissert. Abs., v. 18, no. 1, p. 198. Sandstones and thinly interbedded rusty-brown-weathering siltstones, dark shales, and ironstones. Disconformably overlies Lovell member (new) of Cloverly formation; gradationally underlies Thermopolis shale.

In Bighorn Basin.

Crooked Creek Formation (in Meade Group)

Pleistocene: Southwestern Kansas and northwestern Oklahoma.

C. W. Hibbard, 1949, Michigan Univ. Mus. Paleontology Contr., v. 7, no. 4, p. 69 (fig. 1), 70–73. Proposed for sediments laid down during cycle of deposition which followed Meade formation; includes the following succession (ascending): (1) sands and gravels, (2) silt, (3) Pearlette ash, and (4) overlying deposits up to and including a well-developed caliche; as thus defined, includes Stump Arroyo member (new) at base. Type locality for the Crooked Creek is the same locality that was designated by Frye and Hibbard (1941) as type locality of Meade formation; it is now known that beds to which Cragin (1896) applied name Meade formation do not occur in this sequence of Pleistocene deposits but belong to an older series of Pleistocene beds.

C. W. Hibbard, 1958, Am. Jour. Sci., v. 256, no. 1, p. 55 (fig. 1), 56, 57, 58. Top formation in Meade group. Comprises (ascending) Stump Arroyo member, Pearlette ash lentil, and Atwater member (new). Thickness as much as 60 feet. Overlies Ballard formation (new); underlies Kingsdown formation.

A. J. Myers, 1959, Oklahoma Geol. Survey Bull. 80, p. 57–58, pl. 2. Name Crooked Creek formation is applied in Harper County to gravels, sand, silt, and Pearlette volcanic ash lentils which unconformably overlie Ogalalla formation and Whitehorse group and are generally blanketed by post-Crooked Creek sand dune. Pearlette ash, which is only recognizable unit, forms a 13-foot lenticular bed in NW¼ sec. 10, T. 28 N., R. 26 W., but is absent elsewhere in county. Thickness 0 to 70 feet.

Type locality: S½ sec. 16, W½ sec. 15, and N½ sec. 21, T. 33 S., R. 28 W., on east side of Crooked Creek, Meade County, Kans.

Crooked Fork Group

Pennsylvanian (Pottsville Series): Eastern Tennessee.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [folio], p. 1, 6, pls. 3, 4, 6. Includes all strata between top of Crab Orchard Mountains group (new) and base of Slatestone group (new). Consists of alternating sequence of three sandstones and three shales. Northwest of type area, upper and lower sandstones converge so that in northern part of Barthell Southwest quadrangle group is essentially thick conglomerate overlying Rockcastle conglomerate. Thickness at type locality 360 feet; on Cumberland block 150 to 330 feet. Includes (ascending) Dorton shale (new), Crossville sandstone, Burnt Mill shale (new), Coalfield sandstone (new), Glenmary shale (new), and Wartburg sandstone. Rex coal present near base and Poplar Creek coal at top.

Type section: Southeastward from Wartburg and along Crooked Fork, Morgan County.

Crooked Lake Granite Pebble Conglomerates

Precambrian (Knife Lake Series): Northeastern Minnesota.

J. W. Gruner, 1941, Geol. Soc. America Bull., v. 52, no. 10, p. 1583 (table 1), 1615. Name applied to coarse granite pebble conglomerates that were deposited on the arkosites and graywackes which rest directly on the Saganaga granite. Some 12-inch Saganaga granite boulders are common in the middle or top of the conglomerate as well as at the bottom. Conglomerates reach a thickness of nearly three-fourths of a mile, or one-half that much where isoclinally folded over their width in sec. 36, T. 66 N., R. 6 W. Conglomerate is limited by a fault on western margin. In this report, Knife Lake series is divided into 20 members. Table of approximate chronological sequence (ascending) shows Crooked Lake conglomerate as unit 15 occurring above Ester Lake graywackes and below an unnamed lower slate pebble conglomerate.

Report covers a belt in eastern Vermilion district more or less parallel to international boundary.

Crooked River Formation[1]

Recent(?): Central northern Oregon.

Original reference: E. T. Hodge, 1927, Geol. Soc. America Bull., v. 38, p. 163.

Cascade Mountains.

Crooks Complex[1]

Precambrian: Central Arizona.

Original reference: T. A. Jaggard, Jr., and C. Palache, 1905, U.S. Geol. Survey Geol. Atlas, Folio 126.

Named for exposures in Crooks Canyon in northwestern part of Bradshaw Mountain quadrangle.

Cropsey Drift

Pleistocene (Wisconsin): Northern Illinois.

H. B. Willman and others, 1942, Illinois Geol. Survey Bull. 66, p. 145 (fig. 85), 146 (fig. 86), 159–161. Largely till, locally both overlain and underlain by outwash deposits of gravel and sand. Maximum thickness about 50 feet; commonly less than 15 feet. Overlies Bloomington drift; underlies Farm Ridge drift. [Report lists six drifts in the Tazewell; for sequence see under Shelbyville.]

Named for morainic ridge at Cropsey, McLean County.

Crosby Lentil (in Starkey Tongue of Sherburne Formation)

Crosby Sandstone[1] Member (of Standish Formation)

Upper Devonian: West-central New York.

Original reference: I. W. Fox, 1932, Am. Assoc. Petroleum Geologists Bull., v. 16, no. 7, p. 677, 681, 687.

P. D. Torrey and others, 1932, Am. Petroleum Inst. Div. Production Paper 826–4A, figs. 6, 7. Crosby sandstone in Standish shale and flags below Bluff Point flagstone.

W. L. Grossman, 1944, Geol. Soc. America Bull., v. 55, no. 1, p. 67, pl. 1. Reallocated. Lentil lies at base of Starkey tongue of Sherburne formation. Further described as heavy-bedded crinoidal very fine calcareous sandstone.

Wallace de Witt, Jr., and G. W. Colton, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2824–2825. In area between Gorham and Penn Yan, Genundewa limestone member of Genesee grades laterally into Crosby sandstone of Torrey. In vicinity of Keuka Lake and Keuka Lake Outlet, Torrey's Crosby sandstone forms basal part of eastward-thickening wedge of Ithaca member of Genesee. East of Seneca Lake, Crosby sandstone of Torrey is in lower part of Ithaca. At Williams Brook, the Williams Brook coquinite of Caster (1933) is apparently at horizon of Crosby sandstone—the horizon of Genundewa limestone member. Interval between top of Geneseo shale member of Genesee and Torrey's Crosby is 170 feet near Keuka Lake, 200 feet at Seneca Lake, and 385 feet in vicinity of Ithaca.

Named from exposures at Crosby on east shore of Lake Keuka.

Crossen Trachyte (in Buck Hill Volcanic Series)

Crossen Trachyte (in Pruett Formation)

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. Lava flows intercalated in Pruett formation are (ascending) Crossen trachyte, Sheep Canyon basalts, and Potato Hill andesite.

S. S. Goldich and M. A. Elms, 1949, Geol. Soc. America Bull., v. 60, no. 7, p. 1144 (fig. 3), 1151–1153, 1171 (fig. 6), 1178, pl. 1. Porphyritic flows, 115 to 150 feet thick. Rests on tuff and fresh-water limestone of the Pruett. In vicinity of Potato Hill underlies tuff beds which are succeeded by Potato Hill andesite. Near northern boundary of Buck Hill quadrangle, Sheep Canyon basalt overlies the trachyte. In Alpine quadrangle, trachyte was eroded by stream and channel subsequently filled by Sheep Canyon basalt; small erosional remnants of trachyte now appear as inliers in the Sheep Canyon.

W. N. McAnulty, 1955, Geol. Soc. America Bull., v. 66, no. 5, p. 536 (table 1), 546–547, pl. 1. Described in Cathedral Mountain quadrangle. Rank raised to formation in Buck Hill volcanic series. Average thickness approximately 200 feet; maximum thickness 265 feet at Mount Ord. Top of Eocene is placed at prominent disconformity between Crossen trachyte and Sheep Canyon basalt.

Named for the fact that it caps Crossen Mesa in north-central part of Buck Hill quadrangle, Brewster County.

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. 1, 11, 19, pls. 2, 3, 4, 6, 8. Includes all strata between top of Frozen Head sandstone of Vowell Mountain group (new) and the top of Cross Mountain. Thickness at type section 554 feet. Includes (ascending) shale interval, Low Gap sandstone (new), shale interval, Tub Spring sandstone (new), and shale unit.

Type locality: Cross Mountain, Lake City quadrangle, Anderson County. Section is on road leading to top of Cross Mountain. Group includes youngest Pennsylvanian beds in Tennessee and is preserved only on the higher peaks and ridges in the Cumberland Mountains.

Cross Plains Sandstone[1]

Pennsylvanian: Western Arkansas and central eastern Oklahoma.

Original reference: A. Winslow, 1896, New York Acad. Sci. Trans., v. 15, p. 51.

Derivation of name not stated.

Crossville Sandstone (in Crooked Fork Group)

Crossville Sandstone Member (of Duskin Creek Formation)

Pennsylvanian (Pottsville Series): Eastern Tennessee.

H. R. Wanless, 1946, Geol. Soc. America Mem. 13, p. 37, 44 (table 3), 139. Light-gray fine- to medium-grained even-bedded sandstone; iron-stained, giving bands of pink, yellow, brown, and gray both on and across the bedding. Thickness about 39 feet. Occurs at top of Duskin Creek formation about 75 feet above Rockcastle sandstone. Known commercially as Crab Orchard sandstone, but name Crab Orchard preoccupied; hence, Crossville proposed.

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. Rank raised to formation in Crooked Fork group (new). Thickness as much as 130 feet. In Morgan County, unit varies from a single thin sandstone to a bipartite or tripartite sandstone; only lower bench believed to represent the Crossville of the type area. Underlies Burnt Mill shale (new); overlies Dorton shale (new).

Well exposed on Pigeon Ridge Road, northwest of Byrd Creek, near Cumberland Homesteads CCC Camp, about 6 miles south of Crossville, Cumberland County.

Crosswicks Clay[1] (in Matawan Group)

Upper Cretaceous: New Jersey, northern Delaware, and eastern Maryland.

Original reference: T. A. Conrad, 1869, Am. Jour. Sci., 2d, v. 47, p. 359–360.

C. W. Carter, 1937, Maryland Geol. Survey, v. 13, p. 251–256. In banks of Chesapeake and Delaware Canal, conformably underlies Englishtown sand; unconformably overlies Magothy formation. Thickness about 50 feet.

R. A. Schmidt, 1948, Jour. Paleontology, v. 22, no. 4, p. 392 (table 1). Shown in Matawan group in northern Delaware.

Named for village of Crosswicks, on Crosswicks Creek, Burlington County, N.J.

Croton Gypsum[1]

Permian: Central northern Texas.

Original reference: A. M. Lloyd and W. C. Thompson, 1929, Am. Assoc. Petroleum Geologists Bull., v. 13, pl. 9.

Mapped in Stonewall County. Derivation of name not stated.

Croton Limestone (in St. Louis Limestone)[1]

Mississippian: Southeastern Iowa.

Original reference: F. M. Van Tuyl, 1925, Iowa Geol. Survey, v. 30, p. 231.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 813. About 30 feet of compact buff dolomitic limestone which grades into or is interbedded with dense gray nondolomitic limestone. Underlies Verdi member.

Named for exposures in vicinity of Croton, Lee County.

Croton Falls Diorite

Croton Falls Hornblendite[1]

Upper Ordovician(?): Southeastern New York.

Original reference: C. R. Fettke, 1914, New York Acad. Sci. Annals, v. 23, p. 228.

T. W. Fluhr, 1948, Rocks and Minerals Mag., v. 23, no. 8, p. 699. Referred to as diorite in map legend. Age shown as probably Upper Ordovician.

Occurs at Croton Falls and extends northeastward along east side of Croton River, Westchester County.

Crouse Limestone (in Council Grove Group)

Crouse Limestone Member (of Garrison Shale)[1]

Permian: Oklahoma, Kansas, and Nebraska.

Original reference: K. C. Heald, 1916, U.S. Geol. Survey Bull. 641–B, p. 21, 22.

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

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 39, p. 64–65. Condra (1935) employed term Bigelow limestone as comprising (ascending) Sabetha limestone (Crouse limestone), Blue Rapids shale, and Funston limestone. The Bigelow thus included strata between the Easly Creek shale and Speiser shale. To be consistent with classification applied to strata above and below them, these beds should be divided into formations. Proposed that Bigelow be dropped as stratigraphic term and that Crouse limestone, Blue Rapids shale, and Funston limestone be recognized as formations. In Council Grove group, Wolfcamp series.

Named for Crouse Hill, Foraker quadrangle, Osage County, Okla.

Croweburg Formation (in Cabaniss Group)

Croweburg 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, 195. Cherokee group is divided into 15 cyclic formational units. The Croweburg, 12th in sequence (ascending), overlies the Coalvale and underlies the Ardmore. Average thickness 18 feet. Contains coal here referred to as Tebo. [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 midcontinent composite stratigraphic section as Croweburg formation in Cabaniss group. Underlies Verdigris formation; overlies Fleming formation.

C. C. Branson, 1954, Oklahoma Geol. Survey Guide Book 2, p. 5. Listed as a coal cycle in Senora formation, Cabaniss group, in Oklahoma.

W. V. Searight, 1955, Missouri Geol. Survey and Water Resources Rept. Inv. 20, p. 25, 34. Exposed in Vernon County, Mo., where it is about 6 feet thick. Derivation of name given.

W. B. Howe, 1956, Kansas Geol. Survey Bull. 123, p. 22 (fig. 5), 68–72. Formation in Cabaniss subgroup of Cherokee. Includes beds above Fleming coal and extends to top of Croweburg coal. From base upward, succession includes massive dark lenticular limestone and dark-gray calcareous shale (cap-rock of Fleming coal), dark-gray to black shale containing clay-ironstone concretions, lenticular sandstone and underlimestone, underclay, and Croweburg coal. Each division, except Croweburg coal, is extremely variable in thickness, lithology, and distribution.

Named for association with Croweburg coal type locality of which is in strip pits about 1 mile east of Croweburg, Crawford County, Kans.

Crow Creek Member (of Pierre Shale)

Crow Creek zone (in Sully Member of Pierre Shale)

Upper Cretaceous: Central South Dakota.

J. P. Gries and E. P. Rothrock, 1941, South Dakota Geol. Survey Rept. Inv. 38, p. 14–18, pl. 1. Sand and marl zone at base of Sully member (new) of Pierre shale. Name replaces term Gregory marl of previous reports.

D. R. Crandell, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 12, p. 2340 (table 1), 2343, 2346. Rank raised to member of Pierre shale. Defined to include sandstone and calcareous shale and marl beds lying between noncalcareous shales of Gregory member below and DeGrey member (new) above. Thickness ranges from a few feet to 15 feet. Type locality designated.

Type locality: At mouth of Crow Creek, Buffalo County.

Crow Hill Member (of Waits River Formation)

Silurian and (or) Devonian: Northeastern Vermont.

L. M. Hall, 1959, Vermont Geol. Survey Bull. 13, p. 21–23, 26, pl. 4. Series of interbedded quartzites, micaeous quartzites, gray quartz-mica schists, quartz-feldspar granulites, and minor calcareous rocks distinct from typical Waits River. Member closely resembles Gile Mountain formation and may be continuous with it, but continuity cannot be proved due to lack of outcrops.

Name derived from Crow Hill, southwest of village of St. Johnsbury, St. Johnsbury quadrangle.

Crowleyan series[1]

Tertiary, lower: Missouri and Illinois.

Original reference: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 252.

Derivation of name not stated.

Crow Mountain Sandstone Member (of Chugwater Formation)

Crow Mountain Formation (in Chugwater Group)

Triassic: Northwestern Wyoming.

J. D. Love, 1939, Geol. Soc. America Spec. Paper 20, p. 12, 43, 44. Predominantly sandstone with minor amount of shale; nonfossiliferous. Thickness 202 feet. Overlies Red Peak member (new); underlies Popo Agie member. Not recognized in any localities to west or in Wind River Mountains.

E. B. Branson and C. C. Branson, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 135. Referred to as Crow Mountain formation in

Chugwater group. In Wind River Mountains, overlies Alcova dolomite and underlies Popo Agie formation.

T. C. Woodward, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 2, p. 231–232. In Deadman Butte area, Natrona County, restricted use of name Crow Mountain sandstone member is applied to Triassic Chugwater interval between the Alcova below and Popo Agie members. Thickness 165 to 185 feet. In area where Love defined the Crow Mountain, the Alcova is absent; he probably included as part of the Crow Mountain the 20 to 80 feet of sandstone at top of Red Peak member.

Name derived from Crow Mountain, near southeastern end of Washakie Range.

Crown Conglomerate[1]

Upper Cretaceous (Gulf Series): Western Texas.

Original reference: J. A. Udden, 1907, Texas Univ. Bull. 93, p. 66–67.

Named for Crown Peak, Brewster County.

Crownian 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. 830, 838, 840. 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. *Maclurites magnus* Lesueur considered guide to Crown Point limestone.

Crown Point Lava Member (of Troutdale Formation)

Pliocene, upper(?): Northwestern Oregon.

W. D. Lowry and E. M. Baldwin, 1952, Geol. Soc. America Bull., v. 63, no. 1, p. 10. Name applied to 30-foot flow of Boring lava interbedded in Troutdale formation.

Occurs in vicinity of Crown Point, east of Portland.

Crown Point Limestone[1]

Middle Ordovician: Eastern New York and west-central Vermont.

Original reference: H. P. Cushing, 1905, New York State Mus. Bull. 95.

W. M. Cady, 1945, Geol. Soc. America Bull., v. 56, no. 5, p. 524 (table), 548–550. Chazyan succession (Chazy group) in west-central Vermont comprises (ascending) Crown Point limestone, Beldens limestone with Weybridge member (both new), and Middlebury limestone (new). Crown Point limestone consists of lead-gray compact massive rock that weathers to gray surface. Thickness 0 to 150 feet. Overlies upper Beekmantown Bridport dolomite (new) at the meridian of Shoreham and west. Lies on Bascom formation (new) and is gradationally overlain by Beldens formation east of meridian of Cornwall.

Marshall Kay and W. M. Cady, 1947, Science, v. 105, no. 2736, p. 601. Inasmuch as Crown Point limestone (Cady, 1945) is structurally separated from Crown Point limestone of type locality and other outcrops in New York and is succeeded by Beldens formation rather than Valcour limestone, it is proposed here that "Crown Point" formation east of Champlain thrust in west-central Vermont be designated Burchards limestone.

Philip Oxley, 1950, (abs.) Geol. Soc. America Bull., v. 61, no. 12 pt. 2, p. 1492. Discussion of Chazyan stratigraphy west of Champlain thrust, New York and Vermont. Lower Middle Ordovician sequence is Day Point (oldest), Crown Point and Valcour limestones. Day Point basal quartz sands and succeeding crosslaminated, locally reefy calcarenites and shallow water deposits of transgressing sea. Southward-lapping Crown Point limestones are preponderately deeper water argillicalcisiltites, but locally, and particularly toward top, are *Stromatocerium* reefs. Lower limestones of offlapping Valcour tend to match facies of underlying Crown Point. Upper Crown Point reefs are most widespread, forming roughly linear, discontinuous trend from near Isle La Motte, Vt., south of Essex, N.Y.

Philip Oxley and Marshall Kay, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 4, p. 820, 825 (fig. 4), 828 (fig. 6), 830–833, measured sections. Discussion of Ordovician Chazyan series of Champlain Valley, N.Y. and Vt. Series is divided into three stages: Dayan, Crownian, and Valcourian. Crown Point substage (Cushing, 1905) was division B of Brainerd and Seely (1888, Am. Geologist, v. 2) originally described southwest of Chazy, N.Y., from exposure of original Chazy limestone (Emmons, 1842). Sequence is 250 feet of dark-blue-gray massive argillicalcisiltites, gray-weathering, with buff silty crenulated laminae at intervals up to 4 inches; a 20-foot zone of lighter gray medium to coarse calcarenite lies about 50 feet above base. The Crown Point becomes more argillaceous and thinner bedded toward top. Calcarenites of Fleury member (new) of Day Point underlie with slight disconformity and succeeding is a 2-foot light-yellowish-gray fine-textured dolomite, the base of Hero member (new) of Valcour formation. Has normal or basinal facies and reef facies.

Probably named for exposures at or near Crown Point, Essex County, N.Y.

†Crow Ridge Series[1]

Jurassic and Cretaceous: Western central Montana.

Original reference: W. H. Weed, 1901, U.S. Geol. Survey 22d Ann. Rept., pt. 2, p. 399–455.

Named for southwest spur of Crow Peak, Elkhorn region.

Crows Mill Limestone (in McLeansboro Formation)[1]

Pennsylvanian: Central western Illinois.

Original reference: T. E. Savage, 1915, Illinois Geol. Survey Bull. 20, p. 99–107.

Sangamon County.

Crow Wing Formation[1]

Precambrian (Animikie): Central Minnesota.

Original reference: C. Zapffe, 1930, Lake Superior Min. Inst. Proc., v. 28, p. 101–106.

M. S. Woyski, 1949, Geol. Soc. America Bull., v. 60, no. 6, p. 1002. Listed in geologic succession of central Minnesota as presumably Animikie in age.

Apparently named for extensive outcrops in northern part of Crow Wing County.

Croydon Group

Middle Devonian(?): South-central New Hampshire.

C. A. Chapman and others, 1938, Geologic map and structure sections of the Mascoma quadrangle, New Hampshire (1:62,500): New Hampshire Highway Dept. Described as fine-grained white to gray weakly foliated quartz diorite and granodiorite. Composed of oligoclase, quartz, biotite, and microcline. Belongs to Oliverian magma series whose age is post-Lower Devonian and probably Upper Devonian.

C. A. Chapman, 1952, Geol. Soc. America Bull., v. 63, no. 4, p. 391–392, pl. 1. Middle Devonian(?). Outcrop area largely in Sunapee quadrangle.

Confined to Croydon dome immediately east of Croydon Mountain in Grantham and Croydon Townships, Sullivan County.

†Crusher Hill (alternating) Shales and Limestones (in Council Grove Group)[1]

Permian: Central Kansas.

Original reference: L. C. Wooster, 1905, The Carboniferous rock system of eastern Kansas, p. 9.

Derivation of name not stated.

Crystal Gray Quartz Monzonite (in Stearns Magma Series)

Precambrian (middle Keweenawan): Central Minnesota.

M. S. Woyski, 1949, Geol. Soc. America Bull., v. 60, no. 6, p. 1002, 1008–1009, pl. 1. Pinkish gray; granitoid; seriate; phenocrysts 1 to 2 centimeters, grains of ground mass 1 to 5 millimeters; appears to have been heavily contaminated by St. Cloud gray granodiorite (new) and then attacked by deuteric reactions.

Exposed in quarry in NE¼ sec. 27, T. 124 N., R. 29 W., Stearns County. Derivation of name not given.

†Crystal City Sandstone[1]

Lower Ordovician: Eastern Missouri.

Original reference: A. Winslow, 1894, Missouri Geol. Survey, v. 6, p. 331, 352, 358.

Named for exposures at Crystal City, Jefferson County.

Crystal Falls Formation[1]

Precambrian (Upper Huronian): Northern Michigan.

Original reference: J. Zinn, 1933, Michigan Acad. Sci., Arts., and Letters, v. 18, p. 446–448, 454.

Has been traced almost continuously to Iron River district to west and to Florence district to south, Crystal Falls district.

Crystal Falls Limestone Member (of Thrifty Formation)

Crystal Falls Limestone (in Thrifty Group)

Crystal Falls Limestone Member (of Harpersville Formation)[1]

Upper Pennsylvanian: Central northern Texas.

Original references: F. B. Plummer and R. C. Moore, 1921, Texas Univ. Bull. 2132, p. 161–164; 1922, Jour. Geology, v. 30, p. 24, 31, 39.

Wallace Lee, 1938, Texas Univ. Bur. Econ. Geology Pub. 3801, p. 64–65, 66–67. Member of Harpersville formation. Consists of lower limestone, gray, finely crystalline, 1 foot thick; shale, 1½ feet; and light-yellowish to buff limestone, 1 foot thick. Overlies shale and limestone in lower part of formation; separated by shale interval from limestone referred to by some writers as "Upper Crystal Falls limestone."

F. B. Plummer and H. B. Bradley, 1949, Texas Univ. Bur. Econ. Geology Pub. 4915, p. 6–20, figs. pls. Lower Crystal Falls limestone overlies Quinn clay (new). Curry clay (new) occurs between the lower and upper Crystal Falls limestone layers, just above Quinn clay in areas where sandstone deposits of Park Mountain and its probable equivalent, the Cisco Lake sandstone, do not occur.

John Kay, 1956, *in* North Texas Geol. Soc. Field Guidebook May 25–26, p. [13], fig. 4. Shown on columnar section as limestone in Thrifty group.

L. F. Brown, Jr., 1960, Texas Univ. Bur. Econ. Geology Rept. Inv. 41, p. 7 (fig. 2), 8 (fig. 3), 23–26, pls. 1, 3. Plummer and Moore (1921) stated that the Crystal Falls limestone "occurs 40 to 80 feet above the base of the Harpersville formation," which is top of Breckenridge limestone. The Crystal Falls was described as "yellow or gray limestone, weathering locally red or purple, with an average thickness of 2 or 3 feet." A section accompanying type description (idem, p. 163) was measured along Clear Fork of Brazos River west of Crystal Falls, Stephens County. However, this section does not include an unnamed limestone 23 feet above the Breckenridge designated "C1" by Bradish (1937, Geologic map of Stephens County, revised) and discussed by Lee (1938, Texas Univ. Bull. 3801). Crystal Falls limestone has been called "Lower Crystal Falls" by Bradish (1937) and some other writers. Plummer and others (1949, Texas Univ. Pub. 4915) showed sections of Crystal Falls type area. Difference in interpretation may be noted by comparing section by Plummer and others (fig. 18) at Crystal Falls type locality (fig. 6 of present report) and their sections 23, 24, and 25, with sections 9, 10, and 11, respectively, of present report. In general, present report agrees with Lee's stratigraphic description for section between the Breckenridge and "Upper Crystal Falls" limestones in northern Stephens County. Type section of Crystal Falls herein redescribed. Type Crystal Falls composed of an upper 1-foot limestone bed separated by about 1 foot of shale from a lower limestone bed that is 1 to 3½ feet thick. Limestone weathers from gray to yellowish orange; upper surface is ferruginous, commonly dark red or purple. Upper surface uneven and has wave or "moundlike" undulations with amplitudes up to 5 feet. Overlies Quinn clay member; underlies Curry clay member which in turn underlies unit termed "Upper Crystal Falls member." Area of report is northern Stephens County.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 72, 74, pl. 27. Bed here correlated with Breckenridge is shown on geologic map of Coleman County (Hudnall and Pirtle, 1929) as Lower Crystal Falls limestone. The generally persistent upper part of Chaffin limestone member of Thrifty formation has been variously called Breckenridge limestone (Plummer and Moore, 1921; Bullard and Cuyler, 1935, Texas Univ. Bull. 3501), Upper Crystal Falls limestone (Hudnall and Pirtle, 1929), Crystal Falls limestone (Cheney, 1950, Abilene Geol. Soc

Guidebook Nov. 2–4), and Chaffin limestone (Sellards, 1933, Texas Univ. Bull. 3232; Nickell, 1938; Cheney and Eargle, 1951, Geologic map of Brown County).

Type section (Brown): Measured from the shale beneath Breckenridge limestone to top of "Upper Crystal Falls" limestone. Beds 1–4 of section (fig. 6 and pl. 2, A) crop out on State land and beds 4–14 on property of Truman Robertson of Crystal Falls. Breckenridge limestone crops out in bed of Clear Fork of Brazos River from dam beneath bridge on Farm Road 578, down stream to first bend. Lower part of section (fig. 6, beds 1–7C) was measured southwestward from first bend below dam (pl. 2, A), across the dam and old bridge road to good exposure of bed 4 (pl. 1, bed c), and upward to exposure of the Crystal Falls in railroad cut no. 1; upper part of Quinn clay (bed 5) is well exposed at clay exposure no. 1. The interval from the top of Crystal Falls limestone to coal in Curry clay was described at clay exposure no. 2 (beds 7C–11), about 25 yards southwest of railroad cut no. 1; the offset is along bed 7C. Upper part of section (beds 11–14D) was described in railroad cut no. 2 to west; offset correlated with coal (bed 11). Named from Crystal Falls, Stephens County.

Crystal Mountain Sandstone[1]

Ordovician(?): Southwestern Arkansas and southeastern Oklahoma.

Original reference: A. H. Purdue, 1909, Geol. Soc. America Bull., v. 19, p. 557; 1909, Slates of Arkansas: Arkansas Geol. Survey, p. 30, 32.

August Goldstein, Jr., and T. A. Hendricks, 1953, Geol. Soc. America Bull., v. 64, no. 4, p. 424 (fig. 2). Shown on columnar section as massive light-gray calcareous to quartzitic sandstone; chert conglomerate at base in McCurtain County, Okla. Thickness 500 to 850 feet. Underlies Mazarn formation; unconformably overlies Collier formation. Cambrian-Ordovician.

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

W. D. Pitt, 1955, Oklahoma Geol. Survey Circ. 34, p. 18–22. Outcrop area in Oklahoma small. Thickness estimated from 5 to 100 feet. Honess (1923, Oklahoma Geol. Survey Bull. 32) estimated 500 feet. Comprises a basal conglomerate and a massive sandstone member. Overlies Collier limestone; underlies Mazarn shale.

Named for Crystal Mountains, Montgomery County, Ark.

Crystal Pass Limestone 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, 15.

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 140 feet thick, overlies Valentine limestone member of Sultan, and underlies Dawn limestone member of Monte Cristo limestone. Herein 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. Middle Devonian.

D. F. Hewett, 1956, U.S. Geol. Survey Prof. Paper 275, p. 41. Because no fossils have been found in Crystal Pass limestone and there are no unconformities under or over the limestone, its age must be open to debate. Age of Sultan limestone is considered to be Middle or early Late Devonian.

U.S. Geol. Survey currently considers the Sultan limestone and its members to be Middle and Upper Devonian in age.

Named for Crystal Pass, sec. 2, T. 25 S., R. 58 E., Clark County, Nev.

Crystal Peak Dolomite

Middle Ordovician: Western Utah and eastern Nevada.

G. W. Webb, 1956, Utah Geol. and Mineralog. Survey Bull. 57, p. 12–13, 42–43 (fig. 11). Name applied to dolomite separating Watson Ranch tongue (new) of Swan Peak quartzite from overlying Eureka quartzite. Dolomites are closely parted by reddish or yellow silt seams and are gray or black and fine or medium in grain. Thickness about 85 feet.

Named for occurrences at Crystal Peak, near Ibex, Millard County, Utah.

Crystal River Formation (in Ocala Group)

Eocene (Jackson): Northern and western Florida.

H. S. Puri, 1953, (abs.) Jour. Sed. Petrology, v. 23, no. 2, p. 130. Proposed for the 108 feet of limestone exposed in Crystal River Rock quarry in Citrus County. Includes all calcareous sediments of upper Eocene age lying stratigraphically between the Williston formation and the overlying Oligocene limestones.

W. E. Moore, 1955, Florida Geol. Survey Bull. 37, p. 30–36. In this report, includes all limestones containing Jackson Eocene orbitoid and camerinid faunas that underlie the Marianna limestone or younger beds and overlie beds of Cook Mountain (lower middle Eocene) age with *Operculinoides sabinensis*. White to cream-colored soft granular permeable limestone. Thickness in Jackson County about 200 feet including Bumpnose member (new).

H. S. Puri, 1957, Florida Geol. Survey Bull. 38, p. 31–38. Moore (1955) erroneously included in the unit all upper Eocene beds overlying the *Operculinoides sabinensis* faunizones of the Lisbon formation (Claiborne). Bumpnose member is not considered a valid stratigraphic unit. Type locality stated.

Type locality: Crystal River Rock Co. quarry, NE¼SW¼ sec. 6, T. 19 S., R. 18 E, Citrus County.

Crystal Spring Formation

Precambrian (Pahrump Series): Southern California.

D. F. Hewett, 1940, Washington Acad. Sci. Jour., v. 30, no. 6, p. 240; 1956, U.S. Geol. Survey Prof. Paper 275, p. 26, 28, 29, pl. 1. Comprises about 2,000 feet of quartzite, arkose, shale, and limestone, intruded by sills of diorite and syenite, with beds of dolomite and chert at top and thick coarse conglomerate at base. Base of series; underlies Beck Spring dolomite (new); unconformably overlies Precambrian granite gneiss. Base of formation observed at only one locality, on west end of ridge 2 miles east of Horse Springs; here conglomeratic quartzite rests on Precambrian gneissic granite.

L. A. Wright, 1952, California Div. Mines Spec. Rept. 20, p. 7 (fig. 3), 9–12, 13. Described in Superior talc area, Death Valley region, where it consists of lower 800 feet of conglomerate, quartzite, and shale, middle 600 feet of dolomite, and upper 200 feet of alternating quartzite, shale, and dolomite layers; a diabase sill, 200 to 600 feet thick, lies at or near the base of the massive dolomite; below sill is alternation zone which contains commercial talc deposit. Underlies Beck Spring dolomite; overlies Archean quartzite, gneiss, and schist.

Crops out in belt that extends for 5 miles around north slope of Kingston Range and in two areas on eastern slope of range, Ivanpah quadrangle. Name derived from Crystal Spring on north slope of Kingston Range.

Cuba Formation (in Canadaway Group)

Cuba Member (of Canadaway Formation)

Cuba Sandstone[1]

Upper Devonian: Western New York.

Original reference: J. M. Clarke, 1902, New York State Mus. Bull. 52, p. 524–528.

J. G. Woodruff, 1942, New York State Mus. Bull. 326, p. 14, 16–18, 23–27. Referred to as Cuba formation in Canadaway group. Thickness about 40 feet in Wellsville quadrangle. Overlies Machias formation; underlies Wellsville formation (new) of Conneaut group.

I. H. Tesmer, 1955, New York State Mus. Sci. Service Circ. 42, p. 10 (fig. 1), 12–14. Rank reduced to member status in Canadaway formation.

Well exposed in quarry east of Erie depot at Cuba, Allegany County.

Cuba Sandstone (in Carbondale Formation)[1]

Cuba Sandstone (in Carbondale Group)

Pennsylvanian: Western and central 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. 50 (fig. 22), 107–108, 195, 196, 204, 206, 207. Light brownish gray and spotted with bright brown specks; commonly thin bedded and shaly in upper part, the beds thickening downward. Thickness 3 to more than 80 feet; through most of Glasford quadrangle and east of Cuba in Havana and Canton quadrangles, ranges from 30 to 80 feet and varies inversely with underlying St. David beds. Underlies Big Creek shale near base of Brereton cyclothem, Carbondale group.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 35. Replaced by Vermilionville sandstone member of Carbondale formation. Name Cuba preempted.

Named from exposures north of Cuba in sec. 8, T. 6 N., R. 3 E., Havana quadrangle, Fulton County.

Cubierto Shale (in Puente Formation)

Miocene, upper: Southern California.

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

A. O. Woodford, T. G. Moran, and J. S. Shelton, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 4, p. 521. Thin-bedded gray micaceous clay shale and fine- and medium-grained sandstone. Thickness 864 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.

Cub Mountain Formation

Eocene: Central New Mexico.

M. W. Bodine, Jr., 1956, New Mexico Bur. Mines Min. Res. Circ. 35, p. 1, 8–11, figs. 2, 3. Consists of beds of pale-yellow to gray coarse-grained quartzose sandstones, with lenses of quartzite and chert-pebble conglomerate. Color not at all reliable because it changes drastically, both vertically and horizontally. Thickness at least 500 feet. Underlies Tertiary rocks with unconformity and overlies Mesaverde group with apparent unconformity. May be as old as latest Cretaceous or as young as Miocene.

G. B. Griswold, 1959, New Mexico Bur. Mines Mineral Resources Bull. 67, p. 7 (table 2), 12, pl. 2. Thickness about 2,000 feet. Mapped as Eocene.

Named for isolated peak located 7 miles due south of Carrizozo and 18 miles due west of Capitan, Lincoln County. Exposed in southwest flank of the mountain.

Cucamonga Complex

Pre-Upper Cretaceous: Southern California.

R. M. Alf, 1948, Geol. Soc. America Bull., v. 59, no. 11, p. 1104 (fig. 2), 1107–1108, pl. 6. Characterized by discontinuous bands of pale and graphitic limestone, complex gneiss, and quartz monzonite mylonite. Aggregate thickness of the two sections sampled 231 feet.

K. J. Hsu, 1955, California Univ. Dept. Geol. Sci. Bull., v. 30, no. 4, p. 259–274, geol. map. Name replaced by Cucamonga Canyon group.

Occurs in San Gabriel Mountains southeast of Los Angeles.

Cucamonga fan deposits

Recent: Southern California.

E. M. Mackevett, 1951, California Div. Mines Spec. Rept. 5, p. 11. Contains a wide assemblage of clastic materials; some of constituent boulders exceed 2 feet in diameter. Distributaries have cut as much as 40 feet into the fan.

Almost surrounds Jurupa Mountains, western San Bernardino and Riverside Counties.

Cucamonga Canyon Group

Age unknown: Southern California.

K. J. Hsu, 1955, California Univ. Dept. Geol. Sci. Bull., v. 30, no. 4, p. 259–272, geol. map. Divided into two subgroups on basis of textural criteria: layered plutonics and cataclastic plutonics. Distinction between the two is in many places difficult because all gradations of textures from typically granoblastic to ultracataclastic are represented. Group forms an east-northeast-trending belt south of Aurela Ridge group (new); the two are separated by Cucamonga Canyon thrust. Alf (1948) described these rocks as "Cucamonga complex" and considered them a heterogeneous aggregation of rocks of different origins. Present study indicates that most Cucamonga Canyon rocks were derived from Aurela Ridge granulites under conditions represented by the amphibolite facies.

Exposed in lower Cucamonga Canyon, San Bernardino County.

Cucaracha Formation[1]

Miocene, lower: Panamá.

Original references: D. F. MacDonald, 1913, Canal Records, v. 6, p. 214; 1913, Geol. Soc. America Bull., v. 24, p. 709.

W. P. Woodring and T. F. Thompson, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 2, p. 240–241, 246 (fig. 2). Chiefly massive generally greenish-gray waxy highly slickensided bentonitic clay. Bed of agglomeratic andesitic tuff, 10 to 35 feet thick, occurs about 200 feet below top of formation. Maximum thickness about 625 feet. Overlies Culebra formation; underlies La Boca formation. Early Miocene.

W. P. Woodring, 1957, U.S. Geol. Survey Prof. Paper 306–A, p. 39, 51 (fig. 4), pl. 1. Underlies La Boca member of Panamá formation. Assigned to early Miocene because both underlying Culebra formation and overlying Panama formation are considered to be of that age.

Type region: Along Gaillard Cut south of Continental Divide where village of Cucaracha was located near site of Cucaracha slide.

Cuchara Formation[1]

Eocene: Southern Colorado and northern New Mexico.

Original reference: R. C. Hills, 1893?, Colorado Sci. Soc. Proc., v. 4, p. 9; paper read Feb. 2, 1891.

W. S. Burbank and E. N. Goddard, 1937, Geol. Soc. America Bull., v. 48, no. 7, p. 947. Overlies Poison Canyon beds, with marked unconformity at northern end of Huerfano Park, and entirely overlaps formation locally; because the Cuchara is, in turn, overlapped along western side of park by Huerfano beds, it is assigned questionably to lower Eocene (Wasatch).

R. B. Johnson and J. G. Stephens, 1954, U.S. Geol. Survey Oil and Gas Inv. Map. OM–146. Described in La Veta area, Huerfano County, where it unconformably overlies Poison Canyon formation; unconformably underlies Huerfano formation. Composed of thin to massive red, pink, and white sandstone beds and thin red and tan shale beds. Estimated thickness more than 5,000 feet in center of Raton Basin on northern flank of West Spanish Peak; probably not more than 2,500 feet present in La Veta area. Eocene.

Named for exposures along Cuchara River north and south of La Veta, Huerfano County, Colo.

Cuchillo Formation[1] (in Trinity Group)

Lower Cretaceous (Comanche Series): Southwestern Texas, and northern Mexico.

Original references: R. H. Burrows, 1909, Min. and Sci. Press, v. 99, p. 324; 1910, Soc. geol. Mexicana Bol., t. 7, p. 95.

Gayle Scott, 1939, Texas Univ. Bur. Econ. Geol. Pub. 3945, p. 969–1077. Overlies Las Vigas formation; underlies Glen Rose in Sierra Blanca-Quitman Mountain area. Ammonite zone of *Sonneratia trinitensis* and *Douvilleiceras mammillatum* of Trinity group.

Named from Conchos Valley section north of Kansas City, Mexico & Orient Railroad, a short distance north of Presidio, Presidio County, Tex. Fossil collection made near Aurora mine, 5 kilometers south of Cuchillo Parado.

Cuchillo Negro Formation (in Mud Springs Group)

Pennsylvanian (Derry Series): Central New Mexico.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 27 (table 2), 31 (fig. 2), 37, 39. Name proposed for all strata between top of Mud Springs [Hot Springs] formation below and base of Des Moines series above. At type locality, formation is composed almost entirely of medium- to light-gray massive to nodular cherty limestone. Calcareous algae are abundant in some parts of formation and make up more than 50 percent of some strata. Two thin beds of greenish to brownish coarse-grained sandstones to granule conglomerates occur in lower part of formation in some areas of the Mud Springs Mountains; one of these sandstones occurs at the base and the other occurs about 15 feet above base of formation. Thickness at type locality about 28 feet.

M. L. Thompson, 1948, Kansas Univ. Paleont. Contr. 4, Protozoa, art. 1, p. 73 (fig. 8), 74. Overlies Fra Cristobal formation (new) which name replaces preoccupied Hot Springs formation.

Type locality: Near west end of Whiskey Canyon in northern part of Mud Springs Mountain, just west of westernmost box canyon, in southwestern part of sec. 1, T. 13 S., R. 5 W., Sierra County. Name derived from Cuchillo Negro Peak where formation is well exposed.

Cucuracha Formation

See **Cucaracha Formation,** correct spelling.

Cuerbio Basalt

Pleistocene(?): North-central New Mexico.

C. E. Stearns, 1943, Jour. Geology, v. 51, no. 5, fig. 2. Mapped in Galisteo-Tonque area. Pleistocene. Younger than Santa Fe formation.

C. E. Stearns, 1953, Geol. Soc. America Bull., v. 64, no. 4, p. 476, 477, pl. 1. Basalt flows interbedded with Tuerto gravel (new) are tentatively correlated with Cuerbio basalt.

A. E. Disbrow and W. C. Stoll, 1957, New Mexico Bur. Mines Mineral Resources Bull. 48, p. 5 (table 1), 29–30, pl. 1. In this report [Cerrillos area], basalt flows that are interbedded with and overlie upper part of Ancha formation, together with an associated cinder cone, are placed in Cuerbio basalt. Two flows mapped; each about 20 feet thick. Pleistocene(?). Name credited to Kirk Bryan (unpub. ms.).

Type locality and derivation of name not stated.

Cuero Formation (in Fleming Group)

Miocene, upper: Southern Texas.

A. W. Weeks, 1941, (abs.) Am. Assoc. Petroleum Geologists 26th Ann. Mtg. Program, p. 20. Name appears on a chart; occurs below Lapara member of Goliad formation and above Oakville formation.

A. W. Weeks, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 12, p. 1724–1726. Proposed for the predominantly red, pink, green, and gray section of clays and sandstones lying above the Oakville formation and below the Goliad formation. Thickness about 350 feet. In Bee, Karnes, and DeWitt Counties, formation is identical with the section assigned to the Lower Lagarto by Weeks (1933, Am. Assoc. Petroleum

Geologists Bull., v. 17, no. 5) and is part of section assigned to Lagarto (emended) by Plummer (1933, Texas Univ. Bull. 3232).

Name taken from a city in DeWitt County.

Cuesta Diabase[1]

Lower Cretaceous: Southern California.

Original reference: H. W. Fairbanks, 1904, U.S. Geol. Survey. Geol. Atlas, Folio 101.

Extends from near Cuesta Pass on south to northern edge of San Luis quadrangle. Named for exposures near Cuesta and Cuesta Pass, San Luis Obispo County.

Cueva Rhyolite[1]

Eocene: Southern New Mexico.

Original reference: K. C. Dunham, 1935, New Mexico School Mines Bull. 11, p. 53, 55.

V. C. Kelley and Caswell Silver, 1952, New Mexico Univ. Pubs. in Geology 4, p. 114 (fig. 14). Age shown on correlation chart as Eocene.

Type locality: La Cueva, west of mouth of Fillmore Canyon, Organ Mountains, Dona Ana County.

Cuivre Shale

Mississippian (Kinderhook): Northeastern Missouri.

M. G. Mehl, 1960, Denison Univ. Jour. Sci. Lab., v. 45, art. 5, p. 98–100. Proposed to designate stratigraphic unit between Hannibal shale and Louisiana limestone. Predominantly very dark gray to blue-black somewhat fissile clay shale; in some places massive and shows blocky weathering; sandy at base with lenses of hard gray sandstone with calcareous and pyritiferous cement. Thickness 12 feet at type locality. Unconformable below, resting on Louisiana or Bowling Green limestone; unconformable beneath the Hannibal.

Type locality: SE¼NE¼SE¼ sec. 35, T. 54 N., R. 3 W., Pike County, about 4½ miles north of Bowling Green. Here, in one of head branches of Grassy Creek, entire thickness of unit is exposed. Named from Cuivre Township, near northeastern corner of which the type locality is located.

Culberson series[1]

Permian: Western Texas.

Original reference: C. R. Keyes, 1932, Pan-Am. Geologist, v. 57, p. 350, 351, 354.

Occurs on Wiley Ridge, Wiley Mountains.

Culbert Breccia

Pleistocene(?): Southwestern Utah.

E. F. Cook, 1957, Utah Geol. and Mineralog. Survey Bull. 58, p. 16 (fig. 2a), 39. Composed of angular to subangular blocks of monzonite porphyry, as much as 5 feet in diameter, in a poorly cemented matrix. Considerable differences in color and density. Of mudflow origin and cited also as mudflow fanglomerate. Of probable Pleistocene age according to text; shown as Pliocene(?) age on fig. 2a. Generalized section of formations in area shows breccia stratigraphically above Pine Valley latite (new).

Exposed in small patches on east side of Culbert Canyon and in the Comanche Creek drainage, Pine Valley Mountains, Washington and Iron Counties.

Culebra Dolomite Member (of Rustler Formation)

Permian: Southeastern New Mexico and western Texas.

J. E. Adams, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 11, p. 1600 (fig. 2), 1614. Name applied to 35-foot dolomite in upper part of Rustler. Name suggested by W. B. Lang 1938, New Mexico State Engineer 12th and 13th Bienn. Rept.), who divided Rustler into 11 units; Culebra member is unit 6 (descending) in this classification. Member is also good marker in subsurface where it extends into western Texas.

Exposed east of Pecos River, central Eddy County, N. Mex.

Culebra Formation[1]

Culebra Clays or Beds

Miocene, lower: Panamá.

Original reference (Culebra clays): R. T. Hill, 1898, Harvard Coll. Mus. Comp. Zoology Bull., v. 28, no. 5, p. 192–195.

A. A. Olsson, 1942, 8th Am. Sci. Cong. Proc., v. 4, p. 239. Referred to as Culebra beds. Upper Oligocene.

W. P. Woodring and T. F. Thompson, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 2, p. 236–240, 246 (fig. 2). Formation includes Emperador limestone member. Estimated maximum thickness about 500 feet. Conformably overlies Las Cascadas agglomerate; underlies Cucaracha formation. Upper Oligocene and lower Miocene. First named Culebra clays by Hill (1898).

W. P. Woodring, 1957, U.S. Geol. Survey Prof. Paper 306–A, p. 34–39, 51 (fig. 4), pl. 1. Lower Miocene.

Type region: Central Gaillard Cut area, where town of Culebra was located on west side of canal during construction.

Culebra Lake Clay

Late Cenozoic: North-central New Mexico.

V. C. Kelley, 1956, New Mexico Geol. Soc. Guidebook 7th Field Conf., p 111–112. Accumulated in waters impounded by lava flows to the south. Some of the lavas poured into the lake, and, with the clay, formed subaqueous pudding-stone and pillow structure. Deposited in late Santa Fe time.

In Rio Grande depression between Taos and Santa Fe.

Cullom Limestone[1]

Pennsylvanian: Southeastern Nebraska and eastern Kansas.

Original reference: G. E. Condra and N. A. Bengston, 1915, Nebraska Acad. Sci. Pub., v. 9, no. 2, p. 7, 11, 20, 35.

G. E. Condra and E. C. Reed, 1937, Nebraska Geol. Survey Bull. 11, 2d ser., p. 57. Condra (1927, Nebraska Geol. Survey Bull. 1, 2d ser.) wrongly correlated Beil limestone as Cullom. At Cullom Station, the bed so named is part of Westerville limestone.

Named for Cullom Station, Cass County, Nebr.

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Cultus Formation[1]

Triassic: Southern British Columbia, Canada, and central northern Washington.

Original reference: R. A. Daly, 1912, Canada Geol. Survey Dept. Mines Mem. 38, maps 16 and 17.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 17. In extreme western part of Cascades just south of Canadian boundary are outcrops of dark-gray to black argillite, together with intercalated bands of greenish-gray sandstone, grit, and conglomerate which have been described as Cultus formation.

Mapped around south shore of Cultus Lake, British Columbia.

Culver Springs Shale Member (of Brodhead Formation)

Lower Mississippian: Northwestern Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 76, 147. Basal member of Brodhead formation, Pilot Knob facies (new). Thickness 40 feet. Underlies Lebanon Junction siltstone member (new); overlies New Providence formation, Keith Knob facies (new).

Good exposure on slope along northern side of Belmont-Pitts Point Road, 2 miles west of Culver Springs School, 3½ miles west of Belmont, southwestern Bullitt County.

Cumberland facies (of Clinton Formation)

Silurian (Niagaran): Western Maryland and western Virginia.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 238, 242–244. Clinton formation in Virginia is composed almost entirely of shale and sandstone and varies geographically in character and proportions of its constituents. At northeast and southwest ends of Appalachian Valley (in Virginia), formation comprises a rather homogeneous body of shale and thin layers of sandstone. It is proposed to designate this lithologic expression of formation the Cumberland facies. Merges laterally into Iron Gate facies (new). Facies is well displayed at north end of Rose Hill, Cumberland, Md., where approximately 600 feet of section is exposed.

Type locality not stated.

†Cumberland Quartzite[1]

Precambrian: Northeastern Rhode Island.

Original reference: J. B. Woodworth, 1899, U.S. Geol. Survey Mon. 33, p. 106–107.

Crops out on south side of Sneech Pond, along to main street southeastward for 1½ miles in village of Cumberland Hill, Providence County.

Cumberland Sandstone[1]

Upper Ordovician (Richmond): Southern Kentucky.

Original reference: N. S. Shaler, 1877, Kentucky Geol. Survey, 2d ser., v. 3, p. 152, 153, 155, 159–160. 387.

W. R. Jillson, 1951, Geology of the McFarland Creek oil pool; Frankfort, Ky., Roberts Printing Co., p. 13. In Monroe County, 40 to 50 feet of Cumberland sandstone (Richmond-Upper Ordovician) is exposed beneath Chattanooga shale.

Named for exposures along Cumberland River in Cumberland and adjoining counties.

Cumberland Gap Shale Member (of Chattanooga Shale)[1]

Devonian and (or) Mississippian: Southern Tennessee and southwestern Virginia.

Original reference: J. H. Swartz, 1927, Am. Jour. Sci., 5th, v. 14, p. 485–499.

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

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 3, p. 167, chart 5 (columns 93, 94, 97). Shown on Mississippian correlation chart as Kinderhook. Age of Cumberland Gap shale has not been determined, but may include strata of early as well as middle New Albany age.

Well exposed along Lee Highway on north edge of town of Cumberland Gap, Tenn.

Cumberland Head Shale[1] or Formation

Middle Ordovician: Northwestern Vermont and eastern New York.

Original reference: H. P. Cushing, 1905, New York State Mus. Bull. 95, map forming pl. 13.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 274–275, pl. 2. Redescribed as formation including argillaceous limestones and limestone-bearing black shales overlying lowest Sherman Fall Shoreham limestone and underlying Stony Point black shale in type region. Thickness typically about 150 feet. Assigned to Trenton group. Geographically extended to Vermont. Type region mentioned.

R. B. Erwin, 1957, Vermont Geol. Survey Bull. 9, p. 32–37, 74–75, 77–80, 82, pl. 1. Described on Isle la Motte and in several fault blocks on South Hero Island in Lake Champlain.

Type region: [South] Hero Island, Grand Isle County, Vt., 2 miles southeast of Cumberland Head. Named for Cumberland Head near Plattsburgh, Clinton County, N.Y.

Cumberland River Sandstone[1]

Upper Ordovician: Southern Kentucky.

Original reference: A. M. Miller, 1919, Kentucky Dept. Geol. and Forestry, ser. 5, Bull. 2.

Named for exposures along Cumberland River in Cumberland and adjoining counties.

Cummingsville Member (of Galena Formation)

Middle Ordovician: Southeastern Minnesota and northwestern Iowa.

M. P. Weiss, 1955, Jour. Paleontology, v. 29, no. 5, p. 764–766; 1957, Geol. Soc. America Bull., v. 68, no. 8, p. 1036–1037. Proposed for interbedded limestones and shaly limestones at base of Galena formation that were formerly included in overlying Prosser member. Unit is an argillaceous limestone, yellowish-gray to pale-yellowish-brown, generally microgranular, and thin and crinkly bedded, with conspicuous to thick shaly partings. Thin beds are typically grouped into massive units that are separated by smoother more prominent shaly partings. Thickness at type locality 63 feet; essentially uniform throughout its extent. Overlies Decorah formation; base is the level at which the green shales of the Decorah are succeeded by rock that is predominantly limestone, usually beds of lumpy or nodular limestone in a shale matrix.

Type section: One-half mile north of Cummingsville, on east edge of SE¼ sec. 21, T. 105 N., R. 12 W. Name derived from hamlet of Cummingsville, Olmsted County, Minn., on State Highway 30, 3½ miles west of Chatfield.

Cummins Station Shale Member (of Muldraugh Formation)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 76, 212–214. Shale, slightly silty, blue-gray to olive-gray, with thin siltstone ribs. Forms basal unit of Maretburg facies (new) of formation. Thickness 12 to 18 feet. Overlies Floyds Knob formation.

Type section: Along Louisville and Nashville Railroad and nearby hillsides midway between Maretburg and Brodhead, one-half mile west of Cummins Station, Rockcastle County. Named for station on railroad.

Cumnock 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, 25–43.

J. A. Reinemund, 1955, U.S. Geol. Survey Prof. Paper 246, p. 31–35, pl. 1. Conformably overlies Pekin formation; conformably underlies Sanford formation; in Colon, cross structure grades laterally into conglomerate and sandstone beds that are indistinguishable from strata in the Pekin and Sanford. Includes two coal beds, the Cumnock and Gulf, 200 to 260 feet above base of formation. Strata below coal beds consist mainly of light-gray, medium-dark-gray, and dark-greenish-gray siltstone and fine-grained sandstone and contain small amounts of claystone and shale; strata above coal beds consist mainly of medium-light-gray to black shale and include small amounts of claystone, siltstone, and sandstone; shale is irregularly calcareous and carbonaceous. Thickness 750 to 800 feet in north-central part of Sanford basin, northwest of Deep River fault.

Named for section exposed in mine shaft at Cumnock, Lee County. Crops out in narrow belt along center and northwestern side of Sanford basin, is duplicated four times by longitudinal faulting in western part of basin, and is present locally at southern end of Durham basin.

Cundiff Limestone (in Caddo Creek Formation[1]

Pennsylvanian: Central northern Texas.

Original reference: J. M. Armstrong, 1929, Texas Bur. Econ. Geology, geol, map of Jack County.

Crops out near Cundiff in eastern part of Jack County. Named for village of Cundiff.

Cunningham Granite

Precambrian: Central western Georgia.

D. F. Hewett and G. W. Crickmay, 1937, U.S. Geol. Survey Water-Supply Paper 819, p. 30, pl. 1. Commonly massive coarse-grained rock dark in color in contrast to other igneous and metamorphic rocks of region. Boundaries locally cut across lamination of Woodland gneiss (new) and the Cunningham is believed to be intrusive into the Woodland.

Named for Cunningham Crossroads in Talbot County, southeast of Manchester, where central part of the largest mass of the rock is exposed; area is south of Towaliga fault.

Curdsville Limestone[1] (in Lexington Group)

Curdsville Limestone Member (of Hermitage Formation)

Middle Ordovician: Central Kentucky and central Tennessee.

Original reference: A. M. Miller, 1905, Kentucky Geol. Survey Bull. 2, p. 9, 18.

C. W. Wilson, Jr., 1939, (abs.) Geol. Soc. America Bull., v. 50, no. 12, pt. 2, p. 1993; 1949, Tennessee Div. Geology Bull. 56, p. 84 (fig. 15), 85–88. member at base of Hermitage formation in Tennessee. Consists of thin beds of medium-grained to coarsely crystalline blue to gray limestone interbedded with partings of gray shale. Maximum thickness 15 feet. Overlies Carters limestone of Stones River group.

D. K. Hamilton, 1948, Econ. Geology, v. 43, no. 1, p. 41. Basal formation in Lexington group in Kentucky. Consists of cherty coarsely crystalline gray-blue limestone, about 20 feet thick. Underlies Hermitage formation; overlies Tyrone limestone of Highbridge group.

Named for Curdsville Station, Mercer County, Ky.

Curecanti Quartz Monzonite

Curecanti Granite[1]

Precambrian: Central western Colorado.

Original reference: J. F. Hunter, 1925, U.S. Geol. Survey Bull. 777.

Exposed for 3½ miles along Black Canyon, from a point 1½ miles east of Curecanti Creek to Nelson Gulch, Gunnison River region.

†Curl Formation[1]

Pennsylvanian: Northeastern Oklahoma.

Original reference: D. W. Ohern, 1910, Oklahoma State Univ. Research Bull. 4, p. 26.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 100. Abandoned by Oklahoma Geological Survey.

Named for Curl Creek, Nowata County.

Curlew Limestone Member (of Spoon Formation)

Curlew Limestone Member (of Tradewater Formation)[1]

Curlew Limestone (in Macedonia Formation)

Curlew Limestone (in Tradewater Group)

Middle Pennsylvanian: Western Kentucky and southern Illinois.

Original references: D. D. Owen, 1856, Kentucky Geol. Survey, v. 1, pl. showing section of Lower Coal Measures; 1857, Kentucky Geol. Survey, v. 3, p. 13, 23.

J. M. Weller, 1940, Illinois Geol. Survey Rept. Inv. 71, p. 40. Curlew limestone occurs in Macedonia formation about 20 or 30 feet above a more or less local sandstone that lies above the Murray Bluff sandstone. Light gray, compact, and generally 3 to 4 feet thick; contains chert; and locally weathers to a porous cherty residium.

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, 20–21

[1943]. Curlew limestone included in Tradewater group. Occurs in Macedonia cyclothem above Murray Bluff sandstone and below Curlew coal and Curlew sandstone in Stonefort cyclothem. Light-colored limestone, very siliceous and cherty, and locally grades into a bed of solid chert. Thickness variable, maximum 5 to 6 feet. Known from Williamson County, Ill., to Butler County, Ky.

W. H. Smith, 1957, Illinois Geol. Survey Circ. 228, p. 8 (fig. 2), 9. Overlies Creal Springs sandstone (new) in vicinity of Creal Springs.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 32, 45. Reallocated to member status in Spoon formation (new). Overlies New Burnside coal member; underlies O'Nan coal member. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

U. S. Geological Survey has discontinued the use of the name Tradewater in Illinois.

Type locality: South side of Indian Hill, near Curlew, Shawneetown quadrangle, Union County, Ky.

Curlew Sandstone (in Stonefort Formation)

†Curlew Sandstone (in Tradewater Formation)[1]

Curlew Sandstone (in Tradewater Group)

Pennsylvanian: Western Kentucky and southern Illinois.

Original references: D. D. Owen, 1856, Kentucky Geol. Survey, v. 1, pl. showing section of Lower Coal Measures; 1857, Kentucky Geol. Survey, v. 3, p. 13, 23.

J. M. Weller, 1940, Illinois Geol. Survey Rept. Inv. 71, p. 41. Basal sandstone in Stonefort formation. Massive micaceous crossbedded more or less friable member that unconformably overlies Macedonia formation (new).

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]. Included in Stonefort cyclothem, Tradewater group. Occurs above Curlew coal and below Bald Knob coal which is below Stonefort limestone.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 32. Replaced by Granger sandstone member of Spoon formation (both new).

Apparently named for Curlew, Union County, Ky.

Curley bed

Curley limestone member (of Gardner Dolomite)

Mississippian: Central Utah.

T. S. Lovering and others, 1949, Econ. Geology Mon. 1, p. 6 (table 1). A 2-foot bed of light-gray fine-grained wavy-bedded limestone in Gardner dolomite. Underlain by 6 feet of pink lithographic dolomite; overlain by thin-bedded blue limestone.

P. D. Procter and D. L. Clark, 1956, Jour. Sed. Petrology, v. 26, no. 4, p. 313–321. Referred to as member of Gardner. An unusual biostrome. Described in detail and distribution noted.

Crops out over area of at least 600 square miles west of Provo. Type locality and derivation of name not stated.

Currant Tuff

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

G. T. Faust and Eugene Callaghan, 1948, Geol. Soc. America Bull., v. 59, no. 1, p. 33–40. Contains a wide variety of tuffs—crystal tuff, crystal-vitric tuff, vitric-crystal tuff, and vitric tuffs. Thickness ranges from a few feet to over 400 feet. Occurs between two groups of volcanic flows here referred to as lower volcanics and upper volcanics.

C. J. Vitaliano, 1951, U.S. Geol. Survey Bull. 978–A, p. 1, 7–9, pl. 2. Considered to be late Miocene or early Pliocene.

E. F. Cook, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 140 (fig. 4). In Grant Range, overlies Stone Cabin tuff (new) and underlies Windous Butte tuff (new). Windous Butte tuff has K–A age of 34 million years.

Named for Currant Creek area, in White Pine and Nye Counties, 29 miles southwest of Ely. Tuff is the host rock for magnesite in district.

Currant Creek Formation

Currant Creek Formation (in Wasatch Group)

Upper Cretaceous(?): Northeastern Utah.

P. T. Walton, 1944, Geol. Soc. America Bull., v. 55, no. 1, p. 117–120, pls. 1, 2, 3. Proposed for sequence of conglomerates, sandstones, and variegated shales, which, in western part of Uinta Basin, transect Mesaverde Niobraran beds and unconformably underlie Eocene strata of probable Uinta age. Thickness along Red Creek 4,550 feet. Tentatively referred to Upper Cretaceous but probably represents transitional strata deposited from late Upper Cretaceous to Eocene during early phases of Laramide folding.

M. D. Williams, 1950, Utah Geol. Soc. Guidebook 5, p. 106–107. Possibilities of Cretaceous age for Currant Creek and of correlation with conglomerates of Price River formation (as mapped by Spieker) must be considered. In many parts of Wasatch Mountains, thick conglomerates presently and formerly considered as Wasatch unconformably overlie strata of varying ages. Until relationship between these conglomerates and those of Price River formation is understood, seems best to assign Currant Creek to Wasatch group (redefined); considered Paleocene-lower Eocene.

Exposed from Currant Creek to a few miles east of Duchesne River, Wasatch and Duchesne Counties.

Curry Clay Member (of 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. 8. Named in road log.

F. B. Plummer and H. B. Bradley, 1949, Texas Univ. Bur. Econ. Geology Pub. 4915, p. 17–21, pl. 3. Purplish red and greenish red, grading in places into deep maroon. Thickness varies from a few feet to 32 feet depending upon thickness of sand in section above it. Occurs between upper and lower Crystal Falls limestone layers, just above Quinn clay in areas where thick sandstone deposits of Parks Mountain and its probable equivalent, Cisco Lake sandstone, do not occur. [Member of Harpersville formation].

L. F. Brown, Jr., 1960, Texas Univ. Bur. Econ. Geology Rept. Inv. 41, p. 7 (fig. 2), measured sections. Member of Harpersville formation in report on Stephens County. Thickness 1 to more than 15 feet. Overlies Crystal Falls limestone member; underlies unit referred to as "Upper Crystal Falls" limestone member.

Named for Curry Farm, 5 miles south and 2¼ miles west of Breckenridge, Stephens County.

Curry 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. Referred to as iron-bearing member of Vulcan iron-formation. Underlies Loretto slate member; overlies Brier slate member.

Named for exposures north of Curry mine, Menominee district, [Dickinson County].

Curry Mountain 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. Curry Mountain shale is lowermost in sequence (ascending). Underlies Long Canyon sandstone (new). Curry Mountain shale is assigned to Delevanian stage (new). Name credited to J. Q. Anderson.

W. P. Popenoe, R. W. Imlay, and M. A. Murphy, 1960, Geol. Soc. America Bull., v. 71, no. 10, chart 10e (column 15). Shown on correlation chart as member of Panoche formation. Overlies Center Peak conglomerate member (new).

Occurs in Alcalde Hills, Coalinga-Ortigalito area, San Joaquin Valley.

Curtin Limestone (in Black River Group)

Curtin Limestone (in Hunter Group)

Curtin limestone facies (of Oak Hall Member of Nealmont Limestone)

Middle Ordovician (Trentonian): Central Pennsylvania.

G. M. Kay, 1943, Econ. Geology, v. 38, no. 3, p. 194, 197–203. Named as upper unit in Black River group in central Pennsylvania. Consists of impure and relatively pure limestone. Contains five metabentonites, A–E. Subdivided to include Valley View member (new) below and redefined Valentine member above. Thickness about 143 feet at type locality. Thins from 100–150 feet along northwest side of Nittany Valley to extinction along line from Tyrone to north of Lemont, Oak Hall and Spring Mills and south of Millheim. Unconformably underlies Nealmont limestone; overlies Stover member of Benner limestone.

Marshall Kay, 1947, (abs.) Geol. Soc. America Bull., v. 58, no. 12, pt. 2, p. 1199. Assigned to upper Bolarian (Hunterian) series.

Marshall Kay, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. [1402], 1409. Uppermost unit in Hunter group and Hunter subseries (Bolarian series).

Marshall Kay, 1956, Geol. Soc. America Bull., v. 67, no. 1, p. 78, 95, 102. Described as a calcilutite facies of the Oak Hall member of Nealmont limestone. Age changed to Trentonian.

Type section: In quarry wall south of headframe of Bell mine of America Lime and Stone Co. at Bellefonte, Centre County. Named from Curtin Gap 3 miles northeast of Bellefonte.

Curtis Formation (in San Rafael Group)[1]

Upper Jurassic: Southeastern and central Utah and western Colorado.

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. 78–79. In San Rafael Swell, an erosional unconformity displaying irregularities of as much as 50 feet in height occurs at top of Entrada sandstone (new). Resting on this channeled surface is Curtis formation. Consists of series of greenish-gray glauconitic conglomerates, sandstones, and shales, and contains Upper Jurassic fossils. Thickness 193 feet at type locality; 252 feet at Summerville Point, at north end of the Swell; 50 feet near mouth of San Rafael River. Underlies Summerville formation (new) with boundary gradational. San Rafael group.

H. D. Thomas and M. L. Krueger, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 8, p. 1278–1279. Discussion of stratigraphy of Uinta Mountains, Utah. Name Stump is used in Weber River, Duchesne River, and Lake Fork areas so that southeastern Idaho Jurassic terminology is uniform in all western sections. East of Lake Fork, name Curtis is used and along eastern part of mountains, the lithologic character is somewhat different than that on west. In general, the Curtis is made up of basal medium-grained to coarse-grained crossbedded sandstone which rests with sharp contact on subjacent beds [Entrada]. Middle part of formation is greenish-gray shale with intercalated fossiliferous sandstones, limestones, and coquinal limestones. At Whiterocks Canyon and near Vernal and Manila, formation has conspicuous limestone member at top which is characterized by brachiopod genus *Kallirhynchia*. Twin Creek limestone of Sears' (1924, U.S. Geol. Survey Bull. 751–G) Vermilion Creek section is the Curtis.

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, pl. 5. Described in Zion Park region where it is 40 to 50 feet thick; consists of gray roughly bedded limestone and thick gypsum; unconformably overlies Entrada sandstone and unconformably underlies Winsor formation (new).

H. J. Bissell, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 4, p. 599–600. In Strawberry Valley quadrangle, Utah, 725 feet thick; overlies Entrada sandstone, and underlies Morrison formation.

C. B. Hunt, Paul Averitt, and R. L. Miller, 1953, U.S. Geol. Survey Prof. Paper 228, p. 38 (table), 72–73, strat. sections. Described in Henry Mountains region where it is as much as 175 feet thick and consists of evenly bedded gray sandstone and shaly sandstone, glauconitic(?), numerous siliceous geodes and concretions at some places; local thin basal conglomerate. Underlies Summerville formation, unconformably overlies Entrada sandstone.

D. M. Kinney, 1955, U.S. Geol. Survey Bull. 1007, p. 85–89, pls. 1, 2, 6. Described in Uinta River-Brush Creek area, Utah, where it is 144 to 270 feet thick. Unconformably overlies Entrada formation; underlies Morrison formation.

Named for exposures on Curtis Point, near head of Cottonwood Springs Wash, on northeastern side of San Rafael Swell, southeastern Utah.

Curzon Limestone Member (of Topeka Limestone)

Curzon Limestone (in Shawnee Formation)[1]

Pennsylvanian (Virgil Series): Northwestern Missouri, southwestern Iowa, northeastern Kansas, and southeastern Nebraska.

Original reference: J. A. Gallaher, 1898, Missouri Bur. Geology and Mines Bienn. Rept., p. 57.

G. E. Condra and E. C. Reed, 1937, Nebraska Geol. Survey Bull. 11, 2d ser., p. 20, 46, 50–51. Reallocated to member status in Topeka limestone; underlies Jones Point shale member; overlies Iowa Point shale member. Iowa occurrences noted. Type locality designated. [Name spelled Curzen.]

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2035; 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. Member of Topeka formation. Overlies Iowa Point shale member; underlies Jones Point shale member. This is a 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. Variable in texture; commonly divided into two or three units by thin shale partings. Near Thurman, Fremont County, a fine-grained sublithographic brecciated bed that contains soft green shale within the fractures is common near top of member; in Mills County, to the north, upper beds are thicker and contain dark-brown chert; near Howe, Adair County, to the northeast, it is made up of light-gray *Osagia*-bearing bed overlying fine-grained massive fossil-bearing limestone; west of Macedonia, Pottawattamie County, it is composed of alternating shales and limestones. Thins northeastward; thickness 9 feet near Thurman; 6 feet near Macedonia; about 3 feet near Howe. Member of Topeka limestone. Underlies Jones Point shale member; overlies Iowa Point shale member.

Type locality: East of Curzon Station, southeast of Forest City, Holt County, Mo. Reason for change in spelling of name of station since Gallaher's time not known.

Cushing Granodiorite[1]

Late Carboniferous(?): Southwestern Maine.

Original reference: F. J. Katz, 1917, U.S. Geol. Survey Prof. Paper 108, p. 176.

Named for exposures on Cushing Island, in Casco Bay.

†Cushing Limestone Member (of Elmdale Formation)[1]

Pennsylvanian: Central northern Oklahoma.

Original reference: C. N. Gould, 1925, Oklahoma Geol. Survey Bull. 35, p. 80.

Exposed about one-half mile west of Cushing, Payne County.

Cusseta Sand

Cusseta Sand Member (of Ripley Formation)[1]

Upper Cretaceous: Western Georgia and eastern Alabama.

Original reference: J. O. Veatch, 1909, Georgia Geol. Survey Bull. 18, p. 86–89.

C. W. Cooke and A. C. Munyan, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 7, p. 790–791. Rank raised to formation. In western

Georgia, overlaps Blufftown and Eutaw formations in Marion County and extends eastward on the Tuscaloosa as far as Peach County, where it is overlain by basal Eocene Clayton formation. Above the Cusseta is more than 100 feet of dark-gray micaceous sand representing the Ripley formation.

L. W. Stephenson and W. H. Monroe, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 12, p. 1643 (fig. 2), 1649–1650. Geographically extended into eastern Alabama where it merges into Selma chalk; merging takes place in an east-west stretch of 15 or 20 miles in region south of Montgomery; intertonguing consists of two main westward extending tongues of sand, one below and one above an eastward extending tongue of chalk. In its westward continuation through Alabama, the updip near-shore facies of Cusseta becomes a coarse sand with fine-gravel lenses in basal part. North-facing escarpment known as Chunnenuggee Ridge, which extends from Union Springs eastward toward Chattahoochee River, is physiographic expression of the Cusseta. Underlies Ripley formation; presence of unconformity separating the two not established.

D. H. Eargle, 1948, Southeastern Geol. Soc. 6th Field Trip [Guidebook]. p. 44, 45. In this report [Cretaceous of east-central Alabama], the Cusseta is considered a member of Ripley formation.

Named for exposures in vicinity of Cusseta, Chattahoochee County, Ga.

Cussewago Limestone[1]

Devonian or Carboniferous: Northwestern Pennsylvania.

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

Cussewago Sandstone[1]

Cussewago Stage

Mississippian: Northwestern Pennsylvania and eastern Ohio.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. Q_4, p. 91–98, 202, 203, 204, 205 (fig. 63).

W. M. Laird, 1941, Pennsylvania Geol. Survey Prog. Rept. 126, p. 12–16. Discussed as Cussewago stage in lower part of Oil Lake series. Includes interval between Berea stage above and Riceville stage below.

Wallace de Witt, Jr., 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 21. Discussion of relationship of Berea, Corry, and Cussewago sandstones in Ohio and Pennsylvania. Bedford shale has been traced eastward across Ohio into Pennsylvania where it lies below Berea and above the Cussewago sandstone. In Pennsylvania, name Cussewago was first applied to this shale by White, and later name Hayfield was substituted by Chadwick (1925, Geol. Soc. America Bull., v. 36, no. 3). Cussewago limestone of White, renamed Hayfield by Chadwick and redefined as Littles Corners by Caster (1934, Bulls. Am. Paleontology, v. 21, no. 71) is described as occurring in this shale in Bartholomew quarry (outcrops 55 of this report). Name Cussewago as originally applied by White included sandstone and shale below Berea in outcrop at Bartholomew quarry. Because of lack of formal description, name has been redefined by later workers and extended beyond areal limits of the sandstone. However, Cussewago sandstone forms a mappable lithologic unit and is best horizon marker in its outcrop area. Cussewago sandstone merits rank of formation and is here defined as the typical friable greenish-brown medium-grained quartz sandstone below Bedford shale at Bartholomew quarry. Here, top of Cussewago lies 37 feet below graphic siltstone layer at base of Orangeville shale and 29 feet below top of Berea sandstone. This section is on a tributary of Cussewago Creek, which is type locality of Cussewago as cited by White. Cussewago sandstone has been designated by Caster (1934) as western facies of Cobham conglomerate of Warren, Pa., region. The two are separated horizontally by shales and cannot be traced into one another. Recognition of Cussewago as independent unit lying below Berea sandstone, and separated by Bedford shale from that sandstone, has not been general. Inclusion of Cussewago and Bedford in Berea in Ohio is largely responsible for introduction of hypothetical threefold Berea formation in Ohio. Mississippian.

Wallace de Witt, Jr., 1951, Geol. Soc. America Bull., v. 62, no. 11, p. 1351 (fig. 3), 1353–1354, 1362. In Crawford County, Pa., underlies Shellhammer Hollow formation (new). Underlies Riceville shale.

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 in Cussewago Valley, Crawford County, Pa. Exposed in Bartholomew quarry, Hayfield Township.

†Cussewago Shales[1]

Devonian or Carboniferous: Northwestern Pennsylvania.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. Q_4, p. 94–96.

Wallace de Witt, Jr., 1951, Geol. Soc. America Bull., v. 62, no. 11, p. 1356, 1366. In Bartholomew section, Hayfield Township, White reported 35 feet of Cussewago shale, including 2 feet of limestone near the top, between his Cussewago sandstone and his Corry sandstone. Bedford shale has been traced into this outcrop, where it lies between Cussewago sandstone and White's Corry. Bedford has priority; recommended that name Cussewago shale be dropped from literature.

Named for exposures in Cussewago Valley, Crawford County.

Cussewago Slate[1] or monothem[1]

Mississippian: Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 53, 103, table opposite p. 61.

Custards shale member[1] (of Meadville Stage)

Mississippian: Northwestern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 137.

Well exposed at Peterson's Falls, on Rocky Creek, 2 miles west of Custards, Crawford County.

Custer Formation[1] or Group

Triassic, (?): Oklahoma, Kansas, and Texas.

Original reference: R. Roth, 1932, Jour. Geology, v. 40, no. 8, p. 688–725.

Robert Roth, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 4, p. 421–474. Trace of unconformity at base of Custer mapped from Wheeler County southward to Coke County, Tex. Suggested that beds occupying interval between base of Dockum and the unconformity mapped be given one formation name, Custer, and that names now in usage be confined to the facies which they represent. In Collingsworth and Wheeler Counties, contact between base of Custer and older beds is one of sandstone resting on shale or gypsum. In Collingsworth and Hall Counties, includes Dozier Mounds dolomite member. In Childress and Cottle Counties, Childress dolomite is 3 to 20 feet above base of Custer. In King and Stonewall Counties, base is sandstone or gypsum. In Fisher, Nolan, and Coke Counties, base is marked by sandstone or anhydrite and a fine quartz conglomerate. In these counties, Eskota dolomite is from a few feet to 20 feet above base. Sediments below are shale, sandstones, or gypsum, or the "Blaine of Texas." In Nolan and Coke Counties, pre-Custer erosion has removed most of "Blaine of Texas," and the Custer rests on upper sandstone facies of the San Angelo. Terms Cloud Chief, Quartermaster, and Whitehorse have been very loosely applied to sediments of Custer age in Texas.

Ira Cram, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 4, p. 474. In Andarko basin, Oklahoma, Roth's Custer formation would include sediments between base of Marlow formation and the Tertiary. In this area, there are unconformities which separate Marlow formation from Rush Springs formation and the Rush Springs from higher sediments. These mechanical changes may or may not be recognizable in other areas, but their presence over several counties in Oklahoma satisfied requirements for dividing Custer unit into formations. Custer cannot be correctly termed a formation because it contains within its boundaries good formations. Term Custer is an Oklahoma term, and Oklahoma conditions are important. Custer unit is correctly classified as a 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.

Robert Roth, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 8, p. 1412, 1413. Overlies Pease River group (new).

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 100. Abandoned by Oklahoma Geological Survey. Roth grouped the Whitehorse, Cloud Chief, and Quartermaster and considered them of Triassic age. Grouping is not recognized, and name is not used.

Named for Custer County, Okla., where almost whole formation is exposed.

Custer Granite Gneiss[1]

Jurassic(?): Southwestern British Columbia, Canada, and central northern Washington.

Original reference: R. A. Daly, 1912, Canada Geol. Survey Dept. Mines Mem. 38, map 15.

Forms Custer Ridge, British Columbia.

Custerian series[1]

Early Cretacic: South Dakota.

Original reference: C. R. Keyes, 1925, Pan-Am. Geologist, v. 43. p. 109, 125, 126.

Well exposed in Black Hills. Named for exposures in Custer County, S. Dak.

Cutalossa Member (of Stockton Formation)

[Upper Triassic]: East-central New Jersey.

M. E. Johnson and D. B. McLaughlin, 1957, Geol. Soc. America Guidebook Atlantic City Mtg., p. 52–53 (table). Medium to coarse thick-bedded arkose with interbeds of red-brown fine sandstone. Thickness 232 feet. May or may not include overlying 787 feet of red and gray sandstone and red shale and underlying 373 feet of red and brown sandstone [see Stockton formation]. Older than Raven Rock member (new); younger than Prallsville member (new).

In area along Delaware River from Stockton northward to 3 miles west of Milford, Hunterdon County.

Cutbank Sand'

Cut Bank Sandstone

Jurassic or Lower Cretaceous: Northwestern Montana (subsurface and surface).

Compiler unable to locate original reference.

R. J. Weimer, 1959, Billings Geol. Soc. Guidebook 10th Ann. Field Conf., p. 88. Surface section of Cut Bank sandstone shows an intertonguing in the lower 10 feet of gray medium- to coarse-grained sandstone (Cut Bank) and laminated glauconitic sandstone and siltstone (Swift). Jurassic. Editors note states that Weimer's correlations of the Cretaceous Jurassic section differ radically from those in other articles of the guidebook.

Surface section measured in NE¼ sec. 34, T. 30 N., R. 11 W., in Cut Bank area.

Cutler cyclothem (in McLeansboro Group)

Pennsylvanian: Southern Illinois.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, pl. 1. Shown on correlation chart as underlying Gimlet cyclothem and overlying Bankston cyclothem. Includes Cutler limestone and Cutler coal.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 43. Strata of cycle now referred to Sparland cyclothem, but strata included in cycle in southern and southwestern Illinois do not include all strata included in Sparland. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification independent of rock-stratigraphic classification.

Type locality: Secs. 2 and 3, T. 6 S., R. 4 W., Perry County.

Cutler Formation[1]

Cutler Group

Permian: Southwestern Colorado, northeastern Arizona, northwestern New Mexico, and southeastern Utah.

Original reference: W. Cross and E. Howe, 1905, U.S. Geol. Survey Geol. Atlas, Folio 120.

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. Includes (ascending) Halgaito tongue, Cedar Mesa sandstone tongue (new), Organ Rock tongue (new), White Rim sandstone member (new), DeChelly sandstone member, and Hoskinnini tongue (new).

L. G. Henbest, 1948, (abs.) Geol. Soc. America Bull., v. 59, no. 12, pt. 2, p. 1330. On basis of fossil evidence, at least part of redbeds of Cutler at type locality are believed to be of Pennsylvanian age.

C. B. Hunt, Paul Averitt, and Ralph Miller, 1953, U.S. Geol. Survey Prof. Paper 228, p. 39–45, pls. 1, 15. Formation includes all Permian rocks exposed in canyons east of Henry Mountains. Divided into three members (ascending) : Cedar Mesa sandstone, Organ Rock tongue, and White River sandstone. In Monument Valley, southeastern Utah and northeastern Arizona, comprises (ascending) Halgaito tongue, Cedar Mesa sandstone member, Organ Rock tongue, DeChelly sandstone member, and Hoskinnini tongue.

S. A. Wengerd and J. W. Strickland, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 10, p. 2174. Includes Rico basal member. Overlies Hermosa formation. [See Hermosa formation for explanation of "R" datum.]

George Herman and S. L. Sharps, 1956, Intermountain Assoc. Petroleum Geologists [Guidebook] 7th Ann. Field Conf., p. 81. Rico should not be considered basal unit of Cutler.

S. A. Wengerd and M. L. Matheny, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 9, p. 2054, 2055 (fig. 3). Rank raised to group. Includes (ascending) Rico transition facies, Halgaito formation, and Cedar Mesa formation. Overlies Hermosa group.

J. H. Stewart, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 1854–1856, 1857 (fig. 3). In most of southeastern Utah and southwestern Colorado, Cutler formation of Permian age overlies Rico formation of Pennsylvanian and Permian(?) age and underlies Moenkopi formation of Triassic(?) and Early and Middle(?) Triassic age. In salt anticline region, the Cutler is absent over crests of some anticlines and pinches out northeast along southwestern edge of Uncompahgre Plateau. In southwestern Utah, consists of reddish-brown horizontally bedded siltstone and sandstone redbed tongues with light-colored very fine- to fine-grained cross-stratified sandstone members. In Monument Valley, members, as recognized in this report, are (ascending) Halgaito tongue, about 400 feet thick; Cedar Mesa sandstone member, about 800 feet; Organ Rock tongue, about 500 feet; and DeChelly sandstone member, about 300 feet. Formation is stratigraphically restricted above to exclude Hoskinnini member which is reallocated to Moenkopi formation. Thickness about 2,000 feet in southern part of southeastern Utah; thins irregularly northward to about 700 feet in some parts of east-central Utah; zero to several thousand feet in salt anticline region; maximum thickness not known.

R. O. Lewis, Sr., and R. H. Campbell, 1959, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–194. Mapped in Elk Ridge 3 NE quadrangle, San Juan County, Utah. Includes Cedar Mesa sandstone member, Organ Rock tongue, and Hoskinnini tongue. Overlies Rico formation; underlies Moenkopi formation.

Named for exposures on Cutler Creek, which enters Uncompahgre River about 4 miles north of Ouray, Ouray County, Colo.

Cutler Limestone (in McLeansboro Group)

Cutler Limestone Member (of McLeansboro Formation)[1]

Pennsylvanian: Southern Illinois.

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

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. 17 (fig. 3), 25–26. Columnar section shows Cutler limestone in McLeansboro group. In St. Clair, Perry, and Randolph Counties, the Cutler is a light-gray bed about 5 feet thick which lies about 15 feet above Bankston Fork limestone. Included in Gimlet cyclothem.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 11, pl. 1. Correlation chart shows Cutler limestone in Cutler cyclothem (new) and in Sparland cyclothem. Type locality given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 37. Replaced by Piasa limestone member of Modesto formation (new).

Type locality: Secs. 2 and 3, T. 6 S., R. 4 W., Perry County. Named for exposures in vicinity of Cutler.

Cutoff Shaly Member (of Bone Spring Limestone)

Permian (Leonard Series): Southern New Mexico and western Texas.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 569–570, pl. 2. Consists of several hundred feet of buff, dove-gray, or black thin-bedded limestones and siliceous shales at top of formation. Assigned to the Bone Spring because, 2 miles north of Bone Spring, the beds are truncated and overlain unconformably by Delaware Mountain group. At type locality, overlies Victorio Peak gray member. In some areas, lies between the Victorio Peak gray member and the sandstone tongue of the Cherry Canyon formation; in other areas, underlies Brushy Canyon formation.

P. B. King, 1948, U.S. Geol. Survey Prof. Paper 215, p. 16, 18, 24, pl. 3 [1949]. Name Cutoff shaly member given to discontinuous sets of beds at top of Bone Spring limestone exposed in three general districts: area from which it is named; Shumard Canyon, where it is separable into two divisions; and along base of Delaware Mountains. Mapped in New Mexico.

Type exposure: On west face of Cutoff Mountain near Texas-New Mexico line.

Cutright Sandstone Member[1] (of Edwardsville Formation)

Lower Mississippian: Southern Indiana.

Original reference: P. B. Stockdale, 1931, Indiana Dept. Conserv., Div. Geology Pub. 98, p. 76, 118, 181, 182, 189, 212, 250.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 74. Cutright sandstone, Weed Patch, and Mount Ebel sandstone members included in Allens Creek facies of Edwardsville. Lower Mississippian.

Named derived from Cutright Bridge across Salt Creek, center sec. 4, T. N., R. 1 E., from Cutright Ridge to the south, and from the Cutright community, Monroe County.

Cutter Member (of Montoya Formation)

Cutter Formation or Dolomite (in Montoya Group)

Upper Ordovician: Southern New Mexico.

V. C. Kelley and Caswell Silver, 1952, New Mexico Univ. Pubs, in Geology 4, p. 57, 62–64, fig. 4. Thin sequence of light-gray-weathering generally unfossiliferous claystone, limestone, calcitic dolomite, and dolomite in

Caballo Mountains. Limestone is medium gray to dark gray on fresh surfaces and weathers blue gray. Dolomite is light gray to dark gray and along with the calcitic dolomite weathers light gray or light tan. Both limestone and dolomite are generally microgranular or sublithographic. Chert present as occasional bands parallel to bedding or as rounded nodules; it is dark gray to black on fresh exposure and weathers black. Thickness 121 to 162 feet in Mud Springs Mountains, from 50 to 115 feet from Palomas Gap south, and 130 feet at Granite Wash. Conformably overlies Aleman formation (new). Underlies Percha formation at north end of San Andres Mountains. Unit here named Cutter was called Fusselman(?) by Darton (1917, U.S. Geol. Survey Prof. Paper 108–C; 1928, U.S. Geol. Survey Bull. 794). Montoya group.

L. C. Pray, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 8, p. 1907 (footnote). Cutter formation (name pub. by Kelley and Silver after submission of ms. for present rept.) is probably correlative with Valmont dolomite (new) of Sacramento Mountains.

F. E. Kottlowski and others, 1956, New Mexico Bur. Mines Mineral Resources Mem. 1, p. 1, 26. Term Cutter, as applied by Kelley and Silver (1952) to lower part of Richardson's (1909) Fusselman, has priority over Pray's (1953) term Valmont, but agewise should yield to Entwhistle's (1944) term Raven. Where not eroded by pre-Onate erosion, the Cutter is relatively uniform in thickness beneath Fusselman dolomite, being 168 feet in Ash Canyon and 182 feet in Hembrillo Canyon. In Rhodes Canyon, only lower beds are present, and thickness varies from 26 to 75 feet. Cutter, however, has been used more often in south central New Mexico. Overlies Aleman dolomite. Unconformably underlies Fusselman dolomite in Ash and Hembrillo Canyons, and Onate formation in Rhodes Canyon. Montoya group.

Dorothy Hill, 1959, New Mexico Bur. Mines Mineral Resources Bull. 64, p. 3. Cutter formation (uppermost Montoya) is Upper Ordovician or Lower or Middle Silurian. Determination based on study of corals.

Type locality: Cable Canyon section opposite Sierrite mine in NW¼ sec. 10, T. 16 S., R. 4 W., Caballo Mountains.

Cutting Dolomite

Cutting Dolomite (in Beekmantown Group)

Lower Ordovician: West-central Vermont.

W. M. Cady, 1945, Geol. Soc. America Bull., v. 56, no. 5, p. 524, 539–540, 541–542, 543. Sequence of dolomite beds averaging 1 or 2 feet in thickness. At base is thinly laminated sandstone that bears worm boring "*Scolithus.*" Nodules of black chert occur in upper part of the dolomite. Thickness about 350 feet. Underlies Bascom formation (new); overlies Shelburne marble. Corresponds to Division C of the "Calciferous" of Brainerd and Seely (1890, Am. Mus. Nat. History Bull., v. 3). Beekmantown group (Beekmantownian).

Type locality: On eastern dip slope of Cutting Hill in southeastern Shoreham Township, Addison County.

Cuyahoga Group[1] or Formation[1]

Cuyahoga Formation (in Pocono Group)

Mississippian: Ohio and western Pennsylvania.

Original reference: J. S. Newberry, 1870, Ohio Geol. Survey Rept. Prog. 1869, p. 21.

J. E. Hyde, 1915, Jour. Geology, v. 23, p. 655–682. Formation includes five facies: Toboso conglomerate, Hocking Valley conglomerate, Granville shale, Scioto Valley shale, and Vanceburg sandstone. Named members: Berne, Black Hand, Buena Vista, Churn Creek, Fairfield, Henley, Lithopolis, Raccoon, and Rarden.

H. P. Cushing, Frank Leverett, and F. R. Van Horn, 1931, U.S. Geol. Survey Bull. 818, p. 48–54, pl. 20. Cuyahoga, in its typical area, is elevated to rank of group. Comprises (ascending) Orangeville shale, Sharpsville sandstone, and Meadville shale. Thickness 165 to 425 feet. As generally recognized in Ohio, overlies Sunbury shale, a thin representative of which is present in basal part of Orangeville shale. Unconformable below Sharon conglomerate.

F. T. Holden, 1941, Illinois Acad. Sci. Trans., v. 34, no. 2, p. 172; 1942 Jour. Geology, v. 50, no. 1, p. 34–67. Seven lithologic facies, each subdivided into a varying number of members and submembers are recognized in Cuyahoga formation: Tinkers Creek shale (new), River Styx conglomerate (new), Killbuck shale (new), Toboso conglomerate, Granville shale, Hocking Valley conglomerate, and Henley shale. Facies named in progressive order from northeastern Ohio to south-central Ohio. Cuyahoga directly underlies Logan formation. Named members: Meadville shale, Sharpsville sandstone, Orangeville, Black Hand conglomerate, Armstrong sandstone, Black Hand shale, Burbank, Pleasant Valley Black Hand siltstone, Raccoon shale, Fairfield sandstone, Lithopolis siltstone, and Henley shale. Sunbury shale not recognized as distinct formation in area of this report; all black shale immediately overlying Berea sandstone is included in Orangeville member of Cuyahoga.

P. A. Dickey, 1941, Pennsylvania Geol. Survey, 4th ser., Bull. M–22, p. 5. Group, in Titusville quadrangle, is 130 to 150 feet thick. Not subdivided in this area. Overlies Corry sandstone; underlies Shenango group.

Wilber Stout, Karl Ver Steeg, and G. F. Lamb, 1943, Ohio Geol. Survey, 4th ser., Bull. 44, chart facing p. 108. Formation, as shown on generalized section, comprises (ascending) Henley, Buena Vista, Portsmouth, Black Hand, and Berne members. Overlies Sunbury; underlies Logan.

P. A. Dickey, R. E. Sherrell, and L. S. Matteson, 1943, Pennsylvania Geol. Survey, 4th ser., Bull. M–25, p. 18–20, map. Cuyahoga group, in Oil City quadrangle, includes strata between basal member (A) of Shenango formation and Corry sandstone of Berea group. Thickness about 140 feet. Consists of alternating beds of shale and sandstone. Group not subdivided.

J. F. Pepper, Wallace de Witt, Jr., and D. F. Demarest, 1954, U.S. Geol. Survey Prof. Paper 259, p. 10 (fig. 4), 13. Group comprises (ascending) Sunbury shale, Orangeville shale, Sharpsville sandstone, and Meadville shale. Overlies Berea sandstone.

J. F. Hall, 1958, Dissert. Abs., v. 18, no. 2, p. 559. Southern Hocking County, Ohio, contains strata ranging in age from Kinderhook-Osage series of Mississippian to Conemaugh series of Pennsylvanian. Oldest outcropping unit, the Cuyahoga shale member of Cuyahoga formation, consists of about 75 feet of interbedded shales and sandstones. Overlying and grading into shale member in a facies relationship is Black Hand member, composed of 175 feet of coarse-grained sandstone and lenses of conglomerate. Disconformably underlies Logan formation of Osage series.

E. J. Szmuc, 1958, Dissert, Abs., v. 18, no. 6, p. 2109. Cuyahoga rocks are marine clastic deposits, which include fine-grained shelf sediments and coarse-grained deltaic or bar sediments. Maximum thickness about 600 feet in northern Ohio. Formation comprises (ascending) Orangeville, Sharpsville, Strongsville (new), Meadville, Rittman, Armstrong, Wooster (new), and Black Hand. Cuyahoga-Shenango contact in northwestern Pennsylvania and northeastern Ohio is conformable. Cuyahoga-Logan contact in Wayne and Ashland Counties, Ohio, locally is surface of minor disconformity. In most of northern Ohio, a major unconformity separates Cuyahoga strata from Lower Pennsylvanian rocks.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Mapped in Pocono group.

Named for exposures along Cuyahoga River, between Akron and Cleveland, Ohio.

Cuyama Formation[1]

Cuyama Beds

Pliocene(?): Southern California.

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

Chester Stock, 1947, Southern California Acad. Sci., v. 46, pt. 2, p. 84–85. New faunal evidence indicates Miocene age for Cuyama beds.

Crops out in Cuyama Valley, Ventura County.

Cuyamaca Gabbro

Cuyamaca basin intrusive[1]

Upper Cretaceous: Southern California.

Original reference: F. S. Hudson, 1922, California Univ. Pub., Dept. Geol. Sci. Bull., v. 13, no. 6, 181, 192–207.

S. C. Creasey, 1946, California Jour. Mines and Geology, v. 42, no. 1, p. 18, 19–21, pl. 3. Described in Julian-Cuyamaca area as Cuyamaca gabbro. Youngest rock in area; intrusive into Julian schist and Stonewall quartz diorite.

Richard Merriam, 1946, Geol. Soc. America Bull., v. 57, no. 3, p. 234. Mapping in Ramona area has shown that Cuyamaca basic intrusive (Hudson, 1922) and San Marcos gabbro (Miller, 1937) are probably the same. In this area, name San Marcos gabbro is applied.

D. L. Everhart, 1951, California Div. Mines Bull., 159, p. 66–74, pls. 3, 4, 5. Described in Cuyamaca Peak quadrangle. Writer followed Creasey (1946) in referring to rocks as Cuyamaca gabbro, thereby retaining original locality name given by Hudson, but substituting more appropriate gabbro for term basic intrusive. Considered older than Green Valley tonalite.

Named for the three peaks of Cuyamaca Mountains, Ramona and Cuyamaca quadrangles, San Diego County.

Cuyuna Member (of Crow Wing Formation)[1]

Precambrian (Huronian): Central Minnesota.

Original reference: C. Zapffe, 1930, Lake Superior Min. Inst. Proc., v. 28, p. 101–106.

Cuyuna district, Crow Wing County.

†Cuyuna Series[1]

Cuyuna Slates

Precambrian (Huronian): Central Minnesota.

Original reference: C. K. Leith, 1907, Econ. Geology, v. 2, p. 145–152.

G. M. Schwartz, 1951, Geology of the Cuyuna Range: Minnesota Univ. Center for Continuation Study Mining [Geology] Symposium [No. 2], p. 3. For the most part, the Cuyuna slates have been considered to belong to the Virginia slate. This correlation has very little evidence to support it.

Occurs in Cuyuna Range, Crow Wing County.

Cygnian Substage

Pennsylvanian (Desmoinesian): Missouri, Iowa, Kansas, Nebraska, and Oklahoma.

W. V. Searight *in* W. B. Howe and W. V. Searight, 1953, Missouri Geol. Survey and Water Resources Rept. Inv. 14, pl. 1. Named on a stratigraphic column of Carroll and Livingston Counties, Mo. Comprises Cabaniss and Marmaton groups.

W. V. Searight and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 12, p. 2748 (fig. 1), 2749. Shown on a northern midcontinent composite stratigraphic column. Cygnian substage together with underlying Venteran substage (new) make up the Desmoinesian stage.

W. V. Searight, 1955, Missouri Geol. Survey and Water Resources Rept. Inv. 20, p. 22. Type area stated.

Type area: Along Marais des Cygnes River (Little Osage) in Vernon County, Mo., and to west in Bourbon and Lynn Counties, Kans.

Cynthia Falls Sandstone (in Tuxedni Group)

Cynthia Falls Sandstone Member (of Tuxedni Formation)

Middle Jurassic: Central southern Alaska.

L. B. Kellum, 1945, New York Acad. Sci. Trans., ser. 2, v. 7, no. 8, p. 203 (table 1). Medium-grained gray sandstone grading horizontally into alternating sandstone and conglomerate. Thickness 800 feet.

C. E. Kirschner and D. L. Minard, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 95 [1949]. Thick-bedded to massive, medium- to coarse-grained sandstone. Dark gray green; weathers light gray. Contains many lenticular layers of subrounded pebbles. Bed of arenaceous siltstone, from 50 to at least 100 feet thick, present near middle of member. Member 600 to 900 feet thick. Underlies Bowser member (new); overlies unnamed siltstone member. Derivation of name and geographic distribution given.

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

Named for conspicuous waterfall on Hardy Creek. Forms hogback ridges along flanks of Tonnie syncline and Fitz Creek anticline and well exposed in nearly all creeks tributary to Fitz Creek from the west; in **Iniskin Peninsula.**

Cynthiana Formation[1]

Middle Ordovician: East-central Kentucky, southern Indiana, and southwestern Ohio.

Original reference: A. F. Foerste, 1906, Kentucky Geol. Survey Bull. 7, p. 10, 13, 14, 211–212.

A. C. McFarlan, 1938, Geol. Soc. America Bull., v. 49, no. 6, p. 992–995. Several names have been applied to different members of the Cynthiana. There is confusion in the literature in regard to the relationships, due both to regional variation in lithology and fauna, and to overlap. Formation as defined herein comprises following members: Rogers Gap, Greendale, Millersburg, Nicholas limestone, Bromley, and Gratz; in southern and western Bluegrass are other pre-Greendale beds that are characterized by a fauna not known elsewhere in central Kentucky. Thickness 38 to 125 feet. Marked unconformity at base; formation rests at different places on all formations from top of Perryville (Cornishville) to Jessamine formation (in Lexington limestone). Underlies Eden.

A. C. McFarlan, 1943, Geology of Kentucky: Lexington, Ky., Kentucky, Univ., p. 11 (footnote), 19–23. Name Sulphur Well member proposed for beds below Greendale member.

A. C. McFarlan and W. H. White, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1641–1645. Lexington-Cynthiana-Eden is probably a conformable succession. Cynthiana consists of fossiliferous limestone and shale 40 to 100 feet thick varying in character in different parts of area. Following divisions discussed: Greendale, Millersburg, Nicholas limestone, Rogers Gap beds, Bromley shale, Gratz shale, and *Allonychia* zone. Facies of divisions change from place to place. Unit formerly termed Sulfur [Sulphur] Well member is herein considered facies of upper Lexington. Pre-Cincinnatian.

D. K. Hamilton, 1950, Kentucky Geol. Survey, ser. 9, Bull. 5, p. 18. All subdivisions of interval between top of Benson limestone and base of Eden formation should be referred to as members of Cynthiana. This would include as members the lithologic and paleontologic units heretofore defined as Brannon, Woodburn, Greendale, Millersburg, Nicholas, Rogers Gap, Bromley, and Gratz.

L. H. Lattman, 1954, Am. Jour. Sci., v. 252, p. 257–276. Rogers Gap [member of Cynthiana] formation, uppermost member of the Mohawkian, and overlying Fulton shale, lowermost member of the Cincinnatian, are faunally indistinguishable in area of this report [Ohio Valley around Cincinnati]. They appear to be lithologic facies of same time-rock unit. Evidence indicates advisability of extending Cincinnatian series downward to embrace Cynthiana formation, rather than including it in the Mohawkian as has been common practice.

F. R. Hall and W. N. Palmquist, Jr., 1960, U.S. Geol. Survey Hydrol. Inv. Atlas HA–25. Generalized columnar section of rocks in Carroll, Gallatin, Henry, Owen, and Trimble Counties, Ky., shows Cynthiana formation, 80 to 173 feet thick, above Benson limestone member of Lexington and below Eden formation. Includes Woodburn limestone member at base, and Devils Hollow facies above; upper part formation unnamed. Middle Ordovician.

Named for Cynthiana, Harrison County, Ky.

Cypress Sandstone[1]

Cypress Sandstone (in Homberg Group)

Upper Mississippian (Chester Series): Southern Illinois, northwestern Alabama, southern Indiana, western Kentucky, and Tennessee.

Original reference: H. Engelmann, 1868, St. Louis Acad. Sci. Trans., v. 2, p. 189–190; paper read in 1862.

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), 830. Assigned to Homberg group (new). In standard Mississippian section, underlies Golconda formation and overlies Paint Creek formation.

T. G. Perry and N. M. Smith, 1958, Indiana Geol. Survey Bull. 12, p. 27, pl. 1. In Indiana, Cypress sandstone is 25 to at least 40 feet thick. Typically cream-white to light-tan fine-grained subangular well-sorted sandstone in which thinner beds are laminated locally; in some places, massive and crossbedded. Sandstone herein referred to as Cypress can be traced into the thick-bedded Big Clifty sandstone. Correlation of the Beech Creek limestone of Indiana with the Chester section of Illinois is uncertain at this date. If future investigations show that Beech Creek is equivalent to the lower part of Golconda formation of southern Illinois, beds herein termed Cypress should be designated Big Clifty.

S. W. Welch, 1958, U.S. Geol, Survey Oil and Gas Inv. Chart OC–58. In northwestern Alabama, Mynot sandstone member of Pride Mountain formation (both new) is equivalent to strata referred to by Butts (1926, Alabama Geol. Survey Spec. Rept. 14) as Cypress sandstone.

Named for exposures on Cypress Creek, southeastern Union County, Ill.

Cypress Creek Chert[1]

Lower Devonian: Southwestern Tennessee.

Original reference: C. O. Dunbar, 1917, Geol. Soc. America Bull., v. 28, p. 207.

Cyprian Sandstone Member (of Thermopolis Shale)

Lower Cretaceous: Northeastern Montana.

M. M. Knechtel, 1959, U.S. Geol. Survey Bull. 1072–N, p. 739–740, pls. 52, 53. Name applied to prominent sandy unit near middle of Thermopolis. Thickness about 25 feet. Unit has been referred to as Muddy sand.

Typically exposed in Cyprian Creek on southwest side of road that crosses NE¼NW¼ sec. 31, T. 25 N., R. 24 E., 2 miles southwest of Landusky, Phillips County, Little Rocky Mountains.

Cyrene Member (of Edgewood Limestone)[1]

Silurian (Albion Series): Northeastern Missouri and southwestern Illinois.

Original reference: T. E. Savage, 1913, Geol. Soc. America Bull., v. 24, p. 361, 376.

T. J. Laswell, 1957, Missouri Geol. Survey and Water Resources Rept. Inv. 22, p. 16, 17, 18, 19. Described in Bowling Green quadrangle where it is typically a light-gray to dusky brown finely crystalline limestone. Includes Noix oolitic facies, which. at Clinton Springs, is about 7 feet 2 inches thick; maximum thickness of Cyrene 17 feet. Underlies Bowling Green member.

Named for exposures at Cyrene, Pike County, Mo.

†Cyril Gypsum Member[1] (of Greer Formation)

Permian: Central Oklahoma.

Original reference: F. G. Clapp, 1920, Mining and Metall., Am. Inst. Mining and Metall. Engineers, no. 158, sec. 27, Feb. 1920.

Named for exposures near Cyril, Caddo County.

Dadina Schist[1]

Mississippian: Southeastern Alaska.

Original reference: W. C. Mendenhall, 1905, U.S. Geol. Survey Prof. Paper 41, p. 27, map.

Occurs along south side of a tributary of Dadina River that drains from flanks of Snider Peak.

Dagger Flat Sandstone[1]

Dagger Flat Formation

Upper Cambrian: Southwestern Texas.

Original reference: P. B. King, 1931, Am. Assoc. Petroleum Geologists Bull., v. 15, no. 9, p. 1064–1066.

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. Dagger Flat formation subdivided at type locality into Buttrill Ranch member (new) below and Roberts Ranch member (new) above.

Type locality: South side of Dagger Flat northeast of Buttrill Ranch, Brewster County. Exposed in long narrow belts in center of anticlines in both Marathon and Dagger Flat anticlinoria.

Dagmar Dolomite

Dagmar Limestone[1]

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), 6–7. In East Tintic Mountains, consists of dense medium- to light-gray laminated dolomitic limestone that weathers creamy white. Thickness 75 to 100 feet. Underlies Herkimer limestone, contact sharp; overlies Teutonic limestone, contact commonly gradational through 10 feet or more, base placed at base of lowermost laminated bed. Type locality indicated.

J. K. Rigby, 1958, Utah Geol. Soc. Guidebook 13, p. 14 (fig. 3), 16–17. In Stansbury Mountains, commonly less than 20 feet thick and consists of light-medium-gray finely crystalline dolomite; distinctly laminated. Overlies Teutonic limestone; underlies Herkimer limestone.

Type locality: Near Dagmar mine, 1 mile west-northwest of Eureka, Juab County.

Dagmar Limestone Member (of Ute Formation)

Middle Cambrian: Southeastern Idaho and northern Utah.

G. B. Maxey, 1955, Dissert. Abs., v. 15, no. 4, p. 558. Incidental mention.

Dake Quartzite[1]

Precambrian: Central southern Wisconsin.

Original reference: A. Leith, 1935, Kansas Geol. Soc. Rept. 9th Ann. Field Conf., p. 329–330, fig. 216.

Well exposed on south bank of Baraboo River, near west Baraboo, and on a low ridge 2 miles east of Baraboo on north side of main highway from Baraboo to Portage, Sauk County.

Dakin Hill Member (of Littleton Formation)

Lower Devonian: Southwestern New Hampshire.

M. T. Heald, 1950, Geol. Soc. America Bull., v. 61, no. 1, p. 45 (fig. 2), 54–55, pl. 1. Uppermost part of Littleton formation in Lovewell Mountain quadrangle. Consists of porphyproblastic orthoclase gneiss, biotite-quartz gneiss, biotite-sillimanite gneiss and pyritiferous gneiss. Evidence of bedding rare and foliation poorly developed. Thickness undetermined, the breath of outcrop may mean that the thickness is of the order of 10,000 feet. Overlies May Pond member (new). Occupies a large area extending from southern boundary to northern boundary of quadrangle.

C. A. Chapman, 1952, Geol. Soc. America Bull., v. 63, no. 4, p. 387, 390–391, pl. 1. In Sunapee quadrangle where May Pond member is absent, Dakin Hill member overlies Hubbard Hill member and is separated from it by a mass of Kinsman quartz monzonite. Thickness from knife edge to 2,500 feet.

Dakin Hill is in Cheshire County.

Dakota Sandstone,[1] **Formation, Quartzite,** or **Group**

Dakota Stage

Lower and Upper Cretaceous: Nebraska, eastern Colorado, Kansas, Minnesota, southeastern Montana, northeastern New Mexico, North Dakota, western Oklahoma, and eastern Wyoming.

Original reference: F. B. Meek and F. V. Hayden, 1862, Philadelphia Acad. Nat. Sci. Proc., v. 13, p. 419, 420.

N. H. Winchell, 1875, *in* William Ludlow, Report of a reconnaissance of the Black Hills of South Dakota, made in the summer of 1874, U.S. Engineer Dept., U.S. Army: Washington, U.S. Govt. Printing Office, p. 32, 60, 64. Report mentions the light-colored sandstones of the Dakota group of the Cretaceous. Thickness about 500 feet.

Henry Newton and W. P. Jenney, 1880, U.S. Geog. and Geol. Survey Rocky Mountain Region, p. 151–180. Group described in Black Hills region where it is prominently developed, forming capping rock to foothills that surround the Hills on all sides. Appears with its characteristic composition—coarse yellow or red sandstones with discontinuous variegated clays. At places, considerable thickness of very soft and fine white sandstone appears at base. Elsewhere considerable portions are hard dense quartzite. No animal fossils, but many remnants of plants—in no case more than mere coaly fragments. Lower Cretaceous. Thickness 250 to 400 feet.

G. H. Eldridge, 1896, U.S. Geol. Survey Mon. 27, p. 62–65. In Denver basin, formation is from 225 to 350 feet thick and commonly consists of two or three nearly equal benches of massive sandstone separated by narrow bands of shale which locally become fire clays. Characteristic conglomerate occurs at base of formation; at summit, a zone of hard white slaty shales, 10 to 30 feet thick, transitional to Benton shale of Colorado group. Fossil flora found throughout. Overlies Morrison formation (new).

W. P. Jenney, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 2, p. 568–593. Newton's Dakota group of Black Hills is subdivided into five divisions 1 to 5, descending. Proposed names for the divisions, No. 5, Beulah clays, Upper Jurassic; No. 4, Hay Creek coal formation; No. 3, Barrett shales; No. 2, Oak Creek beds; and No. 1, Dakota sandstone. Dakota sandstone is Upper Cretaceous, the other units Lower Cretaceous. Dakota sandstone divided into two units, lower 30 to 45 feet thick and upper 35 to 45 feet. Unconformably underlies Fort Benton.

N. H. Darton, 1901, U.S. Geol. Survey 21st Ann. Rept., pt. 4, p. 489–599. In Black Hills, Dakota sandstone (formation), 35 to 150 feet thick, overlies Fuson formation. Underlies Graneros shale of Benton group.

G. W. Stose, 1912, U.S. Geol. Survey Geol. Atlas, Folio 186. Dakota sandstone described in Apishapa quadrangle, Colorado. Consists of massive gray sandstone, weathering rusty brown, generally in two ledges with variable thin dark shale parting. Thickness 63 to 83 feet. Overlies Purgatoire formation (new); underlies Graneros shale of Benton group. Purgatoire formation was formerly considered part of Dakota sandstone and is so mapped in Walsenburg and Pueblo folios. Upper Cretaceous.

G. I. Finlay, 1916, U.S. Geol. Survey Geol. Atlas, Folio 203. Dakota sandstone (formation) consists of light-colored quartz sandstone having average thickness in Colorado Springs quadrangle of 100 feet. Unconformably overlies Glencairn member (new) of Purgatoire formation, although unconformity is probably not extensive. Commonly conformably overlain by Graneros shale of Benton age, but near north side of quadrangle intervening formations are overlapped by Dawson arkose, which there lies unconformably on the Dakota. Upper Cretaceous.

W. T. Lee, 1923, U.S. Geol. Survey Bull. 751–A, p. 1–22. Dakota group is divided into five informally named formations (ascending): Lower sandstone, Lower shale, Middle sandstone, Middle shale, and Upper sandstone. Group is well exposed about 2 miles north of Bellvue, Colo., and section measured here, about 325 feet thick, may be regarded as type section of group. Lower sandstone (40 feet at Bellvue) is a gray massive coarse-grained usually crossbedded and conglomeratic sandstone, variable in thickness but everywhere present and readily identified; unconformably overlies Morrison formation. Lower shale (40 feet at Bellvue) consists of variable beds of sandy shale and thin layers of hard sandstone; commonly, but not invariably, highly colored—red, purple, green, blue. In Wyoming, this shale has been called middle member of Cloverly. It may prove to be age equivalent of Fuson formation of Black Hills and is probably included in Kootenai of Montana. Middle sandstone (10 feet at Bellvue) is gray, hard, quartzose, evenly bedded, and strongly ripple marked at many localities; variable in thickness, and, where the variegated underlying shale is absent or not distinctive, it cannot be differentiated from the lower sandstone. This middle sandstone has been called upper Cloverly, true Dakota, and second Muddy and probably is included in Purgatoire formation by different workers. Middle shale (200 feet at Bellvue) is thickest formation of group. It is dark-colored bituminous marine shale. In many areas in northern Colorado between Morrison and Boulder, it contains fossil plants which Knowlton refers to the Dakota flora. North of Boulder it has yielded fossil invertebrates which Reeside tentatively places in Kiowa fauna of Kansas and Purgatoire fauna of southeastern Colorado. Near Colorado Springs, this shale is called Glencairn member of Purgatoire formation. In southern Wyoming, it has been included in Graneros shale or lower part of the Benton. It is equivalent to upper part of Thermopolis shale of northern Wyoming. Upper sandstone (35 feet at Bellvue) is variable in character and thickness and in some places thins out entirely. Contains fossil plants, fragments of charcoal, streaks of coal and markings resembling fillings of worm borings. This sandstone is the upper Dakota of northern Colorado but is known in oil industry as Muddy sand. It is herein emphasized that there is no single definite persistent and easily recognized sandstone such as was formerly supposed to exist and was termed the Dakota sandstone. The group as a whole is interpreted as the result of accumulation of sediments near the strand line of the advancing Cretaceous sea, and as such it differs in age from place to place by length of time consumed by advance of strand line across the intervening distance. Whether this advance marks the beginning of Upper Cretaceous time remains to be determined. Area of report extends from Perry Park, Colo., about 35 miles south of Denver, northward along foothills east of Rocky Mountains to Douglas, Wyo., thence northwestward to Thermopolis, and includes section at Lander and Rawlins.

W. W. Rubey and N. W. Bass, 1925, Kansas Geol. Survey Bull. 10, p. 16, 57–65. Dakota sandstone, in Russell County, includes Rocktown channel sandstone member (new).

W. T. Lee, 1927, U.S. Geol. Survey Prof. Paper 149, p. 17–23. Name Dakota group, applied by writer [Lee] (1923) to beds as far west as Lander and as far north as Greybull, Wyo., is accepted by the U.S. Geological Survey only for section at Bellvue, Colo., with understanding that if rocks of Comanche age are proved to be present in Dakota group of that section, they are to be excluded from group. The rocks to which the writer thus applied term Dakota group are described in present report according to their position. They are (ascending) lower conglomeratic sandstone; a variable division of sand shale separable toward north into a highly colored lower shale and sandstone that becomes the middle sandstone of the group where three sandstones are present; upper shale, which was called middle shale in 1923 publication, but which in many sections is the higher of two shales and is therefore designated the upper shale of this group; an upper sandstone which is the upper Dakota of northern Colorado and the Muddy sand of many Wyoming localities and is probably equivalent to Newcastle sandstone of eastern Wyoming. Writer believes that group is well defined from Colorado Springs, Colo., northward nearly to southern boundary of Montana. According to this interpretation, it includes Cloverly formation of Wyoming and some rocks usually included in Benton shale.

W. L. Russell, 1928, Econ. Geology, v. 23, no. 2, p. 134–137. Term Fall River formation replaces Dakota sandstone in Black Hills region.

A. C. Tester, 1931, Iowa Geol. Survey, v. 35, p. 199–322. Discussion of Dakota stage of type locality. Meek and Hayden used term group. Other writers have used series, stage, formation, or sandstone. Lithology of the Dakota, distribution of the various zones, stratigraphic range and interpretations made in present study, all suggest that term stage be used to designate the sandstones, shales, and clays exposed near Dakota City, Nebr., and described by Meek and Hayden as Dakota group. Dakota age is used for time. Best exposures are at Sioux City, Iowa, and its suburbs. This includes Prospect Hill section; exposures at Sioux City Brick Company pits, at Riverside; bluffs along Big Sioux River south of west entrance to Stone Park; Sergeant Bluff, south of Sioux City; Crill Mill section south of Westfield, Iowa; and several sections in vicinity of Homer, Nebr.

R. C. Moore and K. K. Landes, 1937, Geologic map of Kansas (1:500,000): Kansas Geol. Survey. Dakota group as mapped includes Solomon and Ellsworth formations of Late Cretaceous age, and Belvidere formation and Cheyenne sandstone of Early Cretaceous age. Comanche series.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 9, 99–104. In southeastern Minnesota, Dakota formation includes Ostrander member (new). Geological column shows Dakota formation of Dakota series stratigraphically below Coleraine (Benton) formation of Colorado series and above Devonian Senecan series.

B. F. Latta, 1941, Kansas Geol. Survey Bull. 37, p. 68–79. Group includes all strata from base of Cheyenne sandstone to base of Graneros shale. All Cretaceous strata in Stanton County [this report] belong to Dakota group. They comprise (ascending) Cheyenne sandstone, Kiowa shale, and an upper sandstone (formerly called Dakota) that is here named Cockrum sandstone.

A. R. Edwards, 1941, Wyoming Geol. Survey Bull. 32, p. 10. Term Dakota group, in Platte and Laramie Counties, Wyo., includes sequence of sandstones and shales which rest disconformably upon Morrison formation. Consists of five members (ascending): dark-gray coarse-grained sandstone; dark shale; buff hard ripple-marked sandstone; dark carbonaceous shale; and massive hard sandstone. Thickness 250 to 375 feet. Underlies Benton group.

Norman Plummer and J. F. Romary, 1942, Kansas Geol. Survey Bull. 41, p. 315–348. Dakota formation of Kansas, as here defined, has been called variously "Dakota group," "Dakota formation," Ellsworth and Solomon formations, Rocktown channel sandstone member, and "Dakota sandstone." Dakota formation is here defined to include Cretaceous strata from top of Kiowa shale below to top of Graneros shale above. Subdivided into (ascending) Terra Cotta clay and Janssen clay (new) members.

Norval Ballard, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 10, p. 1562. Strata of Dakota group crop out as hogbacks completely surrounding the Black Hills and are present throughout the Dakotas in subsurface. Group comprises an upper unnamed sandstone member, middle or Fuson shale member, and lower or Lakota sandstone member. Maximum thickness 725 feet.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 15 (fig. 7), 18–20. Group was named by Meek and Hayden in 1862. Since that time it has been separated as three formations, the upper one of which is yet called Dakota sandstone, a usage conflicting with name of the group. Lee (1927) correlates the subdivisions of Dakota group at east side of Laramie Range in Wyoming, in a section near Greenacre ranch, as follows (ascending): Lakota sandstone, Fuson shale, Fall River sandstone, Skull Creek shale, and Newcastle sandstone. Studies reveal that Newcastle sandstone, Skull Creek shale, and Fall River sandstone correlate collectively with the so-called Dakota sandstone or top formation of Dakota group in eastern Nebraska. Name Omadi sandstone proposed for the so-called Dakota formation, to include section lying between Fuson and Graneros shales. Dakota group then includes (ascending) Lakota, Fuson, and Omadi. Meek and Hayden did not locate a very definite type locality; hence, type locality is herein designated. Thickness at proposed type locality 392 feet.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 153–154, 155 (fig. 3). Formation consists of clay, shale, siltstone, and sandstone, interbedded and lenticular; contains carbonaceous material, lignite, concretions of hematite and limonite, and locally quartzitic sandstone. Average thickness 215 feet. Contains stratigraphic units formerly called Rocktown channel sandstone, Ellsworth formation, Solomon formation, Reeder sandstone, Marquette sandstone, Spring Creek clay, and others. Comprises (ascending) Terra Cotta clay and Janssen clay members. Underlies Graneros shale; overlies Kiowa shale. Cockrum sandstone of southwestern Kansas is equivalent in age to part of Dakota formation. Gulfian series.

C. B. Hunt and R. L. Miller, 1946, Utah Geol. Soc. Guidebook 1, p. 8. Generalized section of exposed sedimentary rocks in Henry Mountains structural basin shows that Dakota sandstone, 0 to 50 feet thick, overlies Morrison formation and underlies Tununk shale member of Mancos shale.

J. W. Huddle and F. T. McCann, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 75. Dakota sandstone, in Duchesne and Wasatch Counties, Utah, includes lower sandstone, 30 to 40 feet thick, a middle shale, 160 feet thick, and an upper sandstone, 5 to 26 feet thick. Lower sandstone and shale tentatively considered to be of Lower Cretaceous age, and upper sandstone to be of Upper Cretaceous age. Overlies Morrison; contact concealed. Underlies Mancos shale.

W. L. Stokes and D. A. Phoenix, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 93. Term Dakota sandstone, as used in this report [Egnar-Gypsum Valley area, San Miguel and Montrose Counties, Colo.], includes the impure coal, carbonaceous beds, and lenticular, yellow, fluvial sandstones above Burro Canyon formation (new) and below Mancos shale. Average thickness about 125 feet. Upper Cretaceous.

K. M. Waagé, 1952, Colorado Sci. Soc. Proc., v. 15, no. 9, p. 375 (fig. 1). Discussion of clay deposits of Denver-Golden area. Generalized stratigraphic section shows Dakota sandstone, 80 feet thick, overlies Purgatoire formation and underlies Benton shale.

G. O. Bachman, 1953, U.S. Geol. Survey Oil and Gas Inv. Map OM–137. Dakota sandstone in Mora County, N. Mex., is about 180 feet thick; overlies Morrison formation and underlies Benton formation.

G. H. Wood, Jr., S. A. Northrop, and R. L. Griggs, 1953, U.S. Geol. Survey Oil and Gas Inv. Map OM–141. Dakota sandstone in Colfax County, N. Mex., conformably overlies Purgatoire formation and conformably underlies Graneros shale.

K. M. Waagé, 1953, U.S. Geol. Survey Bull. 993, p. 6 (fig. 2), 11–26, pls. 1, 2, 4, 5. Throughout large part of southeastern Colorado, Dakota sandstone is prominent cliff-forming unit averaging about 100 feet in thickness and consisting largely of fine- and medium-grained cross-laminated sandstone. Consists of lower unnamed sandstone unit, Dry

Creek Canyon member (new), and upper sandstone unit. Overlies Glencairn shale member of Purgatoire formation; underlies Graneros shale.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Dakota sandstone mapped in northwestern Oklahoma.

K. M. Waagé, 1955, U.S. Geol. Survey Prof. Paper 274–B, p. 15–49. Discussion of Dakota group in northern Front Range foothills, Colorado. Area includes narrow belt of pre-Benton Cretaceous exposures extending from 2 miles south of Wyoming State line, in Larimer County, where beds emerge from under Cenozoic cover, to fault-terminated end of Dakota hogback just south of Indian Creek in Kassler quadrangle, Douglas County. Northern foothills area corresponds with area in which Lee (1923) applied name Dakota group to pre-Benton Cretaceous rocks of Colorado and divided it into five informal subdivisions. Terminology presented in this report is revision of Lee's (1923) Dakota group and is intended to apply only to northern foothills area. Name Lytle formation is applied to lower part of sequence and South Platte formation (new) to upper part of sequence. Overlies Morrison formation [see Morrison formation, this reference for discussion of Morrison-Lytle contact]; underlies Benton shale. First formal subdivision of Dakota formation was made by Stose (1912) in Apishapa quadrangle. He named lower sandstone and middle shale of the threefold sequence the Purgatoire formation and retained name Dakota sandstone for upper sandstone. Finlay (1916), in Colorado Springs quadrangle, named the sandstone and shale units in the Purgatoire the Lytle sandstone and Glencairn shale members, respectively. With exception of addition to Dakota sandstone of a local refractory shale unit, Dry Creek Canyon member (Waagé, 1953), the subdivision and nomenclature have remained as designated by Stose and Finlay. Names Dakota sandstone, in restricted sense, and Purgatoire formation have been used throughout southeastern and central Colorado and as far north along Front Range foothills as Perry Park in Castle Rock quadrangle. Lee's work in northern foothills led to fivefold rather than threefold subdivision of the Dakota in this area. Lee used his terminology throughout Front Range foothills and correlated his subunits with subdivisions of Stose and Finlay to the south and with Wyoming terminology to the north. No formal changes have been made in nomenclature or subdivision of Lee's Dakota group since it was proposed, and it has existed side by side with southern classification of Stose and Finlay. Terminologies other than that of Lee have been used in northern Front Range foothills presumably because Lee's Dakota group is too broad a unit for detailed work and because some of his subdivisions lack lateral continuity and are difficult to apply. Stose and Finlay's terminology was used in Denver-Golden area by Waagé (1952), but subsequent work leading to present report has shown that it was incorrectly applied and that it is equally as unsatisfactory as Lee's in providing a logical subdivision of pre-Benton Cretaceous strata. George (1927, Colorado Univ. Semicentennial Pub.) called Early Cretaceous rocks throughout eastern Colorado the Purgatoire and incorrectly used names Lakota and Fuson in northern foothills for members of the Purgatoire that he considered equivalent, respectively, for Finlay's Lytle and Glencairn members in Colorado Springs area. This usage, based on incorrect correlation with

Black Hills area, is still used in Colorado by some workers. Others have extended the Cloverly-Thermopolis-Muddy terminology southward from Wyoming, and some still use term Dakota formation in sense in which it was used in early reports of Geological Survey. Several sources of confusion in usage of pre-Benton Cretaceous terminology are apparent in the history of subdivision and nomenclature of the Dakota. First source is taxonomic change from use of terms formation and group as synonyms to their use as terms for separate ranks of rock units. More critical source was tendency to separate the Early Cretaceous from the Late Cretaceous parts of the pre-Benton Cretaceous sequence, a tendency that influenced, and is reflected in, Stose's formal subdivision of Dakota formation. Use of age as criterion for subdivision of rock units, a practice at the root of many nomenclatural problems, can lead only to confusion in correlation and to ambiguity in terminology when applied to complex transgressive deposits like the pre-Benton Cretaceous sequence. Much of the confusion associated with name Dakota stems from this cause. An unfortunate nomenclatural practice, that of retaining name Dakota for Late Cretaceous part of sequence in those areas where Early Cretaceous rocks can be identified and separated, has served to crystallize the confusion. This practice has been applied in Kansas and in Colorado, making it impossible to use name Dakota in a single sense for physical correlation between areas in which Early Cretaceous strata are separated from the Dakota and areas in which occurrence of Early Cretaceous rocks has not been sufficiently well established to permit their separation from the Dakota. Introduction of terminologies from other areas is a recent source of confusion in Colorado pre-Benton Cretaceous classification. Usage of Dakota in present report follows that of Meek and Hayden (1862) inasmuch as it includes all pre-Benton Cretaceous strata. In type area along Missouri River in Nebraska, the Dakota rests on Paleozoic rocks so its lower contact is unequivocal. The characteristic twofold lithogenetic division is present in type area where sharp break separates sandstone with variegated clay below from sandstone with dark-gray clay, carbonaceous clay, and lignite above. In light of previous attempts to make name Dakota reflect opinion on age of rock that it includes, it is emphasized that Dakota group, as used herein, is strictly a rock term, and whether or not the group contains both Lower and Upper Cretaceous rocks, is entirely Lower Cretaceous, or varies in age from region to region is irrelevant to this definition. Because of indefinite nature of Morrison-Lytle contact in parts of northern foothills, it may not be convenient in some places to use Dakota group as a unit for small-scale mapping; in such places, best map units would be Morrison and Lytle formations, undifferentiated, and South Platte formation.

C. A. Repenning and H. G. Page, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 259–263. Dakota sandstone is basal Cretaceous formation of Black Mesa, Navajo, and Hopi Indian Reservations, Ariz. Consists of a lower sandstone member, middle carbonaceous member, and upper sandstone member. Average thickness about 80 feet; maximum thickness 119 feet. Underlies Mancos shale. Believed to be entirely of Late Cretaceous in this area, although presence of Lower Cretaceous beds at base cannot be ruled out.

K. M. Waagé, 1959, U.S. Geol. Survey Bull. 1081–B, p. 13–26. A persistent disconformity separating continental deposits of varied facies from overlying marginal marine deposits and marine deposits was recognized in Dakota group of northern Colorado Front Range (Waagé, 1955), where this twofold lithogenetic pattern was used as basis for subdivision of the group. Earlier (Waagé, 1953) the same disconformity, whose regional significance was not recognized at the time, was used as contact between Lytle and Glencairn members of Purgatoire formation in south-central Colorado. Reconnaissance studies supplemental to those in Front Range and additional studies as yet unpublished reveal the disconformity and the two gross lithogenetic units it separates in the Purgatoire-Dakota sequence of southeastern Colorado and southwestern Kansas, in the Cloverly-Thermopolis-Muddy sequence of Bighorn Basin area and eastern Wyoming, in type area of original Dakota formation along the Missouri River in Iowa and Nebraska, and in Inyan Kara-Skull Creek-Newcastle sequence of Black Hills region. Within the broad twofold lithogenetic framework, the Dakota group and its equivalents vary considerably from place to place. Changes in type of rock, sequence of rocks, and thickness of individual subunits locally obscure basic pattern. Many environments of deposition represented in the two parts of sequence account for much of the variation. Deposits of lower sequence are, in general, typified by fine- to coarse-grained buff to white lenses of sandstone and conglomeratic sandstone, irregularly interbedded with variegated red, green, yellow, gray, and black claystones; shale is rare and commonly limited to local lacustrine deposits; most of the coarser material is chert, quartzite, and quartz, obviously many cycles removed from parent rock. In some areas, such as south-central and southeastern Colorado, lower part of sequence is dominantly sandy, and variegated claystones are rare; in other areas such as the Bighorn Basin, variegated claystone and argillaceous siltstone predominate. Fossils not common in lower part, but plant remains include coniferous wood, cycadeoids, charophytes, and other algae and foliage of ferns and cycods; animal remains include dinosaur bones, fresh-water mollusks, ostracodes, and branchiopods. Lower part of sequence is more closely related lithogenetically to underlying Morrison than to upper part of sequence. No obvious stratigraphic break marks contact with the Morrison, and at many places it is impossible to separate the two units except on some arbitrarily selected local feature. Upper part of Dakota sequence consists chiefly of fine-grained commonly thin-bedded laminated to tabular cross-laminated buff- to brown-weathering sandstone interbedded with gray to black shale and siltstone. Thin bedding and lamination characterize this part of sequence. In some areas, such as central Wyoming, that lay within central part of basin of deposition, nearly the entire sequence is shale and silty shale (Thermopolis) except for some sandy shale and local sandstone at top (Muddy) and base (Rusty beds). Fossils in marginal marine beds include dicotyledonous leaves, wood, false trunks of *Tempskya*, some fresh-water clams, linguloid brachiopods, and Foraminifera. Marine beds contain pelecypods, gastropods, linguloid brachiopods. Foraminifera, bones of fish, crocodiles, and plesiosaurs. Contact of the two parts of sequence is, in many places, a relatively plane surface of disconformity marking an abrupt lithic change. The gross twofold subdivision affords only consistent means of orientation within the varied local Dakota sequences. Whether or not this disconformity transgresses time, it is an excellent datum to use in working out equivalency of lithogenetic units in Dakota sequence, and, if local terminologies can be adjusted to it, many of the Dakota nomenclatural problems will resolve themselves. Many problems of stratigraphy of Dakota and equivalent rocks have their roots in the nomenclature. Report gives historical summary of usage of term Dakota in Black Hills area and points out, among other things, the fact that Darton (1901) miscorrelated these beds with the Dakota of eastern Colorado. He became convinced that the Fort Benton of the Black Hills was the "precise equivalent" of Gilbert's (1896) Graneros shale in eastern Colorado and introduced name Graneros into Black Hills terminology. This miscorrelation has had lasting effect. Name Fuson is still misapplied by some geologists to black shale of Glencairn member of Purgatoire formation, the Skull Creek equivalent in southern part of Colorado Front Range. Name Graneros is still used locally by most geologists in spite of the fact that it is a hangover from miscorrelation by Darton and is misleading in regional correlation. It is used both as a formation and group to include beds between Fall River formation and Greenhorn limestone. Black Hills area is one of several that have followed similar pattern in development of the terminology applied to its pre-Benton (Dakota equivalents) Cretaceous beds. In much of the central and northern Great Plains and Rocky Mountains, these beds vary in stratigraphic detail from place to place, but their sequence is uniform in its major lithogenetic features. This uniformity is obscured by complex and conflicting terminology that has resulted largely from the unfortunate practice of distinguishing stratigraphic units on the basis of their supposed age. Soon after name Dakota was introduced, it came to be used synonymously with sandy basal Upper Cretaceous rocks. Subsequent discovery of Early Cretaceous fossils in these rocks resulted in their subdivision, generally with name Dakota for that part of sequence still considered Upper Cretaceous. Division between Lower and Upper Cretaceous rocks in northern part of interior region has been placed higher and higher in the sequence. In Black Hills, each shift of this time boundary has resulted in change in nomenclature. For Black Hills, where name Dakota has passed from nomenclature, the principal subunits, Lakota, Fuson, and Fall River formations, have not proved to be satisfactory mappable units. This is the problem with which present report is concerned. In Black Hills, the transgressive disconformity discussed above falls within Inyan Kara group. Subdivision and nomenclature of Inyan Kara group is adjusted to conform to this twofold lithogenetic division.

R. G. Young, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 2, p. 154–194. Basal Cretaceous deposits of Colorado Plateau can be subdivided into two formations on basis of carbonaceous content. The lower noncarbonaceous unit, Cedar Mountain formation, consists of mudstones and persistent conglomeratic sandstones which were deposited in an inland floodplain environment. The upper carbonaceous unit, Naturita formation (new), consists of carbonaceous mudstone, coal, persistent conglomeratic sandstones, and beach sandstones deposited on or adjacent to shore of Mancos sea. Naturita deposits can be traced landward into Cedar Mountain deposits, indicating that they are facies of a larger unit, the Dakota group. Upper part of Naturita intertongues with and passes laterally into basal part of Mancos shale throughout much of Colorado Plateau. Group is unconformable above Morrison formation. Lower and Upper Cretaceous.

Type locality (Condra and Reed): In Missouri River bluffs of Dakota County, located 1 mile southeast of Homer, Nebr., in NE¼ sec. 13, T. 27 N., R. 4 E.

Type locality of group (Lee): About 2 miles north of Bellevue, Larimer County, Colo.

Dale quartzites[1]

Lower Cambrian: Utah.

Original reference: C. R. Keyes, 1924, Pan-Am. Geologist, v. 41, p. 38.

Derivation of name not stated.

Dallas deposits[1]

Pleistocene: Central southern Iowa.

Original references: J. L. Tilton, 1913, Science, new ser., v. 38, p. 241; 1913, Iowa Acad. Sci. Proc., v. 20, p. 218.

Named for Dallas, Marion County.

†Dallas Limestone[1]

Upper Cretaceous (Gulf Series): Northern Texas.

Original reference: R. T. Hill, 1887, Am. Jour. Sci., 3d, v. 33, p. 298.

Named for occurrence at Dallas, Marion County.

Dallas Limestone Bed

Dallas Limestone Member (of Yamhill Formation)

Eocene, upper: Eastern Oregon.

J. E. Allen, 1946, Oregon Dept. Geology and Mineral Industries G.M.I. Short Paper 15, p. 2–5. Dallas limestone crops out as dark-gray massive rock, which weathers first to light-buff color and then to deeper shades of iron oxide. Thickness 50 to 75 feet. Occurs at base of marine series of Cowlitz age and above basalt believed to be equivalent of Tillamook volcanics. May occupy stratigraphic position similar to Buell limestone (new).

E. M. Baldwin, 1959, Geology of Oregon: Ann Arbor, Mich., Edwards Brothers, Inc., p. 13. Dallas limestone member of Yamhill formation. Present at base of formation. Composed of fragments of shells, Foraminifera, and calcareous algae intermixed with tuffaceous material derived from underlying volcanic rocks.

Crops out in northeast part of T. 8 S., R. 6 W., from 2 to 4 miles southwest of Dallas, Polk County, on western edge of Willamette Valley. Extensively quarried.

Dalles Formation[1]

Pliocene: Central northern Oregon and central southern Washington.

Original reference: E. D. Cope, 1880, Am. Philos. Soc. Proc., v. 19, p. 61; 1880, Am. Nat., v. 14, p. 458.

R. W. Chaney, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1945. Mammalian remains suggest an early Pliocene or late Miocene age. Plant fossils indicate an age not earlier than lower Pliocene. When these are compared with larger flora from Ellensburg formation in which mammalian remains are well represented, contemporaneity of Dalles is established, and age of both formations may be indicated as Pliocene.

C. R. Warren, 1941, Am Jour. Sci., v. 239, no. 2, p. 106–126. Hood River conglomerate is of contemporaneous origin with the Dalles and Ellensburg formations, both of late Miocene or early Pliocene.

E. T. Hodge, 1942, Oregon State Coll. Studies in Geology Mon. 3, p. 23–26. Hodge (1928, Pan-Am. Geologist, v. 49, no. 5) gave name Madras formation to beds in vicinity of Madras. Present study has shown that the Dalles and Madras are one formation; hence the older name, Dalles, takes precedence. Consists of lava flows and water-spread materials. Lavas vary from 15 to 200 feet and average 75 feet in thickness. Unconformably overlies all older formations. Rhododendron formation extends eastward and becomes Dalles formation. To east and north of Kloan, the Dalles grades into Shutler formation.

R. W. Chaney, 1944, Carnegie Inst. Washington Pub. 553, p. 285–321, pls. Discussion of the Dalles flora. Age of Dalles formation, as indicated by fossil flora, is lower Pliocene.

Dalton Formation[1]

Lower Cambrian: Western Massachusetts and southwestern Vermont.

Original reference: B. K. Emerson, 1899, U.S. Geol. Survey Bull. 159.

P. H. Osberg, 1952, Vermont Geol. Survey Bull. 5, p. 116 (fig. 16). Correlation chart for Vermont shows Dalton formation in southwestern part of State below Cheshire quartzite.

Best exposed at site of former Dalton clubhouse, on high hill south of Dalton Station, in open pasture farther south and on southeastward to lookout tower, Berkshire County, Mass.

Dalton Gneiss[1]

Precambrian: Northwestern Connecticut.

Original reference: W. M. Agar, 1932, Am. Jour. Sci., 5th, v. 23, p. 35.

Dalton Sandstone Member (of Crevasse Canyon Formation)

Dalton Sandstone Member (of Mesaverde Formation)[1]

Upper Cretaceous: Northwestern New Mexico.

Original reference: J. D. Sears 1934, U.S. Geol. Survey Bull. 860–A.

J. E. Allen and Robert Balk, 1954, New Mexico Bur. Mines Mineral Resources Bull. 36, p. 90, 92–93, pl. 1. Reallocated to member status in Crevasse Canyon formation (new). Overlies Dilco member; underlies lower Gibson member. In area of this report [Fort Defiance-Tohatchi quadrangles], comprises two sandstone units from 20 to 45 feet thick, occupying an interval from 40 to 72 feet; lower unit disappears toward southern edge of mapped area, and upper unit thins markedly.

Named for exposures at Dalton Pass, Gallup region, McKinley County.

Dam Breccia

Tertiary: Northwestern Arizona and southeastern Nevada.

U.S. Bureau of Reclamation, 1950, U.S. Bur. Reclamation, Boulder Canyon Proj. Final Repts., pt. 3, Preparatory Exams., Geol. Inv., Bull. 1, p. 80 (fig. 28), 89–92, fig. 34 (geol. map). Dark-red cemented sedimentary breccia. Roughly and indefinitely bedded. No complete section exposed. Based on average dip of 30° and an exposure of 3,500 feet along canyon, estimated thickness is about 1,700 feet. Overlain by latite flow breccia. Older than Spillway breccia (new). Included in older volcanic series of area. Name credited to F. L. Ransome (unpub. rept.).

Named for occurrence at site of Hoover Dam in Black Canyon of Colorado River. Forms floor and lower part of walls of the canyon.

Damascus Red Shale[1]

Upper Devonian: Northeastern Pennsylvania and southern New York.

Original reference: Bradford Willard, 1936, Geol. Soc. America Bull., v. 47, no. 4, p. 571, 584–585.

L. V. Rickard *in* W. H. Young, Jr., and W. L. Kreidler, 1957, New York State Geol. Assoc. Guidebook 29th Ann. Meeting, fig. 2, [p. 23]. Geographically extended to New York.

Well exposed near Damascus, Wayne County, Pa.

Dam Lake Quartzite[1]

Precambrian: Minnesota.

Original reference: H. B. Ayers, 1911, Science, new ser., v. 33, p. 465.

Dam Lake, Aitkin County.

Damnation Limestone[1]

Middle Cambrian: Northwestern Montana.

Original reference: C. F. Deiss, 1933, Montana Bur. Mines and Geology Mem. 6, p. 35.

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1086–1087, 1089, 1090 (fig. 2). Redefined to include former Damnation and Nannie Basin limestones, and name Nannie Basin dropped. Thickness at type locality, herein stated, 149 feet; at Pentagon Mountain, 191 feet. Overlies Gordon shale; underlies Dearborn limestone.

Charles Deiss, 1943, Geol. Soc. America Bull., v. 54, no. 2, p. 213 (table 1), 220. Described in southwest Saypo quadrangle where it is 150 feet thick, overlies Gordon shale, and underlies Dearborn limestone.

Type locality: At west end of Scapegoat basin in S½ sec. 6 SW¼ sec. 5, and N½ sec. 8, T. 18 N., R. 10 W. Named from Damnation Creek on west side of Pagoda Mountain, Flathead Range.

Dana Diorite[1]

Upper Carboniferous or post-Carboniferous: Central Massachusetts and southwestern New Hampshire.

Original reference: B. K. Emerson, 1917, U.S. Geol. Survey Bull. 597, p. 244–247, and map.

J. B. Hadley, 1949, Bedrock geology of the Mount Grace quadrangle, Massachusetts: U.S. Geol. Survey Geol. Quad. Map [GQ–3]. Name based upon an erroneous interpretation by Emerson (1917). Part of unit is represented by Ammonoosuc volcanics in the Mount Grace quadrangle, Massachusetts.

Well developed in Dana and Ware, Mass.

Danbury Granite Gneiss or Augen Granite

Danbury Granodiorite Gneiss[1]

Pre-Triassic: Southwestern Connecticut.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 104, 108, map.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Redescribed as a granite gneiss. Consists of gray to pink gneissic augen granite or augen gneiss. Pre-Triassic. Derivation of name stated.

J. W. Clarke, 1958, Connecticut Geol. Nat. History Quad. Rept. 7, p. 12–15, geol. map. Porphyrite gneissic augen granite characterized by large microcline megacrysts. In this report [Danbury quadrangle], much of area mapped as Danbury granodiorite on State geological map of 1906, including Shelter Rock area, is assigned to Brookfield plutonic series. Name Danbury augen granite is retained for granites that crop out along western shore of Lake Candlewood in towns of Danbury and New Fairfield.

Named for town of Danbury, Fairfield County.

Danby Formation[1]

Lower Cambrian: West-central Vermont.

Original reference: Arthur Keith, 1932, Washington Acad. Sci. Jour., v. 22, p. 360, 396.

W. M. Cady, 1945, Geol. Soc. America Bull., v. 56, no. 5, p. 525, 535–536. Stratigraphically extended to include overlying beds, formerly the Wallingford formation, as Wallingford member. Thickness 400 to 800 feet. Underlies Clarendon Springs dolomite.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, p. 22–23. Described in Castleton area. Crops out in narrow belt extending from boundary of Castleton and Brandon quadranges through Florence and Procter to western slopes of Pine Hill. Southern exposures cover area extending from boundary of quadrangle southwest of Chippenhook northward to western slope of Boardman Hill. Includes Wallingford member in upper part. Overlies Winooski dolomite; underlies Clarendon Springs dolomite. Thickness about 700 feet. Upper Cambrian.

Named for town of Danby, Rutland County.

Dane Member (of Pecatonica Formation)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., p. 41, figs. 3, 10, 12, 16. Dolomite, thin- to thick-bedded, with weak argillaceous streaks and some shale films. Thickness varies from 3 to 14 feet. Shown on columnar section as underlying New Glarus member (new) and overlying Chana member (new).

Occurs in the Dixon-Oregon area.

Danforth Formation[1]

Pliocene: Southeastern Oregon.

A. M. Piper, 1936, Geol. Soc. Oregon County News Letter, v. 2, no. 8, p. 10. Unconformably overlies Steens basalt; unconformably underlies Harney formation (new). Thickness 20 to 800 feet. In southern part of area, consists of four facies: tuff-breccia and associated stratified rocks; basaltic breccia and associated siltstone, sandstone, conglomerate, and two intercalated sheets of basalt; stratified siltstone, sandstone, and ash; and spherulitic rhyolite. In northwestern part of area, formation comprises, in upper part, stratified siltstone, sandstone, tuff, and volcanic ash with intercalated layers of glassy perlitic rhyolite and one rhyolitic tuff-breccia layer; lower part massive rhyolite.

A. M. Piper, T. W. Robinson, and C. F. Park, Jr., 1939, U.S. Geol. Survey Water-Supply Paper 841, p. 43–49, pl. 2. Detailed description. [This is report cited in Wilmarth Lexicon as "in press."]

Name derived from Danforth Ranch in T. 22 S., R. 32½ E., where section is exposed along Cow Creek, Harney County.

Dangkulo Limestone

See Dankuro Limestone.

Daniels Conglomerate

Tertiary, middle (?) : Southwestern Arizona.

James Gilluly, 1937, Arizona Bur. Mines Bull. 141, Geol. Ser. 9, p. 15 (table 1), 46–47, pl. 1; 1946, U.S. Geol. Survey Prof. Paper 209, p. 42–44, pl. 3 [1947]. Coarse stream gravel, partly cemented; includes a little interbedded quartz latite. Carries boulders 4 feet in diameter, but most of the pebbles are less than 3 inches through. As much as 250 feet thick in Chico Shunie Hills, but thinner elsewhere. Unconformably overlies Cornelia quartz monzonite (new), Cardigan gneiss (new), and Chico Shunie quartz monzonite in southern part of quadrangle and Sneed andesite (new) and Childs latite (new) in the Childs Mountain localities. Conglomerate seems more likely to be early Pliocene or even older rather than a correlative of the Gila conglomerate of southeast Arizona.

Poorly exposed in hills just north of Daniels Arroyo, from which it is named, Ajo quadrangle, Pima County. Principal exposure is in southwestern part of Chico Shunie Hills, just north of Daniels Arroyo, where it forms a belt about 1½ miles wide practically from west edge of T. 13 S., R. 6 W., to west boundary of the quadrangle northwest of Teepee Butte.

Dankuro (Dangkulo) Limestone

Recent (early Holocene) : Mariana Islands (Tinian).

Risaburo Tayama, 1939, Correlation of the strata of the South Sea Islands: Geol. Soc. Japan Jour., v. 46, no. 549, p. 346 (correlation chart) [English translation in library of U.S. Geol. Survey]; 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 58, table 4 [English translation in library of U.S. Geol. Survey, p. 69]. Named on correlation chart. Correlated with Tanapag limestone on Saipan, Mirikattan limestone on Rota, and Garukijokku limestone on Palau. A raised coral reef. Recent.

S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 27. Dangkula limestone, a raised coral reef; younger than Sonson limestone. Early Holocene. Name credited to M. Kodaira (unpub. ms.).

Danley Ranch Tongue (of Abo Sandstone)

Lower Permian (Wolfcamp Series) : Central southern New Mexico.

G. O. Bachman and P. T. Hayes, 1958, Geol. Soc. America Bull., v. 69, no. 6, p. 690 (fig. 1), 692–695, 698 (fig. 5). Predominantly soft red shale, reddish-brown cross-laminated shaly siltstone, and very fine grained sandstone; thin ledges of thin-bedded tannish-weathering light-olive-gray limestone, which probably represent minor tongues of Hueco limestone, present in most places; conglomerate of four types present in most localities in lower part of tongue. Maximum thickness about

200 feet; average thickness 100 feet; thickness varies widely as result of intertonguing with Hueco limestone and from marked relief of erosional surface on which Abo was deposited. In most areas, rests with sharp angular unconformity on limestone and shale beds of Pennsylvanian sequence; most commonly these rocks belong to upper unit of Magdalena group.

Type section: Exposed in SW¼ sec. 35, T. 19 S., R. 11 E., about 1 mile west of Danley Ranch headquarters, Otero County. Crops out in Sand Canyon area in narrow, discontinuous band from northeast edge of area to north fork of Culp Canyon.

†Dannemora Formation[1]

Precambrian: Northeastern New York.

Original reference: H. P. Cushing, 1901, New York State Mus. 53d Ann. Rept., pt. 1, p. r36–r69, map.

Well exposed all over Dannemora Mountain and throughout Dannemora Township, Clinton County.

†Dan River Series[1]

Upper Triassic: Central northern North Carolina.

Original reference: E. Emmons, 1856, Geological report of Midland Counties of North Carolina: North Carolina Geol. Survey.

Dan River region.

Dantzler Formation

Cretaceous (Comanche): Subsurface in Mississippi and Louisiana.

R. T. Hazzard, B. N. Blanpied, and W. C. Spooner, 1947, Shreveport Geol. Soc. 1945 Ref. Rept., v. 2, p. 477 (table), 478. Defined as the sand and gray and red-mottled shale section, with fossiliferous zones, which intervenes between base of lower Tuscaloosa and top of Washita limestone. Occurs between 8,905 and 9,910 feet in type well.

Type well: Humble Oil Co.'s B–1 Dantzler well, Jackson County, Miss. Recognized in wells in Forest, Jefferson Davis, Lamar, Lawrence, Marion, and Stone Counties, Miss., and in Washington Parish, La.

Danville Coal Member (of Carbondale Formation)

Pennsylvanian: Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 34, 35, 36, 48 (table 1), 65, pl. 1. Uppermost member of Carbondale formation (redefined). In southern area, occurs above Galum limestone member; in western and northern areas, occurs above Copperas Creek sandstone member; in eastern area, occurs above Herrin (No. 6) coal member. Thickness about 1⅔ feet. Danville (No. 7) coal is extended to No. 7 coal throughout Illinois. In southern Illinois, replaces name Cutler (No. 7) coal; in northern and western areas, replaces name Sparland (No. 7) coal. Coal named by Bradley (1870, Geology and Paleontology, v. 4, Illinois Geol. Survey). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: E½ sec. 7, T. 19 N., R. 11 W., Vermilion County.

Danville Injection Gneiss

Middle Silurian: Southwestern Maine.

L. W. Fisher, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 71. In Lewiston area are seven formations (ascending): Danville injection gneiss, 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.

Occurs in Lewiston area, Androscoggin County.

Danville 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 Danville, Yell County, Ark.

Danville Landing Beds or Group[1]

Danville Landing Formation or Beds (in Jackson Group)

Eocene: Central Louisiana.

Original reference: M. A. Hanna, Donald Gravell, and James McGuirt, 1934, Shreveport Geol. Soc. 11th Ann. Field Trip [Guidebook], p. 35–37, table opposite p. 30.

H. N. Fisk, 1938, Louisiana Dept. Conserv. Geol. Bull. 10, p. 106. Danville Landing beds present in Grant and La Salle Parishes as a 40-foot series of interbedded sands and clays. Grade vertically into underlying Verda member (new) of Yazoo formation and into overlying gypsiferous clays of Vicksburg group.

H. N. Fisk, 1944, U.S. Mississippi River Comm., p. 13 (table 2), 14, 15. Jackson group divided into three formations (ascending): Moodys Branch marl, Yazoo clay, and Danville Landing beds.

G. E. Murray, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 10, p. 1838 (fig. 6), 1839. Danville Landing formation present above Yazoo clay in central Louisiana. In Jackson group.

G. E. Murray, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 4, p. 702 (fig. 1), 703, 704, 705. Formation (beds) underlies Mosley Hill formation (new).

Named for occurrence in vicinity of Danville Landing, reported to be on Ouachita River, Catahoula Parish.

Darby Formation[1]

Middle and Upper Devonian: Northwestern Wyoming.

Original reference: E. Blackwelder, 1918, Washington Acad. Sci. Jour., v. 8, p. 420.

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.

W. W. Rubey, 1958, U.S. Geol. Survey Geol. Quad. Map GQ–109. In Bedford quadrangle, formation consists of alternating thick beds of (1) dark-gray buff-weathering massive dolomitic limestone; and (2) black, yellow, and red sandy calcareous siltstone. Thickness 450 to 550 feet. Overlies Bighorn dolomite; underlies Madison and Brazer limestone (mapped together).

Named for canyon of Darby Creek, on western slope of Teton Range.

Dardanelle Flow or Latite

Miocene and Pliocene: Central California.

F. L. Ransome, 1898, U.S. Geol. Survey Bull. 89, p. 14, 46–52. Discussion of lava flows on western slope of the Sierra Nevada in region drained by Stanislaus River. Latites belong to at least three distinct flows. The youngest, Dardanelle flow (or facies), consists of dark very compact augite-latite, with small scattered phenocrysts of labradorite and augite. Similar to oldest flow, herein named Table Mountain.

Named for occurrence on extreme summit of the West Dardanelle, Tuolumne County.

Darling Creek Glaciation

Pleistocene: East-central Alaska.

T. L. Péwé, 1952, (abs.) Geol. Soc. America Bull., v. 63, no. 12, pt. 2, p. 1289; T. L. Péwé *in* T. L. Péwé and others, 1953, U.S. Geol. Survey Circ. 289, p. 9, 13 (table 1). At least three major Quaternary glaciations recorded at north end of Delta River valley. Darling Creek, the earliest glacial advance, preceded Delta glaciation (new). Maximum extent of Darling Creek glaciers not known, but in immediate area of Big Delta they probably abutted against Yukon-Tanana upland and deflected down Tanana River valley perhaps as far as Richardson. Only isolated remnants of till occur on flat interfluves 2,000 to 3,000 feet above floor of Delta River valley.

Delta River valley in Big Delta area.

Darlington (plant) Bed (in Allegheny Formation)[1]

Pennsylvanian: Southwestern Pennsylvania.

Original reference: J. P. Lesley, 1878, Pennsylvania 2d Geol. Survey Rept. Q, p. 308–316.

Beaver County.

Darlington Shale (in Allegheny Formation)[1]

Pennsylvanian: Southwestern Pennsylvania.

Original reference: J. P. Lesley, 1878, Pennsylvania 2d Geol. Survey Rept. Q, p. 308–316.

Beaver County.

Darlington Underclay (in Allegheny Formation)[1]

Pennsylvanian: Southwestern Pennsylvania.

Original reference: J. P. Lesley, 1878, Pennsylvania 2d Geol. Survey Rept. Q, p. 308–316.

Beaver County.

Darrough Felsite

Permian(?): South-central Nevada.

H. G. Ferguson and S. H. Cathcart, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–40. Masses of fine-grained felsitic rocks largely intrusive into older rocks, chiefly the Pablo formation (new); also probably flows. The rocks are mostly rhyolitic in appearance and are fine grained and procelainlike in texture, commonly with well-defined flow banding. Contains abundant inclusions, particularly near contacts. Locally, in central parts of larger masses, the texture is coarser, resembling a fine-grained granitic rock.

Type locality: East front of Toyabe [Toiyabe] Range, west of Darrough's Hot Springs.

Darty Limestone

Mississippian (Kinderhookian): Illinois.

J. M. Weller, 1948, (abs.) Am. Jour. Sci., v. 246, no. 3, p. 150; J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 153, chart 5. Name proposed for a thin glauconitic limestone occurring in one or two layers and formerly included in basal part of Springville shale of Union County, Ill. Underlies restricted Springville shale; overlies Mountain Glen shale.

Charles Collinson and A. J. Scott, 1958, Illinois Geol. Survey Circ. 254, p. 511. Limestone near base of Springville shale is accepted as Chouteau and name Darty is no longer needed.

Name derived from tributary of Caney Creek, west of Jonesboro, Union County.

Darwin Quartz Diorite

Upper Mesozoic: Southern California.

V. C. Kelley, 1937, Econ. Geology, v. 32, no. 8, p. 992, 996 (fig. 4). Typically a white or light-grayish-green rock; the average or normal phase of the Darwin stock.

V. C. Kelley, 1938, California Jour. Mines and Geology, v. 34, no. 4, p. 514–516, pl. 7. Formation name Darwin quartz diorite is applied to the elongated stock which occupies center of Darwin Hills. Mapped as Darwin quartz diorite.

Occurs in Darwin silver-lead district in Coso Range, Inyo County.

Darwin Sandstone Member (of Amsden Formation)[1]

Pennsylvanian: Northwestern Wyoming.

Original reference (Dorwin): E. Blackwelder, 1918, Washington Acad. Sci. Jour., v. 8, p. 422.

C. A. Burk, 1954, Jour. Paleontology, v. 28, no. 1, p. 1–16. Discussion of faunas and age of Amsden. Faunal evidence confirms Pennsylvanian age of Amsden. [Hence Darwin sandstone is Pennsylvanian.] Fossils used in present report were collected by Biggs (unpub. thesis). Biggs revisited localities at Bull Lake Canyon and Cherry Creek where Branson and Greger (1918, Geol. Soc. America Bull., v. 29, no. 2) collected from what they believed to be Amsden formation. Biggs demonstrated that Branson's and Greger's collection from Bull Lake Canyon was taken from Mississippian Madison limestone but that it was possible that part of their collection from Cherry Creek was taken from the Amsden. This cannot be established because beds are poorly exposed, and Biggs points out that fossils could apparently be obtained only from slope wash. Because the Branson and Greger collections were the only ones figured, they became a standard reference for later geologists; on this basis, the apparent Mississippian age of Amsden was generally accepted by geologists.

J. D. Love, 1954, Tentative diagrammatic correlation of Tensleep, Amsden, Casper, and Hartville formations in Wyoming: Wyoming Geol. Assoc. Guidebook 9th Ann. Field Conf. Correlation chart shows Darwin sandstone member at base of Amsden formation. Stratigraphic, structural, and paleontologic data suggest that base of Darwin is contact between Pennsylvanian and Mississippian rocks. At Bull Lake, Darwin sandstone member overlies Sacajawea formation (this is, at type section of Sacajawea).

A. B. Shaw and W. G. Bell, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 3, p. 333–337. New fossil collections made from lower part of Amsden at Cherry Creek, Wind River Mountains. Mississippian-Pennsylvanian boundary placed more than 48 feet and less than 63 feet above Madison limestone. Lower faunas are Chesteran, and upper faunas tentatively dated Atokan. Presence of two sandstones in the Amsden, both of which have been called "Darwin" is inferred. Since basal sandstone of Amsden at Cherry Creek lies below Mississippian fauna, it cannot be same lithic unit as that identified as Darwin sandstone by Biggs, as quoted by Burk (1954) and Love (1954), elsewhere in Wind River Mountains. Thus there are two sandstones, both lying at base of red-bed sequence, that have been confused as one. Systemic boundary may lie below the upper sandstone, but it cannot lie below the lower sandstone. Love's correlations suggest that the upper sandstone is correlative of type Darwin. Use of name Sacajawea formation at Cherry Creek is not justified.

J. W. Strickland, 1956, Wyoming Geol. Assoc. Guidebook 11th Ann. Field Conf., p. 51–57. Discussion of Mississippian stratigraphy of western Wyoming and Mississippian-Pennsylvanian contact. Recommended that Darwin sandstone should mark base of Amsden formation and term Sacajawea be applied to all strata below Darwin and above Madison group. Darwin sandstone is not present in Cherry Creek section of Shaw and Bell (1955) but a Darwin zone, depicted by conglomerate between 68 and 73 feet above top of Madison, marks base of Amsden.

Name derived from Darwin Peak, in Gros Ventre Range.

Dashner Limestone[1] Member (of Topeka Limestone)

Pennsylvanian: Northeastern Kansas.

Original references: R. C. Moore, 1935, Rock formations of Kansas *in* Kansas Geol. Soc.: Wichita, Kans., [Am. Assoc. Petroleum Geologists 20th Ann. Mtg., Mar. 21–23]; 1936, Kansas Geol. Soc. Guidebook 10th Ann. Field Conf., Sept. 4–7, p. 41.

Derivation of name not stated.

Datil Formation[1]

Datil Volcanics

Tertiary: Southwestern New Mexico.

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

R. H. Wilpolt and others, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 61. Restricted to exclude unit here named Baca formation, which as defined includes the lower 694 feet of Winchester's stratigraphic section. Restricted Datil in that area is 1,140 feet and consists of latite, rhyolites, and andesite flows, agglomerate, tuff, conglomerate, and sandstone. Thickness in area of this report [La Joya area, Los Pinos Mountains, and northern Chupadera Mesa] estimated about 2,000 feet. Truncates several formations; in Socorro Mountains, rests on Madera limestone, the Baca being absent. Age of formation in doubt; if Baca is Eocene, Datil may be Eocene or younger. Mapped as Miocene(?).

W. H. Tonking, 1957, New Mexico Bur. Mines Mineral Resources Bull. 41, p. 6 (table 1), 7 (fig. 2), 26–32, pl. 1. Referred to as Datil volcanics. Winchester failed to measure complete section of Datil in Bear Mountains because above his uppermost 120 feet of quartz rhyolite there is at least 150 feet of vitric and welded rhyolitic tuff and a minimum of 1,200 feet of basalt and basaltic andesitic lava flows. He mapped about 500 feet of the Popotosa-Santa Fe unit as Datil, but did not include it in his measured section. In area of this report [Puertecito quadrangle], the Datil rests on strata of Cretaceous age as well as on Baca formation. Subdivided into (ascending) Spears, Hells Mesa, and La Jara Peak members. Thickness 2,740 to 2,990 feet. Underlies Santa Fe group. Upper Miocene(?).

M. E. Willard, 1959, New Mexico Geol. Soc. Guidebook 10th Field Conf., p. 95–98. Use of Datil formation in restricted sense by some authors and in very broad sense by others (as Tonking) has caused misunderstanding and confusion. On basis of reconnaissance study in Catron County, redefinition of Datil is suggested. Typically, a latite facies makes up lower parts of formation and is commonly gradational into an overlying rhyolite facies of tuff, welded tuff, and flows; rhyolite facies is overlain by, or interfingers with, an andesite facies consisting of flows, dikes, sills, and pyroclastics; conglomerate, sandstone, and siltstone from various sources may be present at any stratigraphic position but are only locally of sufficient thickness to warrant their being designated as facies. At only few places is whole assemblage of facies present; commonly one or two make up bulk of formation. Overlies nonvolcanic (Baca) sediments; underlies basalt and basaltic andesite.

Named for fact it is mountain-forming series of Datil Mountains. Winchester's section measured at north end of Bear Mountains in secs. 4, 5, 8, and 9, T. 1 N., R. 4 W., Socorro County.

Daube Limestone (in Hoxbar Group)

Daube Member (of Hoxbar Formation)[1]

Pennsylvanian (Missouri Series): Central southern 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, chart 6. Shown on chart as formation in the Hoxbar here considered a group.

C. W. Tomlinson and William McBee, Jr., 1959, *in* Ardmore Geol. Soc., Petroleum geology of southern Oklahoma—a symposium, v. 2: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 6 (fig. 2), 42–43. Referred to as member of Hoxbar group. Thickness 10 feet. Lies about 400 feet above Anadarche member and about 500 feet below Zuckerman member. Missourian.

Named for occurrence at abandoned coal mine of Daube, Westheimer, Munzesheimer, and Zuckerman, in SE¼ sec. 8, T. 5 S., R. 2 E., Carter County.

Dauphin Shale (in Martinsburg Group)

Ordovician: South-central and east-central Pennsylvania and northwestern New Jersey.

Bradford Willard, 1943, Geol. Soc. America Bull., v. 54, no. 8, p. 1069 (footnote), 1070, 1118. Name proposed for lower shaly part of group. Underlies Fairview sandstone or Shochary sandstone; overlies Chambersburg limestone or Jacksonburg limestone. Table 1 shows upper part included in interval of Jonestown red beds in Susquehanna Valley and Lehigh and Berks Counties, Pa.

M. E. Johnson and Bradford Willard, 1957, Geol. Soc. America Guidebook Atlantic City Mtg., p. 129. Mostly black shale west of Delaware Valley and black slate in Delaware Valley. Thickness at least 3,500 feet. Geographically extended to New Jersey.

Named from good exposures in Dauphin County, Pa.

Davenport Beds[1]

Davenport Member (of Wapsipinicon Formation)

Middle Devonian: Eastern Iowa.

Original reference: W. H. Norton, 1894, Iowa Acad. Sci. Proc., v. 1, pt. 4, p. 24.

E. H. Scobey, 1940, Jour. Sed. Petrology, v. 10, no. 1, p. 38 (fig. 1), 42–43. Uppermost member of formation. Overlies Spring Grove member; underlies Cedar Valley formation. Typically gray sublithographic dense unfossiliferous pure limestone, which is commonly highly brecciated; a shaly zone just below the Cedar Valley is referred to as Vinton phase. Average thickness between 10 and 30 feet; may be more than 50 feet thick in Scott County where lower boundary cannot be delimited.

Named for occurrence in vicinity of Davenport, Scott County.

David Formation

Eocene, upper: Panamá.

Karl Sapper, 1937, Mittelamerika, Handbuch der regionalen Geologie: Heidelberg, v. 8, Abt. 4a, no. 29, p. 131, 134 (correlation chart). Upper Eocene limestone. Below Majagua formation.

A. A. Olsson, 1942, 8th Am. Sci. Cong. Proc., v. 4, Geol. Sci., p. 234 (chart), 236. David formation applied in broad sense to the younger upper Eocene rocks of Panamá, consisting generally of foraminiferal limestones in their entirety or of shale and sandstone formations in which the limestones may be entirely missing or restricted to reeflike masses. In vicinity of David and Brenon, occurs above Bucarú formation; in Veraguas and Los Santos area occurs below Tonosi limestones.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 334. Poorly defined name. Eocene.

In Chiriqui Province.

David City Formation[1]

Pleistocene (Nebraskan): Eastern Nebraska and northeastern Kansas.

Original reference: A. L. Lugn and G. E. Condra, 1932, Geol. Soc. America Bull., v. 43, no. 1, p. 190.

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 52 (fig. 2), 53–55. In Kansas, term David City formation is applied only to water-laid deposits occurring below and genetically related to Nebraska glacial till; its distribution, therefore, is restricted to Doniphan, Atchison, and Brown Counties. In NE¼SE¼ sec. 6, T. 2 S., R. 20 E., Doniphan County, measured section includes 10 feet of sand, gravel, and cobbles which rest directly on Pennsylvanian limestone (Deer Creek limestone and Calhoun shale) and are conformably overlain by Nebraska till.

Type area: David City, Butler County, Nebr.

Davidson Granodiorite

Davidson Diorite

Miocene(?): Western Nevada.

V. P. Gianella, 1934, Mining and Metallurgy, v. 15, no. 331, p. 299. Davidson diorite is clearly intrusive but its precise place in geological events of area is undetermined.

V. P. Gianella, 1936, Nevada Univ. Bull., v. 30, no. 9, p. 64–68. Described as medium-grained granular rock of light-gray color. Contains many andesite inclusions. Intruded the Alta andesites, probably about middle Miocene.

G. A. Thompson, 1956, U.S. Geol. Survey Bull. 1042–C, p. 52–54, pl. 3. Gianella's (1934) Davidson diorite renamed Davidson granodiorite. Intrudes Alta formation. May be contemporaneous with parts of Kate Peak formation; cannot be younger than all of Kate Peak because it is cut by a few dikes of andesite porphyry of Kate Peak formation. Miocene(?).

Makes up bulk of Mount Davidson, Virginia City quadrangle.

Davidson Granophyre[1]

Precambrian: Southwestern Oklahoma.

Original reference: M. G. Hoffman, 1930, Oklahoma Geol. Survey Bull. 52, p. 39–48.

Crops out in west half of Davidson Hill and northwest along Little Medicine Creek for about one-half mile.

†Davion rock[1]

Miocene: Southern Mississippi.

Original reference: B. L. C. Wailes, 1854, Mississippi Agric. and Geol. Rept., p. 214–216.

Davis Coal Member (of Spoon Formation)

Pennsylvanian: Southeastern and southwestern Illinois and western Kentucky.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 32, 33, 46 (table 1), 64, pl. 1. Assigned member status in Spoon formation (new). Occurs above Stonefort limestone member and below DeKoven coal member. Thickness about 3½ feet. Coal named by Lee (1916, Kentucky Geol. Survey, ser. 4, v. 4, pt. 2); reference of Owen (1856, Kentucky Geol. Survey Bull., v. 1, ser. 1) incorrect. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: Davis mine. one-half mile east of DeKoven, Shawneetown quadrangle, Union County, Ky.

Davis cyclothem (in Tradewater Group)

Pennsylvanian: Southern 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. 16 (fig. 2) [1943]. Shown on columnar section as Davis cyclothem. Occurs below DeKoven cyclothem and above Stonefort cyclothem.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol, Survey Circ. 217, p. 5. Name Colbert cyclothem substituted for preempted name Davis.

Type locality of Davis cyclothem not given, but type locality of Colbert is one-half mile west of Colbert School in SE¼SW¼ sec. 23, T. 10 S., R. 7 E., Saline County.

Davis Formation (in Elvins Group)[1]

Davis Member (of Elvins Formation)

Upper Cambrian: Southeastern Missouri.

Original reference: E. R. Buckley, 1907, Missouri Bur. Geology and Mines, v. 10, 2d ser., separate.

Josiah Bridge, 1937, U.S. Geol. Survey Prof. Paper 186–L, p. 234 (table 1). Table shows Davis as basal formation of Elvins group. Underlies Derby dolomite; overlies Bonneterre dolomite.

V. E. Kurtz, 1960, Dissert. Abs., v. 21, no. 3, p. 595. Referred to as member of Elvins formation. Sharp lithologic change of wide areal extent divided member into a lower dominantly carbonate section and an upper dominantly shale unit. Underlies Derby member; disconformably overlies Bonneterre dolomite.

Named for outcrops on Davis Creek, St. Francois County.

Davis Formation (in Tradewater Group)

Pennsylvanian: Southern Illinois.

J. M. Weller, 1940, Illinois Geol. Survey Rept. Inv. 71, p. 39, 41. Uppermost formation in Tradewater group. Overlies Stonefort formation. Represents a single cycle of deposition. Basal sandstone, Davis, has maximum thickness of 30 feet or more but thins and pinches out to west; Davis coal is persistent seam about 3 feet thick.

Type locality and derivation of name not given.

Davis Creek Beds[1]

Miocene: Northwestern Nevada.

Original reference: R. W. Chaney, 1924, Geol. Soc. America Bull., v. 35, p. 162–163.

Washoe County.

Davis Creek Formation

Upper Jurassic[?] or Cretaceous[?]: Northern California.

J. E. Lawton, 1956, Dissert. Abs., v. 16, no. 10, p. 1885. Shown in list as underlying Brophy Canyon formation and overlying Little Valley formation (both new). Comprises Buck Island member above and Baldy Mountain member (both new). The Upper Jurassic and Cretaceous section, about 40,000 feet, consists of sequence of shale and silty shale which alternate with sequences of sandstone.

Occurs in Morgan-Wilbur area in Lake, Yolo, and Colusa Counties.

Davistown Sandstone (in Washington Group)

Permian: Western Pennsylvania and West Virginia.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 151. Medium- to heavy-bedded, medium-grained brown shaly sandstone. Thickness 10 to 30 feet. Lies 320 feet above Waynesburg coal and a short distance between Jollytown coal. Probable that in parts of West Virginia where Middle Washington limestone is lacking, this sandstone may have been included in Upper Marietta, but from type section given by Hennen, the Upper Marietta is confined to sandstone lying below a calcareous shale which is probable equivalent of Middle Washington limestone rather than bed so called in Hennen's (1909, West Virginia Geol. Survey County Rept. Marshall, Tyler, and Wetzel Counties) section. Therefore, in section where Middle Washington limestone is well developed, it seems prefrable that Upper Marietta be confined to sandstone strata below this limestone, and that sandstone above it be given another name.

A. T. Cross and M. P. Schemel, 1956, West Virgina Geol. Survey, v. 22, pt. 1, p. 53 (fig. 1–141). Columnar section of Lower Dunkard (Washington series) in Ohio River valley, West Virginia, shows Davistown sandstone above Upper Marietta sandstone and below Upper Washington limestone.

Named for quarry in the sandstone just north of National Pike at Davistown, Greene County, Pa.

Dawes Sandstone (in Clinton Group)

Middle Silurian: Central New York.

Tracy Gillette, 1947, New York State Mus. Bull. 341, p. 13, 99–100, 170. Name proposed for light-gray slightly calcareous sandstone. Very cross-bedded and unfossiliferous. Few thin layers of arenaceous shales in basal part. Upper part stained red. Thickness about 8 feet. Unconformably underlies Kirkland iron ore; unconformably overlies Willowvale shale.

Type locality: On small stream known locally as Dawes Quarry Creek flowing west into Oriskany Valley within limits of village of Clinton; section is east of main part of Clinton in town of Kirkland, Oneida County. Outcrop area bounded on west by College Hill Creek on west side of Oriskany Valley and on east by Dawes Quarry Creek.

Dawn Limestone Member (of Monte Cristo Limestone)[1]

Dawn Member (of Monte Cristo Dolomite)

Lower Mississippian: Southeastern Nevada and southeastern California.

Original reference: D. F. Hewett, 1931, U.S. Geol. Survey Prof. Paper 162, p. 10, 17.

J. C. Hazzard, 1951, (abs.) Geol. Soc. America Bull., v. 62, no. 12, pt. 2, p. 1503; 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 5, p. 880, 881, 883 (fig. 2). Geographically extended into Nopah Range, Inyo County, Calif., where it is predominantly limestone 350 feet thick, underlies Anchor limestone member and overlies Sultan limestone (Crystal Pass member). Name Stewart Valley is abandoned, and Mississippian beds previously ascribed to it are assigned to Dawn limestone.

Charles Deiss, 1952, U.S. Geol. Survey Bull. 973–C, p. 114–115, pl. 13. Member described in Sloan district, Nevada, where it is approximately 175 feet thick, and consists of two lithologic units. Lower, which comprises four-fifths of the formation, is dull chocolate gray, tan gray, light gray, or white and consists of a medium to coarsely crystalline, thick-bedded dolomite; upper unit consists of thinner bedded (2 to 18 inches) tan-buff medium crystalline dolomite. Underlies Anchor member; contact arbitrarily drawn at base of lowest bed containing chert.

D. F. Hewett, 1956, U.S. Geol. Survey Prof. Paper 275, p. 42. Described in Ivanpah quadrangle (California-Nevada) where it is made largely up of beds of blue-gray to dark-gray limestone, 2 to 10 feet thick, but is widely altered to dolomite. Underlies Anchor limestone member.

Well exposed west of Dawn mine, SW¼ sec. 15, T. 23, S., R. 58 E., Goodsprings quadrangle, Nevada.

Dawson Arkose[1] or **Formation**

Upper Cretaceous and Paleocene: Eastern Colorado.

Original reference: G. B. Richardson, 1912, Geol. Soc. America Bull., v. 23, p. 267–276.

C. H. Dane and W. G. Pierce, 1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 10, p. 1309–1312, 1314–1315 (fig. 3), 1320–1328. More than 2,000 feet thick; consists of arkosic conglomerate and sands. Merges northward into Arapahoe and Denver formations along foothills of Front Range, where beds stand vertically or dip steeply eastward on west flank of Denver basin. Dawson and Arapahoe along this belt overlie, with erosional irregularity, Laramie formation. In plains region—on east side of basin—where beds dip gently westward into basin, upper part of Dawson is coarsely conglomeratic, but lower consists chiefly of arkosic sands and dark shales, contains beds of lignite, and is not much different than underlying Laramie upon which it rests with apparent conformity. Identifiable remains of *Triceratops* present in lower part, but upper part has not yielded fossils of diagnostic age. Underlies Castle Rock conglomerate.

R. W. Brown, 1943, Geol. Soc. America Bull., v. 54, no. 1, p. 65–86. New fossil evidence places basal part of Dawson arkose and Denver formation in Upper Cretaceous sequence. Proposed that Dawson arkose be restricted to Tertiary strata and that lower part be included in redefined Laramie.

S. O. Reichert, 1956, Geol. Soc. America Bull., v. 67, no. 1, p. 107–111, pls. 1, 2. Arapahoe and Denver formations can be mapped throughout Denver basin, and these names should replace term "lower" Dawson of Dane and Pierce (1936). Dawson formation (type section at Dawson Butte) should designate only "upper" Dawson of Dane and Pierce. Name Green Mountain conglomerate should be abandoned because it is only partial representative of Dawson formation as here restricted.

Named for Dawson Butte, about 6 miles southwest of Castle Rock, Douglas County.

Dawson Bay Formation

Dawson Bay Formation (in Manitoba Group)

Middle Devonian: Surface and subsurface in Manitoba, Canada, and subsurface in northeastern Montana, western North Dakota, and northwestern South Dakota.

A. D. Baillie, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 2, p. 444–452; 1953, Manitoba Dept. Mines and Nat. Resources Mines Br. Pub. 52–5, p. 26–27. Term proposed for lowest sequence of strata of Manitoba group. Lower limit is taken at base of red and green argillaceous zone that overlies Elk Point group. Upper limit marked by top of widespread reefoid and stromatoporid zone. Thickness 100 to 200 feet. In outcrop overlies Winnipegosis formation. Underlies unnamed strata of group.

W. M. Laird, 1953, Interstate Oil Compact Quart. Bull., v. 12, no. 2, p. 74. Underlies Souris River formation (new). Included in Beaver Hill Lake group.

C. A. Sandberg and C. R. Hammond, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 10, p. 2299 (fig. 2), 2302–2304 (fig. 4), 2307–2308, 2309 (fig. 5). Baillie placed Dawson Bay formation and overlying unnamed beds that are approximately equivalent to Souris River formation of present report in Manitoba group. This grouping is not recommended for United States part of Williston basin because Dawson Bay and Souris River formations are readily separable. In Birdbear well, Dunn County, N. Dak., formation lies between depths of 11,052 and 11,170 feet. Ranges in thickness from fraction of foot to 185 feet; thickest along international boundary and in north-central North Dakota. Underlies approximately same area as Elk Point group in Williston basin and northeastern Montana but extends slightly beyond limit of Winnipegosis formation. Overlies Prairie formation of Elk Point group; underlies Souris River formation. Does not outcrop in United States.

Named for exposures along shores of Dawson Bay at northern end of Lake Winnipegosis, Manitoba, Canada.

Dayan 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). These stages 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. 820–829. 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.

Marshall Kay, 1960, Internat. Geol. Cong. 21st, Copenhagen, pt. 7, p. 28–33. Chazyan series has Whiterockian, Dayan, Crownian, and Valcourian stages.

Day Creek Dolomite

Day Creek Dolomite Member (of Cloud Chief Formation)

Day Creek Dolomite (in Cimarron Group or Woodward Group)[1]

Permian: Southern Kansas, eastern Colorado, and northwestern Oklahoma.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 3, 44.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 37. Fine-grained dense dolomite about 2 feet thick in Kansas. Crops out in western Clark County; seemingly absent between northern part of T. 33 S., R. 24 W., and a point in Oklahoma near center of T. 25 N., R. 25 W., (Indian meridian). Overlies Whitehorse sandstone; underlies Taloga formation of Quartermaster group.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped as member of Cloud Chief formation.

T. G. McLaughlin, 1954, U.S. Geol. Survey Water-Supply Paper 1256, p. 81, 82 (fig. 23). Day Creek dolomite exposed in Baca County, Colo., where it underlies Taloga formation.

Named for Day Creek, Clark County, Kans.

Day Point Limestone[1]

Middle Ordovician: Eastern New York and western Vermont.

Original reference: H. P. Cushing, 1905, New York State Mus. Bull. 95.

F. M. Swartz, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1402 (fig. 2). Shown on correlation chart as Chazyan. Below Crown Point formation.

Marshall Kay, 1950, (abs.) Geol. Soc. America Bull. 61, no. 12, pt. 2, p. 1476. Bridport dolomite underlies Chazy Day Point formation within and west of Lake Champlain in Vermont and New York.

R. E. Erwin, 1957, Vermont Geol. Survey Bull. 9, p. 11–20, 63, 65, pls. 1, 2. Described on South Hero Island and Isle La Motte, where it overlies Providence Island dolomite and underlies Crown Point limestone. Thickness about 233 feet on Isle La Motte; 237½ feet on South Hero Island.

Philip Oxley and Marshall Kay, 1959, Am. Asoc. Petroleum Geologists Bull., v. 43, no. 4, p. 820–829. Included in Dayan stage (new). Comprises (ascending) Head, Scott, Wait, and Fleury members (all new). Chazyan.

Well exposed at Day Point, Peru Township, Clinton County, N.Y.

Days Creek Formation (in Myrtle Group)

Lower Cretaceous: Southwestern Oregon.

R. W. Imlay and others, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2775 (fig. 2), 2777 (fig. 3), 2781 (table 1), 2782–2784. Name applied to early Cretaceous clastic sedimentary rocks that concordantly overlie Riddle formation (new). Consists of alternating units of greenish-gray, fine-grained, even-grained sandstone and medium-gray to greenish siltstone; divisible into two members of which lower is distinguished from upper by presence of limestone lenses, by its siltstone units being medium gray instead of greenish gray, by its sandstone units being less massive, and by containing pelecypod *Buchia crassicollis* (Keyserling). Thickness at type section 809 feet. Rests directly on Riddle formation at many places in Douglas County; appears to rest normally on Galice formation at bridge across Illinois River west of O'Brien, Josephine County, but actual plane of contact not visible; in Port Orford area, basal beds containing *Buchia crassicollis* (Keyserling) rest generally on the Riddle but locally overlap onto Colebrooke schist. Contact with Galice and Colebrooke interpreted as angular unconformity. Name Days Creek replaces Horsetown formation and Cretaceous part of Knoxville as used by Diller and Kay (1924, U.S. Geol. Survey Geol. Atlas, Folio 218) in southwestern Oregon.

Type section: Along South Umpqua River in NW¼ sec. 15, SW¼ sec. 47, and E½ sec. 9. T. 30 N., R. 4 W., Douglas County. Named for village of Days Creek.

Daysville Formation (in Ancell Group)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., p. 21, figs. 3, 12. Dolomite, impure, greenish-gray, chalky, thin-bedded. Thickness about 4½ feet. Shown on columnar section as underlying Loughridge formation (new) and overlying Kingdom formation (new).

Occurs in Dixon-Oregon area.

Dayton Limestone[1]

Middle Silurian: Southwestern Ohio.

Original reference: E. Orton, 1870, Ohio Geol. Survey Rept. Prog. 1869, p. 143; 1871, Ohio Geol. Survey Rept. Prog. 1870, p. 271, 297, 299–301, 309, fig. 1 facing p. 310.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Shown on correlation chart below Estill clay and above Waco limestone. Niagaran series.

R. J. Bernhagen, chm., 1960, Ohio Acad. Sci. Sec. Geology Guidebook 35th Ann. Field Conf., p. 17, 21. Silurian section exposed in Yellow Springs region shows Dayton limestone, 5 to 8 feet thick, above Brassfield limestone and below Osgood shale. Clinton group.

Typically exposed in vicinity of Dayton, Montgomery County.

Dayville Member (of Coeymans Limestone)

Lower Devonian: Central New York.

L. V. Rickard, 1956, Dissert. Abs., v. 16, no. 1, p. 102. When traced westward from the Helderbergs, the Coeymans formation thickens to nearly 100 feet at Cherry Valley. Slightly further west, this greatly thickened Coeymans splits into three parts. Lower part, for which name Dayville limestone is proposed, grades laterally into Olney limestone of Syracuse area.

Type locality and derivation of name not stated.

D-Cross Tongue (of Mancos Shale)

Upper Cretaceous: Southwestern New Mexico.

C. H. Dane, A. A. Wanek, and J. B. Reeside, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 2, p. 187, 188 (fig. 2). A marine shale unit ranging from 90 to 191 feet in thickness and decreasing consistently in thickness from south to north. Underlies Gallego sandstone member of Gallup sandstone and overlies lower part of Gallup sandstone. Unit formerly correlated with Pescado tongue but now believed to be a distinct and higher tongue.

Named for exposures at D-Cross Mountains in secs. 17 and 18, T. 3 N., R. 8 W., Socorro County.

Dead Horse Conglomerate 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, 905–906. Consists largely of thin beds of gray flat-pebble limestone conglomerate. Thickness about 108 feet. Underlies Tie Gulch dolomite member (new); overlies Clinetop algal limestone member (new) of Dotsero formation.

Type section: Spur on north side of U.S. Highway 6, one-half mile northeast of bridge over French Creek. Named for exposures along Dead Horse Creek which enters Glenwood Canyon from northwest near NE cor. sec. 30, T. 5 S., R. 87 W., Garfield County.

Dead Horse Tuff

Eocene, upper: Northeastern Nevada.

R. R. Coats, 1957, U.S. Geol. Survey Trace Elements Inv. Rept. TEI–690, Book 2, p. 304–305. Massive dull-green to reddish- and pinkish-gray biotite quartz latite welded tuff. Thickness about 5,000 feet. Grades upward into coarse conglomerate which is overlain by Jarbidge rhyolite (new). Rests on Paleozoic limestone.

U.S. Geological Survey currently considers the Dead Horse Tuff to be upper Eocene in age.

Present in Jarbidge quadrangle.

Deadman Limestone[1]

Upper Triassic: Southeastern Idaho and northwestern Wyoming.

Original reference: G. R. Mansfield, 1915, Washington Acad. Sci. Jour., v. 5, p. 492.

C. A. Moritz, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 8, p. 1801 (table 1). Age shown on table as Upper(?) Triassic.

G. R. Mansfield, 1952, U.S. Geol. Survey Prof. Paper 238, p. 17, 34–35, pl. 1. Mapped in Ammon and Paradise Valley quadrangles. Type locality designated.

Bernhard Kummel, 1954, U.S. Geol. Survey Prof. Paper 254–H, p. 180–181. Mansfield (1927, U.S. Geol. Survey Prof. Paper 152) recognized following sequence of beds between Thaynes and Nugget formations: Timothy sandstone, Higham grit, Deadman limestone, and Wood shale. These units are distinct lithologically and are equivalent to Ankareh formation of Wasatch and Uinta Mountains of western Wyoming. In present report, Timothy sandstone is considered uppermost member of Thaynes. Higham grit and Deadman limestone are recognized as independent formations and Wood shale is considered westward extending tongue of Ankareh formation. At type area, the Deadman is 150 feet thick and directly overlies Higham grit.

H. R. Wanless, R. L. Belknap, and Helen Foster, 1955, Geol. Soc. America Mem. 63, p. 46. Geographically extended into Snake River Range, Wyo.

Type locality: Deadman Creek in northeastern part of T. 4 S., R. 38 E., Paradise Valley quadrangle, Idaho, where formation is crossed by the creek and extends northwestward along the ridge parallel to and northeast of prominent band of Higham grit. Named from Deadman Creek.

Deadman Quartzite

Precambrian: Central Arizona.

E. D. Wilson, 1938, *in* Arizona Bur. Mines Bull. 145, Geol. Ser. 12, pl. 3; 1939, Geol. Soc. America Bull., v. 50, no. 7, p. 1118, 1123. Hard fine- to medium-grained thinly stratified crossbedded cliff-forming quartzite, together with some thin conglomerate and hematitic shale members and an irregular basal conglomerate. In general, upper third weathers grayish brown to white, in contrast to reddish-brown tint of lower part. Thickness ranges from 90 to 110 feet except in a thrust block at the southeast where it is approximately 800 feet. Thins out northward; removed by erosion southward. Unconformably overlies Red Rock rhyolite; conformably underlies Maverick shale (new).

Named from typical occurrence on North Fork of Deadman Creek. Found only within northern half of Mazatzal Range.

Deadman Island Beds[1] (in San Pedro Formation)

Pleistocene: Southern California.

Original reference: J. P. Smith, 1910, Jour. Geology, v. 18, chart opposite p. 217.

Deadman Island no longer exists. Was an island formerly located in San Pedro Harbor but has now been entirely removed by steam shovels.

Deadwood Formation[1]

Upper Cambrian and Lower Ordovician: Western South Dakota, southeastern Montana, and eastern Wyoming.

Original reference: N. H. Darton, 1901, U.S. Survey 21st Ann. Rept., pt. 4, p. 505.

M. R. McCoy, 1952, Billings Geol. Soc. Guidebook 3d Ann. Field Conf., p. 45 (chart), 47. In northern Black Hills, conformably underlies Aladdin sandstone (new).

M. R. McCoy, 1958, Wyoming Geol. Assoc. Guidebook 13th Ann. Field Conf., p. 21. In Powder River Basin, term Deadwood is used to include a series of sandstone, shale, and limestone-dolomites which are Upper Cambrian and Lower Ordovician in age. At type section in Black Hills, Deadwood is 350 to 400 feet thick. Sandstone or conglomerate, often auriferous, marks base of formation; this unit, which rests on beveled schists or quartzites, is erratic in thickness, varying from 2 to 95 feet. Above basal sandstone is series of interbedded blue-gray shales, with 2 or 3 horizons, 10 to 70 feet thick. In upper part, a massive sandstone unit is commonly present, often dolomitic, and sometimes ferruginous. Deadwood thins southward to zero edge.

Type locality: Whitewood Canyon, just below Deadwood, Lawence County, S. Dak.

Deadwood Gulch Rhyolite Tuff[1]

Tertiary: New Mexico.

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

Named for exposures in upper part of Deadwood Gulch, Mogollon district.

Dean Formation (in Great Smoky Group)

Precambrian: Central northern Georgia.

V. J. Hurst, 1955, Georgia Geol. Survey Bull. 63, p. 9, 40–45, pl. 1, map. Staurolite-mica schists, X-biotite schists, quartzites, metaconglomerates, and "pseudo-diorite" beds; interbedded lesser amounts of gray slate, phyllite, and sericite schist; shows marked horizontal variations, abrupt vertical variations, and many breaks in lithologic sequence. Thickness 2,500 to 3,500 feet. Overlies Hothouse formation (new), hybrid character of rocks between the two makes position of boundary largely interpretative; underlies Nantahala slate, formations appear to be gradational through a zone less than 20 feet thick, and concordant; staurolite schist and metaconglomerate formerly included in basal Nantahala are here included in the Dean, and the Dean-Nantahala boundary is drawn at base of dark slate.

Crops out in a one-half-mile wide belt on each limb of Murphy syncline; western belt extends along west side of Dean Ridge, after which formation is named, through Windy Ridge, and along upper course of Sugar Creek; eastern belt lies to west of Lake Toccoa, Mineral Bluff quadrangle, Fannin County.

Dean Sandstone

Permian (Wolfcamp): Western Texas (subsurface).

Lamar McLennan, Jr., and H. W. Bradley, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 4, p. 899, 903, 904, 908. Name was first applied by Seaboard geologists to a sandstone in Gulf Oil Corp.'s Dean No. 1, from 7,990 to 8,190 feet. Type section for Dean as used in this report occurs between depths of 7,550 to 7,660 feet in the Seaboard's Robison 6–A. In type locality, consists of approximately 120 feet of gray-white to brown fine sandstone with thin streaks of tan to brown dense limestone and black shale. Occurs below Spraberry sandstone.

Type well: Seaboard's Robison 6–A, a Spraberry field well in sec. 37, Black 34, T. 5 N., Texas and Pacific Railway Survey, Dawson County.

Deanefield Shale (in Pottsville Formation)[1]

Pennsylvanian: Western Kentucky.

Original reference: J. H. Gardner, 1927, Kentucky Geol. Survey, ser. 6, v. 26, p. 135, 137, 153.

Extends throughout territory from Butler to Daviess Counties and is well exposed around Deanefield and Fordsville, Hartford quadrangle.

Dean Lake Chert

Dean Lake Chert (in Hannan Limestone)

Dean Lake Chert Member[1] (of Madison Limestone)

Mississippian (Kinderhookian and Osagean): Northwestern Montana.

Original reference: C. F. Deiss, 1933, Montana Bur. Mines and Geology Mem. 6, p. 47.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, pl. 2 (column 38). Underlies Rooney chert and overlies Saypo limestone, all in Hannan limestone. Kinderhookian and Osagean.

J. M. Andrichuk, 1955, Billings Geol. Soc. Guidebook 6th Ann. Field Conf., p. 89. Hall (1952, unpub. thesis) proposed that Deiss' Dean Lake be recognized as a formation. Deiss gave thickness of 60 feet at type section. Hall redefined type section of 105-foot thickness to include about 45 feet of overlying similar beds separated by 11 feet of chert-free limestone. Kinderhook.

Type locality: Southeast side of Pentagon Mountain in SW¼ sec. 14 T. 25 N., R. 14 W. Named for small cirque lake lying at foot of cliffs that form upper part of east side of the mountain.

Deansboro Member (of Coeymans Limestone)

Lower Devonian: Central New York.

L. V. Rickard, 1955, New York Geol. Assoc. Guidebook 27th Ann. Mtg., p. 7, 9 (strat. column); 1956, Dissert Abs., v. 16, no. 1, p. 102. Coeymans limestone of central New York, overlying Jamesville member of the Manlius, is entirely younger than the Coeymans of eastern New York.

Name Deansboro is proposed for this part of the Coeymans. Consists of massive gray or blue coarse-grained limestone, 30 to 60 feet thick, characterized by *Gypidula coeymanensis, Brachyprion varistriata, Atrypa "reticularis", Camarothoechia semiplicata, Leptostrophia planulata,* and *Uncinulus mutabilis.* Contains at least four coral reefs. Underlies Onondaga. The "Bishop Brook" is merely a reappearance of the Deansboro at Manlius beneath the pre-Onondaga unconformity.

Type locality and derivation of name not stated.

Dearborn Limestone[1]

Middle Cambrian: Northwestern Montana.

Original reference: C. F. Deiss, 1933, Montana Bur. Mines and Geology Mem. 6, p. 36.

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1075, 1081–1082, 1086, 1089, 1090 (fig. 2); 1939, Geol. Soc. America Spec. Paper 18, p. 26, 30, 33, 40, 54 (fig. 6). As herein defined, conformably overlies Damnation limestone (redefined) and conformably underlies Pagoda limestone. Steamboat limestone, as used in 1933 sequence, has proved to be part of massive upper Dearborn which was repeated in the Dearborn section by low angle overthrust. Steamboat as now used refers to limestone underlying Switchback limestone and overlying Pentagon shale. Thickness at type locality 354 feet. Consists of lower shaly interval and a much thicker upper limestone interval. Middle Cambrian.

Type locality: On north side of valley of North Fork of Dearborn River, in W½ sec. 6, T. 17 N., R. 7 W., south-central part of Lewis and Clark Range, Lewis and Clark County.

Death Canyon Member (of Gros Ventre Formation)[1]

Death Canyon Limestone (in Gros Ventre Group)

Cambrian: Western Wyoming.

Original reference: B. M. Miller, 1936, Jour. Geology, v. 44, no. 2, p. 119.

A. B. Shaw and P. O. McGraw, 1954, Wyoming Geol, Assoc. Guidebook 9th Ann. Field Conf., chart 2; A. B. Shaw and C. R. LeLand, 1955, Wyoming Geol. Assoc. Guidebook 10th Ann. Field Conf., p. 38, 39. Gros Ventre formation of earlier workers is raised to group status in western Wyoming where it contains three mappable formations: 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 Gros Ventre, southern Teton, northern Hoback, and Snake River Ranges, considered middle member of formation; overlies Wolsey shale member; underlies Park shale member. Consists of massive dull-blue-gray limestone in two beds of unequal thickness with an intervening fossiliferous shale. Thickness 207 to 368 feet.

Type section: Along divide between Death and Teton Canyons in Teton Range.

Death Valley Formation[1]

Precambrian: Southeastern California.

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

B. K. Johnson, 1957, California Univ. Pub. Geol. Sci., v. 30, no. 5, p. 355, 378 (fig. 7). This study [Manly Peak quadrangle] has made possible the correlation of formations defined by Murphy (1930, Econ. Geology, v. 25; 1932 [1933]) in Telescope Peak quadrangle with formations now commonly used in Death Valley. Death Valley formation is correlated with Stirling quartzite here assigned to Precambrian as defined in this report.

Mapped over a wide area to west of Death Valley, Panamint Mountains, Inyo County.

Deaton Formation,[1] Series,[1] or Iron-Ore Series[1]

Middle Ordovician: Northwestern Georgia.

Original reference: J. W. Spencer, 1893, Georgia Geol. Survey, Paleozoic group, p. 46, 83.

Named for exposures at Deaton mine, Polk County.

DeBeque Formation

Paleocene, upper, and Eocene, lower: Western Colorado.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 18, pl. 1. Late Paleocene and Wasatchian of western Colorado, to be named and described by Patterson.

J. A. Dorr, Jr., 1952, Geol. Soc. America Bull., v. 63, no. 1, pl. 2 facing p. 64. Correlation chart shows age to be Paleocene (Tiffanian and Clarkforkian) and early Eocene (Wasatchian).

D. B. Kitts, 1956, Am. Mus. Nat. History Bull., v. 110, p. 47, 49, 51. Includes Rifle member (new).

C. L. Gazin, 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 134 (fig. 1), 135. Comprises (ascending) Plateau Valley beds, Lysite equivalent, and Lost Cabin equivalents. Tiffanian, Clarkforkian, and Wasatchian.

Town of De Beque is in Mesa County.

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), 1734 (fig. 4), 1739–1743. Lower 750 feet of type section consists of sandstone members 60 to 330 feet thick alternating with shale members 50 to 150 feet thick; middle 850 feet is massive cliff-forming sandstone that is predominantly light gray; upper 600 feet is alternating shales and sandstones, members averaging about 150 feet in thickness. South of Santa Ynez fault, includes Romero conglomerate lentils (new). In type area, underlies Pendola shale (new); southwest of type section, Pendola is cut out and the Debris Dam is unconformably overlain by middle Eocene Juncal formation. Gradationally overlies unnamed Cretaceous shale unit; base of Debris Dam arbitrarily selected where sandstone first predominates over shale in the transitional sequence.

Type locality: Small canyon that drains westward to Agua Caliente Canyon about 1½ miles northeast of Pendola Guard Station and 1⅛ miles south of Big Caliente Debris Dam, Santa Barbara County. Base of section 6,200 feet S. 1° E. of Big Caliente Dam, and top is 6,700 feet S. of 23° E. of dam. Formation forms part of Auga Caliente anticline. To northwest of type section, beds extend past Big Caliente Debris Dam to northern limit of area; southwestward, they extend approximately 1 mile where they disappear beneath Juncal formation; seemingly they reappear south of Santa Ynez fault in an elongate east-west-trending belt; however, correlation here is uncertain because of lack of fossils and occurrence of Romero conglomerate lentils.

Decathon Dolomite

Silurian: Eastern Nevada and western Utah.

R. W. Rush, 1956, Utah Geol. and Mineralog. Survey Bull. 53, p. 12 (fig. 3), 23 (fig. 5), 25–26, 30–31 (fig. 6), 34–35 (fig. 7), 36–37 (fig. 8), 40–41 (fig. 9), 52–53 (fig. 11), 60. Proposed for light-gray coarsely crystalline, dense dolomite 350 feet thick lying above Roberts Mountain and below Kings Canyon dolomite (new) at Big Springs, Nev. Locally overlies Jack Valley dolomite (new).

Name taken from Decathon Canyon, one of principal drainage channels of southern part of Snake Range, Nev., west of Big Springs Ranch.

Decatur Limestone[1]

Decatur Limestone (in Brownsport Group)

Upper Silurian: Western and central Tennessee.

Original reference: W. F. Pate and R. S. Bassler, 1908, U.S. Natl. Mus. Proc., v. 34, p. 410–432.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Age shown on correlation chart as Niagaran [Middle Silurian].

T. W. Amsden, 1949, Yale Univ., Peabody Mus. Nat. History Bull. 5, p. 10–12, fig. 6. Conformably overlies Brownsport formation. A post- Decatur unconformity is present throughout area [western Tennessee]; Decatur may be overlain by beds ranging in age from Devonian to Cretaceous; as result of this post-Silurian erosion, thickness of Decatur varies greatly within short distances—as near Sewell's Spring, Clifton quadrangle, where thickness ranges from 18 to 70 feet; here, too, some Devonian may be present in upper part.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 266–269, fig. 2. Included in Brownsport group. Everywhere overlain unconformably by formations of the Devonian or by Chattanooga shale. Locally is an overlapping unit; transgresses westward across beveled Lobelville and Bob formations and part of Beech River formation. Believed to be Niagaran in age.

Type section: At Tuck's Mill, 1½ miles north of Decaturville. Named for Decatur Country.

†Decatur Sand (in Claiborne Group)[1]

Eocene, middle: Southeastern Mississippi.

Original reference: E. N. Lowe, 1919, Mississippi Geol. Survey Bull. 14, p. 78.

Crops out mainly near Enterprise, Wautubbee, and Decatur. Named for exposures near Decatur, Newton County.

Decaturville 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. 67.

Probably named for exposures at Decaturville, Camden County.

Decaturville Chert[1]

Decaturville Chert (in Linden Group)

Decaturville chert zone (in Ross Formation)

Lower Devonian: Western and central Tennessee.

Original reference: C. O. Dunbar, 1918, Am. Jour. Sci., 4th, v. 46, p. 744.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., 53, no. 12, pt. 1, chart 4. Shown on correlation chart as uppermost formation in Linden group. Occurs above Birdsong shale and below Quall limestone.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 280, 290–292, 295–296, 301–302. Considered a zone conformably interbedded with beds of Ross limestone member, Bear Branch facies, and Birdsong shale member of Ross formation (new). Term Decaturville zone is applied to the porous fossiliferous gray chert that is developed by chertification of limestone zone that carries large specimens of brachiopods and overlies the Bryozoan zone.

Well exposed in vicinity of Decaturville, Decatur County.

†Decaturville Limestone[1]

Upper Cambrian: Central Missouri.

Original reference: E. M. Shepard, 1904, Bradley Geol. Field Sta. Drury Coll. Bull., v. 1, pt. 1, p. 42.

Named for exposures at Decaturville, Camden County.

Deception Rhyolite (in Ash Creek Group)

Deception Porphyry[1]

Precambrian (Yavapai Series): Central Arizona.

Original reference: L. E. Reber, Jr., 1922, Am. Inst. Mining and Metall. Engineers Trans., v. 66, p. 12.

C. A. Anderson and S. C. Creasey, 1958, U.S. Geol. Survey Prof. Paper 308. p. 15–17, pl. 1. As exposed in Deception Gulch and in part of Mescal Gulch, unit is a hydrothermally altered facies of rhyolitic flows and fragmental rocks. Name therefore modified to Deception rhyolite to include all rhyolitic rocks older than Grapevine Gulch formation (new) and younger than Shea basalt, dacite of Burnt Canyon, Brindle Pup andesite (new), and Buzzard rhyolite (new). A jasper-bearing facies of rhyolite present at top of unit in drainage basin of Ash Creek and in Hull Canyon. A minor facies in Mescal Gulch area contains sericitized plagioclase phenocrysts in microcystalline groundmass. Near Jerome, outcrops are reddish hue, changing to buff and cream in Mescal Gulch, and are pale colored near Ash Creek. Most complete section exposed between Ash Creek and Black Canyon, where rhyolite is about 3,000 feet thick.

Well exposed in drainage basins of Mescal Gulch and Deception Gulch, which is the name for the deep rugged part of Hull Canyon south of Jerome, Yavapai County. Also exposed south of Mingus Mountain between Ash Creek and Black Canyon.

Decew Dolomite

DeCew Limestone[1]

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

Original reference: E. M. Kindle, 1914, Science, new ser., v. 39, p. 918.

D. W. Fisher, 1959, New York State Mus. Sci., Service Geol. Survey Map and Chart Ser. 1. There is variance of opinion as to whether time break exists between Lockport group and underlying Rochester shale. There seems to be physical break between Decew dolomite and Gasport in western New York, but no physical break can be seen from Rochester eastward. The Rochester grades imperceptibly upward into Decew. Decew dolomite is placed in Tonawandan stage (new) because it contains *Arctinurus boltoni* and *Trimerus delphinocephalus* which are unknown in Lockportian stage (new). Middle Silurian.

Well exposed at DeCew Falls, Ontario.

†Decewsville Formation[1]

Decewville Formation[1]

Middle Devonian: Southeastern Ontario, Canada, and western New York.

Original reference: E. O. Ulrich and C. Schuchert, 1902, New York State Mus. Bull. 52, p. 653, chart opposite p. 659.

Named for exposures near village of Decewsville, Ontario.

De Chelly Sandstone

De Chelly Sandstone Member (of Cutler Formation)[1]

Permian: Northeastern Arizona and southeastern Utah.

Original reference: H. E. Gregory, 1915, Am. Jour. Sci., 4th, v. 40, p. 102.

J. A. Momper, 1957, Four Corners Geol. Soc. Guidebook 2d Field Conf., p. 90. Rank raised to formation. Eolian De Chelly grades into continental fluvial deposits overlying differentiated Cutler in southeastern Utah; along northeast margin of southern and western San Juan Basin, loses its identity as it grades into arkosic facies of Cutler. In Arizona, overlies Supai formation; in New Mexico, overlies Yeso formation along its lateral boundary with the Glorieta. Includes Hoskinnini as member.

J. H. Stewart, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 1855 (fig. 2), 1857 (fig. 3), 1862. In and near Monument Valley, De Chelly member of Cutler underlies Hoskinnini (herein reallocated to member status in Moenkopi formation). Thickness about 300 feet.

Gregory (1916) mapped sandstone along Canyon de Chelly, Apache County, Ariz.

Decie Member (of Duff Formation)

Oligocene and younger(?): Southwestern Texas.

W. N. McAnulty, 1955, Geol. Soc. America Bull., v. 66, no. 5, p. 553–554, pl. 1. Northern facies of Duff differs from southern facies in that the effusive rocks are predominantly rhyolite, trachyte, and trachyandesite, whereas flows in southern part are chiefly trachybasalts. A succession that appears to constitute more than half of the formation in Paisana Peak quadrangle is herein named Decie member. Southernmost tongue, a trachyte porphyry, is about 60 feet above base of the Duff and is 60 to 110 feet thick west of Haley Mountain and along west side of McIntyre Peak intrusive mass. A second rhyolite porphyry tongue crops out around east and north sides of McIntyre Peak. Base of the rhyolite is about 150 feet above base of the Duff and has maximum thickness of 237 feet.

Named for exposures on Decie Ranch near McIntyre Peak, Cathedral Mountain quadrangle.

Decker Limestone[1]

Upper Silurian: Northern New Jersey, southeastern New York, and northeastern Pennsylvania.

Original reference: I. C. White, 1882, Pennsylvania 2d Geol. Survey Rept. G_6, p. 76–77, 137–141.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Shown on correlation chart at base of Keyser group below Rondout limestone and above Bossardville limestone. Cayugan series.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Keyser formation passes into Manlius, Rondout, and Decker formations.

Well exposed near Decker's Ferry below Flatbrookville, Sussex County, N.J.

Decker Ferry Limestone[1] or Formation[1]

Silurian: Northern New Jersey, southeastern New York, and northeastern Pennsylvania.

Original reference: I. C. White, 1882, Pennsylvania 2d Geol. Survey Rept. G_6, p. 76–77, 137–141.

Named for exposures near Decker's Ferry below Flatbrookville, Sussex County, N.J.

Decker Ferry Sandstone[1]

Silurian: Northwestern New Jersey and northeastern Pennsylvania.

Original reference: I. C. White, 1882, Pennsylvania 2d Geol. Survey Rept. G_6, p. 77, 140–141.

Well exposed near Decker's Ferry below Flatbrookville, Sussex County, N.J.

Decker Ferry Shales[1]

Silurian: Northwestern New Jersey and northeastern Pennsylvania.

Original reference: I. C. White, 1882, Pennsylvania 2d Geol. Survey Rept. G_6, p. 77, 141.

Well exposed at Decker's Ferry, Sussex County, N.J.

Decorah Shale[1] or **Formation**

Decorah Shale Member (of Galena Formation)

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

Original reference: S. Calvin, 1906, Iowa Geol. Survey, v. 16, p. 60, 84.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 9 (geol. column), 72, 81, 82–86. Considered member of Galena formation in southeastern Minnesota. Underlies Prosser member; overlies Spechts Ferry member of Platteville formation. Includes Guttenberg and Ion submembers. Thickness 27 to 46 feet.

E. R. Larson, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 9, p. 2064–2066. In southeastern Missouri, underlies Kimmswick limestone and overlies Macy formation (new) of Plattin group. Spechts Ferry member traced from type locality into Missouri where it is lower shale-bearing part of formation. Thicknesses: 25 feet in Lincoln County; 18 feet in St. Louis County; 15 feet in Jefferson County; and 20 feet in Perry County, Spechts Ferry member absent.

M. P. Weiss, 1955, Jour. Paleontology, v. 29, no. 5, p. 759–763. Overlies Carimona member (new) of Platteville formation and underlies Cummingsville member (new) of Galena formation. Thickens from about 20 feet at Iowa line to nearly 90 feet at Twin Cities. Spechts Ferry, Guttenberg, and Ion members not recognizable units in Minnesota.

A. F. Agnew, 1956, Geol. Soc. America Guidebook for Field Trips Minneapolis Mtg., Field Trip 2, p. 49–50. Carimona limestone reallocated to member status in Decorah formation in Minnesota for following reasons: lithology is similar to that of limestone bands in Spechts Ferry member; Carimona and Spechts Ferry members wedge out eastward, and Guttenberg member thins eastward, whereas Quimbys Mill member of Platteville wedges out to west and McGregor member of Platteville thins westward; there is disconformity in Platteville at top of Quimbys Mill member.

M. P. Weiss, 1957, Geol. Soc. America Bull., v. 68, no. 8, p. 1029 (fig. 1), 1033–1036, pl. 1. Formation described in Fillmore County, Minn., where it is not differentiated into members. Here, and in adjacent exposures, formation is a shale, grayish yellow green to greenish gray, calcareous, generally fissile, but more massive and blocky where coquinoid layers are absent or sparse. Numerous limestone layers concentrated near base and top and subordinately near middle. A 1- to 2-inch bentonite present near base; this seam is the "putty layer" of Twin City section and is continuous with Spechts Ferry bentonite. Thickens northwestward across county from 22 to 46 feet. Underlies Galena formation, Cummingsville member; overlies Platteville formation, Carimona member. Most fossiliferous unit in Minnesota Ordovician.

A. V. Heyl, Jr., and others, 1959, U.S. Geol. Survey Prof. Paper 309, p. 8 (fig. 2), 11 (fig. 3), 14–17. Formation described in upper Mississippi Valley zinc-lead district (Wisconsin, Illinois, Iowa) where it is about 40 feet thick; includes three members: a basal green-shale member (Spechts Ferry) that thickens toward northwest, a thin-bedded pinkish-buff sublithographic limestone and interbedded carbonaceous brown-shale member (Guttenberg), and a medium-bedded gray dolomite or limestone member (Ion) that has thin greenish-shale partings. Disconformably overlies Platteville formation and grades upward into Galena dolomite.

First described in city and vicinity of Decorah, Winneshiek County, Iowa.

Decota Sandstone (in Kanawha Formation)[1]

Pennsylvanian: West Virginia.

Original reference: C. E. Krebs and D. D. Teets, Jr., 1914, West Virginia Geol. Survey Rept. Kanawha County, p. 292.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 81. In lower Kanawha between Eagle (above) and little Eagle coals.

Named for Decota, Kanawha County.

Dederick Shale Member[1] (of Cherokee Formation)

Dederick Subgroup (of Cherokee Group)

Pennsylvanian (Des Moines Series): Western Missouri.

Original reference: F. C. Greene and W. F. Pond, 1926, Missouri Bur. Geology and Mines, v. 19, 2d ser., p. 38–44.

T. R. Beveridge, 1951, Missouri Geol. Survey and Water Resources, 2d ser., v. 32, p. 51–53, pl. 11. Rank raised to subgroup of Cherokee group; regional correlations are insufficient to determine the position of the Weaubleau area (this report) Dederick within the subgroup. In

Weaubleau quadrangle, unit is undifferentiated and consists of dark-colored shale, in some localities carbonaceous to coal bearing, in others micaceous and silty. Maximum exposed thickness 6 feet; base not exposed. Unconformable on deeply eroded Mississippian rocks [Burlington]; relations of contact with overlying Graydon formation not known.

Named for exposures along railroad in northern part of sec. 26, T. 36 N., R. 29 W., and NE¼SE¼ sec. 36, T. 36 N., R. 29 W., in vicinity of Dederick, Vernon County.

Dedham Granodiorite[1]

Devonian(?): Eastern Massachusetts and southeastern New Hampshire.

Original reference: W. O. Crosby, 1880, Boston Soc. Nat. History Occasional Papers 3, map.

N. E. Chute, 1940, Massachusetts Dept. Public Works Bull. 1, p. 4, 11, 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]. Three rock types described in Brockton quadrangle, Massachusetts. Usual Dedham is pale-pink massive fairly homogeneous medium- to coarse-grained rock. Other varieties are white or light-gray granodiorite and porphyritic granodiorite with pink feldspar phenocrysts. Few dikes of fine-grained albite granite intrude the pink and light-gray varieties. Intrudes Salem gabbro-diorite. Lower Paleozoic(?).

A. W. Quinn and G. H. Springer, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–42. Restricted from Bristol quadrangle and vicinity, Rhode Island-Massachusetts. Pre-Carboniferous rocks of area assigned to Metacom granite gneiss (new) and two unnamed units.

Named for typical exposures about Dedham, Mass.

Deep Canyon Fanglomerate[1]

Quaternary: Southern California.

Original reference: F. E. Vaughan, 1922, California Univ. Pub., Dept. Geol. Sci. Bull., v. 13, no. 9, p. 344, 384–385, map.

Named for Deep Canyon, Riverside County.

Deep Creek Andesite

Pliocene(?): Southwestern Washington.

R. V. Fisher, 1957, Dissert, Abs., v. 17, no. 9, p. 1981. Named and age given as Pliocene(?).

Exposed along Bumping River, Mount Aix quadrangle.

†Deep Creek Beds[1]

Miocene, middle: Central southern Montana.

Original reference: W. H. Dall and G. D. Harris, 1892, U.S. Geol. Survey Bull. 84, p. 287.

East of Fort Ellis along Deep Creek, Little Belt Mountains region.

Deep Creek division[1]

Lower Ordovician: Central Texas.

Original reference: T. B. Comstock and E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept., p. 302–306, pl. 3.

Named for Deep Creek, San Saba County.

Deepian 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 2,100 feet of shales. Unconformable below Campitoan series and above Reedian series.

Occurs in Death Valley region.

Deepkill Shale[1]

Lower and Middle Ordovician: Eastern New York and west-central Vermont, and Canada.

Original reference: R. Ruedemann, 1902, New York State Mus. Bull. 52, p. 546–575.

P. H. Osberg, 1952, Vermont Geol. Survey Bull. 5, p. 116 (fig. 16). Correlation chart for Vermont shows Deepkill shale in Taconic sequence above Schaghticoke shale and below Bald Mountain limestone. Lower Ordovician.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65. no. 3, chart 2 (columns 8, 14). Correlation chart shows Deepkill shale present in Taconic area, New York and Vermont. Canadian and Chazyan. Overlies Schaghticoke shale; underlies Normanskill shale. Also present in Gaspe and New Brunswick.

W. B. N. Berry, 1959, (abs.) Geol. Soc. America Bull., v. 70, no. 12, pt. 2, p. 1568–1569. Graptolite and zonal sequence in Deepkill shale worked out by Ruedemann nearly 60 years ago, and faunas that constitute the zones have been considered standard of comparison for all Early Ordovician graptolites in North America. Also, term "Deepkill" has acquired time-stratigraphic significance in some publications. Reinvestigation and reinterpretation of formation and its faunas reveal that four zones based on graptolite assemblages may be delimited within it. Three of the zones are in the continuous exposure (Ruedemann's beds 1 through 5) in lower part of Deepkill Gorge. The two older zones are latest Early Ordovician, and the third zone is earliest Middle Ordovician. Rocks of fourth zone, which comprise Ruedemann's beds 6 and 7, are in fault contact with Normanskill shale. This zone is Middle Ordovician. One zone is missing between it and next youngest zone in Deepkill shale. Missing zone, although widely represented in other parts of country, has not been found anywhere in New York.

Named from typical exposure in Rensselaer County, N.Y., along Deepkill River, a tributary of the Hudson from the east.

Deep Lake Argillite[1] (in Stevens Series)

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. Remapping of northeastern Stevens County and discovery of Cambrian and Ordovician fossils are thought to justify adoption there of formation names established by Parker and Cannon (1943) for Metaline quadrangle. Part of Deep Lake argillite is considered correlative with Metaline limestone, part correlative with Maitlen phyllite.

Exposed along east shore of Deep Lake, Stevens County.

Deep Lake Metaquartzite[1] (in Snowy Range Series)

Precambrian: Southeastern Wyoming.

Original reference. E. Blackwelder, 1926, Geol. Soc. America Bull., v. 37, p. 620, 623, 625.

J. J. Runner, 1928, Geol. Soc. America Bull., v. 39, no. 1, p. 202. Included at base of Snowy Range series (new); overlies Centennial series (new).

R. S. Agatston, 1951, Wyoming Geol. Assoc. Guidebook 5th 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.

Crops out around Deep Lake, Medicine Bow Mountains.

Deep River Beds[1].

Miocene, middle: Central southern Montana.

Original reference: W. H. Dall and G. D. Harris, 1892, U.S. Geol. Survey Bull. 84, p. 287.

W. T. Thom, Jr., 1957, Billings Geol. Soc. Guidebook 8th Ann Field Conf., p. 11 (table 1). Name appears on generalized stratigraphic section for Crazy Mountain Basin and nearby areas. Overlies Fort Logan beds and together the units dated as middle and upper Miocene.

Deposits occur east of Fort Ellis along Deep Creek (also called Deep River and Smith River); Little Belt Mountains region and Meagher County.

†Deep River Formation[1] or Series[1]

Upper Triassic: Central North Carolina.

Original reference: E. Emmons, 1856, North Carolina Geol. Survey Rept. of Midland Counties, p. 255, 273.

Named for exposures along Deep River.

Deep Run Formation

Deep Run Member (of Ludlowville Shale)[1]

Middle Devonian: Central New York.

Original reference: G. A. Cooper, 1930, Am. Jour. Sci., 5th, v. 19, p. 218, 226, 227.

R. G. Sutton, 1951, Rochester Acad. Sci. Proc., v. 9, no. 5–6, p. 371–372, pl. 1. Member is 55 feet thick at type locality; thins rapidly westward until it wedges out in Batavia quadrangle. Corps out in eastern part of Batavia quadrangle, three-quarters mile southeast of Pavilion Center. Here is consists of 3.6 feet of calcareous shale and is overlain by Menteth limestone 0.6 foot thick.

T. B. Coley, 1954, Jour. Paleontology, v. 28, no. 4, p. 453, 454, 455 (fig. 2). Referred to as Deep Run formation. Thickness 10 feet. Overlies Tichenor formation; underlies Menteth formation. Ostracodes discussed.

Type locality: Ravine, about 1 mile north of Cottage City, on east side of Canandaigua Lake, Ontario County.

Deep Spring Formation[1]

Precambrian(?): Eastern California.

Original reference: E. Kirk, 1918, U.S. Geol. Survey Prof. Paper 110.

C. R. Longwell, 1950, Geol. Soc. America Bull., v. 61, no. 5, pl. 1. Underlies Campito sandstone; overlies Reed dolomite.

U.S. Geological Survey currently designates the age of the Deep Spring Formation as Precambrian(?) on the basis of a study now in progress.

Named for exposures along west side of Deep Spring Valley in canyons north of Antelope Spring, Inyo Range.

Deer Diorite

Pre-Upper Cretaceous: Southern California.

R. M. Alf, 1948, Geol. Soc. America Bull., v. 59, no. 11, p. 1104 (fig. 2), 1109–1110, pl. 6. Medium- to coarse-grained plutonic rock with small to large crystals of hornblende up to 1 inch or more in length. Occurs as a lenticular mass in what is termed Black Belt (nongeographic name) mylonites.

Well exposed in Deer Canyon, San Gabriel Mountains, southeast of Los Angeles.

Deer Creek Formation

Pennsylvanian: South-central Colorado.

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. 1903 (fig. 5), 1904–1910. Proposed for beds previously called Clastic member of Sandia formation by Brill (1952) from Huerfano River south to New Mexico border. Consists of grayish, reddish, and greenish sandstones, siltstone, conglomerates, and shales, interbedded in upper part with gray sandy to argillaceous limestones; crossbedding and cut-and-fill stratification common in sandstones and conglomerates. Thickness at type section 1,119 feet. Unconformably overlies Precambrian at Huerfano River and La Veta Pass; gradationally underlies Madera formation with contact placed at top of highest redbeds. Name Clastic member of Sandia refers to a basal transgressive suite of gray sandstone, shale, and conglomerate, with a few coal beds, underlying Madera formation in central New Mexico (Read and Andrews, 1944). Abandonment of this term in south-central Colorado proposed because in this area red beds included in member bear impress of a different depositional sequence; furthermore, red coloration provides lithologic basis for separating these beds from Madera, whereas, if Brill's nomenclature were followed, separation would be based on paleontology. Assigned to upper Atokan on basis of fusulinids.

Type section: Along Huerfano River, beginning at unconformable contact with Precambrian in E½ sec. 23, crossing Deer Creek and extending to SW¼ sec. 24, all in T. 27 S., R. 72 W., Sangre de Cristo Mountains, between La Veta Pass and Westcliffe.

Deer Creek Limestone (in Shawnee Group)

Deer Creek Limestone Member (of Pawhuska Formation)

Deer Creek Limestone Member (of Shawnee Formation)[1]

Pennsylvanian (Virgil Series): Southwestern Iowa, eastern Kansas, northwestern Missouri, southeastern Nebraska, and central northern Oklahoma.

Original reference: J. Bennett, 1896, Kansas Univ. Geol. Survey, v. 1, p. 117.

R. C. Moore, 1949, Kansas Geol. Survey Bull. 83, p. 126 (fig. 22), 142 (fig. 29), 156. Deer Creek formation, in Shawnee group, underlies Calhoun formation and overlies Tecumseh formation; includes (ascending) Ozawkie limestone, Oskaloosa shale, Rock Bluff limestone, Larsh shale, Haynies limestone, Burroak shale, and Ervine Creek limestone members. This is classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma. In Kansas, the shale between the Rock Bluff and Ervine Creek limestones is called the Larsh-Burroak because it seems to be exactly equivalent to the Larsh shale, Haynies limestone, and Burroak shale as described in Nebraska. The Deer Creek is a member of the Pawhuska formation as defined in Oklahoma.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 17–18. In Missouri, the interval between the Rock Bluff limestone member and the uppermost limestone of the Deer Creek is occupied by shale; this shale has been treated by Missouri Geological Survey as occupying the Rock Bluff-Ervine Creek interval, with implication that intervening Haynies limestone is absent in Missouri. Missouri follows Kansas practice, and the shale is called Larsh-Burroak; the Missouri Survey recognizes the possibility that Burroak shale member may be absent in Missouri and that the uppermost limestone of the Deer Creek may include the Haynies and Ervine Creek limestone members.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 17–18, fig. 5. Comprises (ascending) Ozawkie limestone, Oskaloosa shale, Rock Bluff limestone Larsh shale, Haynies limestone, Burroak shale, and Ervine Creek limestone members. Lower two members not differentiated everywhere. Underlies Calhoun shale; overlies Tecumseh shale. Shawnee group.

Named for exposures on Deer Creek, east of Topeka, Shawnee County, Kans.

Deer Creek Quartzite[1]

Precambrian (Glenarm Series): Northern Maryland.

Original reference: J. P. Lesley, 1892, Pennsylvania 2d Geol. Survey Summ. Rept., v. 1, p 130–132.

Occurs in center of Harford County, marking a sharp, narrow ridge 300 feet high, 4 miles long, and less than 1 mile wide.

Deerfield Diabase[1] (in Newark Group)

Upper Triassic: Central Massachusetts.

Original reference: B. K. Emerson, 1891, Geol. Soc. America Bull., v. 2, p. 451–456.

M. E. Willard, 1951, Bedrock geology of the Mount Toby quadrangle, Massachusetts: U.S. Geol. Survey Geol. Quad. Map [GQ–8]. Revived and described in Mount Toby quadrangle as fine-grained black effusive diabase or trap rock, reddish-brown to nearly yellow on weathered surfaces. Generally massive in thicker parts; upper surface is somewhat vesicular. Locally a flow breccia. Maximum thickness 100 feet. Underlies Turners Falls sandstone (new); overlies Sugarloaf formation. No longer considered a unit of the Holyoke diabase because no direct connection can be traced and source and age of the two may differ. Triassic. Outcrop area described.

Crops out in Greenfield and Mount Toby quadrangles on western and southern slopes of the Mount Toby highland and west of the Connecticut River in the Pocumtuck Range.

Deer Isle Granite

Lower Devonian: South-central Maine.

H. W. Fairbairn and P. M. Hurley, 1957, Am. Geophys. Union Trans., v. 38, no. 1, p. 104 (table 7), 106 (table 9). Incidental mention. Probably comagmatic with Vinalhaven granite.

Occurs on Deer Isle, Hancock County.

Deer Lake Argillite[1]

Paleozoic: Northeastern Washington.

Original reference: C. E. Weaver, 1920, Washington Geol. Survey Bull. 20, p. 54, map.

Exposed along shores of Deer Lake, Stevens County.

†Deer Lake Conglomerates[1]

Precambrian (Keewatin): Northwestern Michigan.

Original reference: C. R. Van Hise and W. S. Bayley, 1895, U.S. Geol. Survey 15th Ann. Rept., p. 490, 492, 496.

Exposed on Kitchi Hills, in vicinity of Deer Lake, Marquette district.

Deer Mountain Red Shale Member (of Hueco Limestone)[1]

Permian (Wolfcamp Series): Western Texa.

Original reference: P. B. King and R. E. King, 1929, Am. Assoc. Petroleum Geologists Bull., v. 13, p. 925.

G. O. Bachman and P. T. Hayes, 1958, Geol. Soc. America Bull., v. 69, no. 6, p. 695, 697. Lee Ranch tongue (new) of Abo sandstone is believed to be stratigraphically lower than Deer Mountain red shale member of type Hueco. The herein named Otero Mesa member of Yeso formation is believed to occupy an intermediate stratigraphic position between Lee Ranch tongue and Deer Mountain red shale.

Named from exposures on Deer Mountain, 4 miles southeast of Cerro Alto [Mountain], Hudspeth County.

Deerpark Stage or Group

Lower Devonian (Ulsterian): North America.

G. A. Cooper and others, 1952, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1733, chart 4. The Devonian is subdivided into 10 stages of which the Deerpark is second in sequence (ascending). [For complete sequence see Helderberg stage, this reference.] Follows Helderberg stage and is succeeded by Onesquethaw stage (new). Includes Oriskany and its correlates.

G. M. Ehlers *in* K. K. Landes, G. M. Ehlers, and G. M. Stanley, 1945, Michigan Dept. Conserv. Geol. Survey Div. Pub. 44, Geol. Ser. 37, p. 35 (table 1). Referred to as group in Mackinac Straits region, Michigan. Underlies Onesquethaw group; overlies Bass Island[s] group. Includes Garden Island formation (new).

Type section (stage): Southeastern Deerpark Township on west slope of Shawangunk Mountains facing Port Jervis, Sullivan County, N.Y.

Deer Plain Formation

Pleistocene (Wisconsin): Central western Illinois and eastern Missouri.

W. M. Rubey, 1952, U.S. Geol. Survey Prof. Paper 218, p. 12 (chart), 90–96, pl. 1. A variable series of gravel, sand, and clay; along Mississippi River and near mouth of Illinois River, consists largely of gravel; up valley of Illinois River, becomes finer grained and passes within only a few miles through sand into silt and clay; at all exposures, material becomes progressively finer grained upward. True maximum thickness unknown; near Deer Plain at least 50 feet; in many smaller remnants 5 to 20 feet. Stratigraphic and physiographic evidence shows that Deer Plain formation is younger than Brussels formation and loess; physiographic relations demonstrate that Deer Plain terrace is younger than Metz Creek terrace and the scattered pebbles of igneous and metamorphic rocks that lie upon it; also evidence shows that Deer Plain formation is too old to be included within the latest or Recent stage of earth history.

Named for exposures near village of Deer Plain, sec. 16, T. 13 S., R. 1 W., Calhoun County, Ill. Deposits occur as a wide terrace in lowlands west of Illinois River and as small terrace remnants along Illinois and Mississippi Rivers; some terrace and deposits are well developed in lowlands west of Mississippi River from Winfield to Old Monroe in Lincoln County, Mo.

Deer Rips Lime-Silicate Gneiss (in Androscoggin Series)

Middle Silurian: Southwestern Maine.

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, Thorncrag biotite-sillimanite gneiss, Tacoma lime-silicate series, and Sabbatus quartz-sillimanite schist. Middle Silurian.

L. W. Fisher, 1938 (abs.) Geol. Soc. America Proc. 1937, p. 81. Deer Rips lime-silicate gneiss and Bates limestone included in Androscoggin series.

Occurs in Lewiston area, Androscoggin County.

Deer River Shale[1]

Middle Ordovician: Northern New York, and southern Ontario, Canada.

Original reference: Rudolf Ruedemann, 1921, New York State Mus. Bulls. 227, 228, p. 124–126, 130.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 284–285. Derivation of name. Middle Ordovician (Mohawkian).

Named for Deer River, northern Lewis County, N.Y.

Deer Trail Group

Deer Trail Argillite[1] (in Stevens Series)

Precambrian (Belt Series): Northeastern Washington.

Original reference: C. E. Weaver, 1920, Washington Geol. Survey Bull. 20, p. 59, map.

W. A. G. Bennett, 1941, Washington Div. Geology Rept. Inv. 5, p. 7–8. Referred to as a group including Stensgar dolomite.

Ian Campbell and J. S. Loofbourow, Jr., 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1250. Described as a group consisting of a series of metasediments, probably of Beltian age, composed dominantly of fine-grained clastics with minor amounts of quartzite and dolomite. Thickness 5,000 feet. Includes (ascending) Togo formation, Edna dolomite, McHale slate (all new), Stensgar dolomite, and Buffalo Hump formation (new). Unconformably underlies Huckleberry group (new).

Present in Stevens County.

Deerwood Iron-Formation Member (of Virginia Slate)[1]

Precambrian: Northeastern Minnesota.

Original reference: C. R. Van Hise and C. K. Leith, 1911, U.S. Geol. Survey Mon. 52, p. 212–215.

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, Deerwood iron-formation and Cuyuna slates have been considered to belong to the Virginia slate. This correlation has very little evidence to support it. General stratigraphy of Deerwood suggests a fourfold subdivision somewhat analogous to subdivisions of Biwabik formation.

Named for development at and near Deerwood, Crow Wing County.

Deese Formation[1]

Deese Group

Pennsylvanian (Des Moines Series): Central southern Oklahoma.

Original reference: W. L. Goldston, Jr., 1922, Am. Assoc. Petroleum Geologists Bull., v. 6, no. 1.

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, an older consisting of "Franks" and Deese and a younger consisting of Collings Ranch (new) and Vanoss. All but Vanoss (youngest) are preserved in synclinal grabens and are moderately to strongly folded and faulted. In vicinity of Mill Creek, sec. 7, T. 2 S., R. 5 E., the Deese is about 1,950 feet thick (top eroded) and consists of pebble-cobble limestone conglomerates interstratified with red and gray shales and a few thin limestones. Conglomerate sequence rests disconformably on Atoka formation. In Buckhorn area south of Sulphur, sec. 26, T. 1 S., R. 3 E., the Deese rests disconformably on Springer shale (Lower Pennsylvanian) and underlies Vanoss conglomerate. In Lake Classen area, conglomeratic Deese rocks rest disconformably on Caney shale (Mississippian); they are steeply dipping to locally overturned and structurally conformable with older folded rocks of Arbuckle anticline.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, p. p. 697, chart 6 (column 37). Shown on correlation chart as Deese group. Occurs below Hoxbar group and above Dornick Hills group. Includes (ascending) Devils Kitchen, Arnold limestone, Rocky Point conglomerate, and Confederate limestone. Base of Hoxbar group is here drawn above Confederate limestone, rather than below it, inasmuch as boundary between Desmoinesian and Missourian deposits preferably should correspond with Deese-Hoxbar contact.

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), 28–36. Group constitutes bulk of Desmoinesian section in Ardmore basin. Top of series was placed by Moore and others (1944) at top of Confederate limestone, basal member of overlying Hoxbar group, but base of Confederate is probably to be preferred in light of reclassification by Thompson and others, (1956, Jour. Paleontology, v. 30, no. 4) of abundant fusulinid in that limestone as *Wedekindellina ardmorensis.* Includes named units (ascending) Devils Kitchen sandstone and conglomerate, Arnold limestone, Rocky Point conglomerate and associated beds, Camp Ground member, Warren Ranch conglomerate facies (new), Williams member, and Natsy member. Overlies Pumpkin Creek limestone member of Big Branch formation of Dornick Hills group.

B. H. Harlton, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 2, p. 213 (fig. 3), 200–221. Term Deese group is used in this report [Cement Pool area] for a succession of rocks comparable in lithologic character and fauna with rocks in Ardmore area. Melton zone formerly assigned to basal Hoxbar is designated to mark top of Deese and is included in West Arm formation (new). Tussy zone, with its Tussy limestone, is well developed at Cement Pool. It is given formational status in this report. Overlies Dornick Hills group.

Type locality: Sec. 33, T. 3. S., R. 1 E., adjoining village of Deese, Carter County.

Degonia Sandstone[1]

Degonia Sandstone (in Elvira Group)

Upper Mississippian (Chester Series): Western Illinois 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. 41.

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. 839. Included in Elvira group (new). Underlies Kinkaid limestone; overlies Clore limestone. Thickness as much as 100 feet; thickest at type locality; thins progressively eastward; in Kentucky, maximum thickness about 18 feet. In southwestern Indiana, probably represented by Mount Pleasant 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 Degonia sandstone extended into southern Indiana where it replaces term Mount Pleasant sandstone. Local Indiana names of upper Chester are dropped and formations given names of standard Chester column.

T. G. Perry and N. M. Smith, 1958, Indiana Geol. Survey Bull. 12, pl. 2. Shown on stratigraphic column of upper Chester in Indiana as hard massive sandstone that weathers blocky. Thickness 10 to 35 feet. Term Elvira not used in Indiana.

Named for Degonia Township, Jackson County, Ill. Forms conspicuous cliffs in bluffs of the Mississippi and sides of the tributary valleys.

DeGraff Coal Member (of Modesto Formation)

Pennsylvanian: Southeastern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 37, 48 (table 1), pl. 1. Name applied to coal member in lower part of formation. Stratigraphically above Piasa limestone member and below Pond Creek coal member (new). Has been referred to as "1st Cutler Rider coal." Name credited to Cady (unpub. ms.). Piasa limestone and DeGraff, Pond Creek, and Lake coals may be included in the complex West Franklin 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: SE cor. NE¼SW¼ sec. 21, T. 5 S., R. 4 E., Perry County. Name derived from DeGraff School about 1 mile northeast of exposure.

DeGrey Member (of Pierre Shale)

Upper Cretaceous: Central South Dakota.

D. R. Crandell, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 12, p. 2340 (table 1), 2341, 2343, 2345–2346. Defined to include Agency-Oacoma zones of previous reports. Consists of clay, shale, and bentonite beds. Underlies Verendrye member (new); overlies Crow Creek member (new); contacts gradational. Thickness at type locality about 82 feet; thickness increases toward Pierre to about 160 feet and decreases toward Chamberlain to about 40 feet.

Type locality: West edge of NW¼ sec. 8, T. 109 N., R. 75 W., Hughes County. Named for DeGrey post office and store. Type section is 2 miles southeast of DeGrey in cut-bank of Missouri River.

DeKalb Granite[1]

Precambrian: Northern New York.

Original reference: H. P. Cushing, 1916, New York State Mus. Bull. 191, p. 13, 17, 19, 23.

Occurs in DeKalb, St. Lawrence County.

DeKalb Limestone Member (of Kansas City Formation)[1]

Pennsylvanian: Iowa, eastern Kansas, northwestern Missouri, and southeastern Nebraska.

Original reference: H. F. Bain, 1898, Am. Jour. Sci., 4th, v. 5, p. 437–439. Named for DeKalb, Decatur County, Iowa.

Dekkas Andesite[1]

Dekkas Formation (in Bollibokka Group)

Permian: Northern California.

Original reference: J. S. Diller, 1906, U.S. Geol. Survey Geol. Atlas, Folio 138.

H. E. Wheeler, 1939, 6th Pacific Sci. Cong. Proc., p. 369–376. Assigned to late Anthrocolithic (Permian) on basis of regional correlation.

J. P. Albers and J. F. Robertson, 1952, (abs.) Geol. Soc. America Bull., v. 63, no. 12, pt. 2, p. 1319. Age designated as Permian on basis of paleontological evidence and data obtained from geologic mapping. Dekkas andesite, composed chiefly of andesitic tuffs, andesitic flows, and mudstone lenses, is at least 3,500 feet thick. Underlies Bully Hill rhyolite; substructural divergence suggests unconformable relationship.

A. H. Coogan, 1957, (abs.) Geol. Soc. America Bull., v. 68, no. 12, pt. 2, p. 1821. Formation, at type locality of Nosoni along Nosoni Creek, is restricted to the 3,840 feet of green massive tuff breccia, tuffaceous conglomerate and sandstone, minor basic flows, black cherty shale, and chert conformably overlying Nosoni formation. Basal contact drawn at top of highest black shale below a thick sequence of massive green tuff breccia. Conformably underlies Pit shale. As originally mapped much of type Dekkas at Dekkas Creek is lateral equivalent of type Nosoni. Fossils show formation to be early Guadalupian age.

A. H. Coogan, 1960, California Univ. Pubs. Geol. Sci., v. 36, no. 5, p. 243–255. Described in Bollibokka area. Included in Bollibokka group (new). Name changed to formation because unit is of varied character. Consists of massive green andesite tuff breccia, green tuffaceous sedimentary rocks, lithic lapilli tuff, gray to purple chloritized basalt and olivine basalt, and scattered beds of red chert, medium-bedded black shale, light-gray cherty shale, red mudstone, and tuffaceous calcareous shale. Formation is herein restricted to the green tuff breccia, tuffaceous sedimentary rocks, and basic flows overlying topmost black shale unit of Member Four of type Nosoni formation. Formation redefined to resolve confusion which resulted from definition of unit on basis of fusulinids. At Dekkas Creek, type locality of Dekkas, Members Three and Four of Nosoni underlie the basalt green tuff breccia of the Dekkas as it is exposed in Nosoni Creek. Diller (1906) mapped all these rocks as Dekkas andesite although more than half are lateral equivalents of type Nosoni. Thickness about 3,840 feet at Nosoni Creek. Underlies Pit shale. No fossils found in Dekkas along Nosoni, Chatterdown, or Dekkas Creeks. Fossils were collected from a tuffaceous limy shale bed on ridge at elevation of 2,700 feet between Horse and Town Mountains in sec. 8, T. 24 N., R. 3 W., Bollibokka Mountain quadrangle. Bed contains *Parafusulina* of type described by Diller as characteristic of Nosoni formation and dates fossiliferous horizon as early Guadalupian. Diller (1906) believed that the Dekkas and Nosoni were separated by an unconformity. He referred the Dekkas to the Triassic because of its conformable relationship with the overlying Pitt and supposed unconformity separating it from overlying Nosoni.

Named for exposures along Dekkas Creek, Redding quadrangle.

DeKoven Coal Member (of Spoon Formation)

Pennsylvanian: Western Kentucky and southwestern and southeastern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 32, 33, 46 (table 1), 63, pl. 1. Assigned member status in Spoon formation (new). In southeastern area, occurs below Palzo sandstone member and above Davis coal member; in southwestern area, occurs below Cheltenham clay member and above Davis coal member. Thickness about 3 feet. Coal named by Lee (1916, Kentucky Geol. Survey, ser. 4, v. 4, pt. 2). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: Near DeKoven Station, Shawneetown quadrangle, Union County, Ky.

DeKoven cyclothem (in Spoon Formation)

DeKoven cyclothem (in Tradewater Group.)

Pennsylvanian: Northern Kentucky and southern Illinois.

H. R. Wanless, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 9, p. 1764 (table 2). In list of cyclothems in southern Illinois, the DeKoven occurs at top of Tradewater group and overlies Davis cyclothem.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 5, 10, pl. 1. Includes DeKoven coal. Stratigraphically below Liverpool cyclothem; overlies Colbert cyclothem (formerly termed Davis). Type locality designated.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 54 (table 3). Included in Spoon formation (new). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois. Cyclothemic classification retained but is independent of rock-stratigraphic classification.

Type locality: Near DeKoven Station, Union County, Ky.

DeKoven Formation[1]

Pennsylvanian (Allegheny): Western Kentucky.

Original reference: L. C. Glenn, 1912, Kentucky Geol. Survey Rept. Prog. 1910 and 1911, p. 27.

Probably named for DeKoven, Union County.

Delaney Gravel

[Quaternary]: Central Texas.

R. W. Mathis, 1944, Jour. Sed. Petrology, v. 14, no. 2, p. 87–88. Scattered gravel deposit consisting of flint, chert, quartz, and some feldspar pebbles. Lower than Uvalde formation.

A. W. Weeks, 1945, Am. Assoc. Petrolem Geologists Bull., v. 29, no. 12, p. 1705. Mathis described Delaney gravel, located west of Austin and occupying a level between the Uvalde and Asylum deposits. Since abundant limestone material is present in Uvalde and younger deposits, Mathis' omission of limestone pebbles in discussion of the Delaney suggests that either he failed to see them or that the Delaney came down from higher levels as erosion progressed and therefore is not in place.

Tops a hill 245 feet above Colorado River level on Delaney Ranch, along Bee Caves Road, 3 miles east of Austin, Travis County. Also occurs along ridge between Barton Creek and Fredericksburg Road and southeast of mouth of Bull Creek.

Delaneys Creek facies[1] (of Carwood Formation)

Lower Mississippian: Southern Indiana.

Original reference: P. B. Stockdale, 1931, Indiana Dept. Conserv., Div. Geology Pub. 98, p. 77, 169–172.

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

Name derived from Delaneys Creek which flows north across east-central T. 3 N., R. 4 E., Washington County.

Delano Peak Latite Member (of Bullion Canyon Volcanics)

Miocene(?): Southwest-central Utah.

Eugene Callaghan, 1939, Am. Geophys. Union Trans. 20th Ann. Mtg., pt. 3, p. 439 (fig. 2), 440 (fig. 3), 442, 443, 445. Brownish red with abundant phenocrysts of oligoclase, hornblende, and biotite, and minor quartz and magnetite in glassy base with fluidal structure. Forms lenticular mass in Bullion Canyon volcanics. Thickness over 800 feet in center of lens; no separate flows distinguished, although upper part has appearance of flow-breccia. Early Tertiary.

U.S. Geological Survey currently considers the Delano Peak Latite to be Miocene(?) in age. This designation is made on the basis of a restudy of Bullion Canyon Volcanics, now considered to be Miocene(?).

Named for occurrence in vicinity of Delano Peak, Marysvale region.

Delassus formation

Cambrian (Cambric) : Southeastern Missouri.

[C. R.] Keyes, 1941, Pan-Am. Geologist, v. 75, no. 3, p. 239. Proposed as a substitute for Buckley's Doe Run dolomite.

Name taken from railroad station near Doe Run, St. Francois County.

Delaware Flags[1]

Upper Devonian: Northeastern Pennsylvania.

Original reference: I. C. White, 1882, Pennsylvania 2d Geol. Survey Rept. G_6, p. 73, 76, 77, 80.

†Delaware Limestone[1]

Silurian (Niagaran) : Central eastern Iowa.

Original references: S. Calvin, 1885, Iowa Univ. State Lab. Nat. Sci. Bull., v. 3, p. 183–189; 1896, Iowa Geol. Survey, v. 5, p. 49–50.

Named for development in Delaware County.

Delaware Limestone[1]

Middle Devonian: Central and northern Ohio.

Original reference: N. H. Winchell, 1874, Ohio Geol. Survey, v. 2, p. 290–302.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1754, chart 4. At type section, several zones can be recognized, one of the most important, the *Hadrophyllum d'orbignyi* zone, near top. Chart shows the Delaware limestone below Plum Brook shale.

G. A. Stewart, 1955, Ohio Jour. Sci., v. 55, no. 3, p. 147–180. Upper of the two Middle Devonian limestones of central and north-central Ohio. Average thickness about 36 feet in central Ohio; maximum thickness in type area about 45 feet. Overlies Columbus limestone; underlies Olentangy shale. Review of terminology.

Named for exposures at Delaware, Delaware County.

Delaware Creek Member (of Caney Shale)

Mississippian (Meramecian and 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. 62–65, 69–71. Gray to dark-gray noncalcareous to slightly calcareous, finely laminated to flaky, partly bituminous shale, locally rotten (shattered), with large amount of finely crystalline gypsum along bedding planes; gray to light-gray to light-buff limestone concretions common, some as much as 12 feet in diameter. Thickness at type locality about 270 feet, dip of beds N. 18° E. 25°. Overlies Ahloso member (new), boundary taken as first or lowest occurrence of softer shale above harder calcareous shale of Ahloso and almost immediate occurrence in it of concretions 3 to 12 feet across; underlies Sand Branch member (new), and boundary is lithologic change from medium-soft-gray shale to dark-gray or nearly black shale of the Sand Branch.

M. K. Elias and C. C. Branson, 1959, Oklahoma Geol. Survey Circ. 52, p. 7, 17–18. Type section redesignated. Thickness 164.8 feet.

Type section: Beds 38 to 97, measured section C, sec. 14, T. 2 S., R. 7 E., Johnston County. Name derived from Delaware Creek which flows eastward in Bromide-Wapanucka area.

Delaware Mountain Group

Delaware Mountain Formation[1]

Permian (Guadalupe Series): Western Texas.

Original reference: G. B. Richardson, 1904, Texas Univ. Min. Survey Bull. 9, p. 38.

R. K. DeFord and E. R. Lloyd, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 8. Rank raised to group. Subdivisions heretofore referred to as lower, middle, and upper are designated by formational names, Brushy Canyon, Cherry Canyon, and Bell Canyon respectively. New names credited to P. B. King.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 576–592, pl. 2; 1948, U.S. Geol. Survey Prof. Paper 215, p. 27–28, pl. 3, strat. sections. Group is about 2,700 feet thick and consists largely of sandstone. Separable into (ascending) Brushy Canyon, Cherry Canyon, and Bell Canyon formations. Northwestward away from basin, lower formation overlaps older rocks along Bone Spring flexure and is absent beyond. Lower part of Cherry Canyon formation persists northwestward as thin sandstone tongue, but upper part changes into Goat Seep limestone. Upper formation changes northwestward into Capitan limestone. Overlies Bone Spring formation; underlies Castile formation.

P. T. Hayes and R. L. Koogle, 1958, U.S. Geol. Survey Geol. Quad. Map GQ–112. Bell Canyon formation of group mapped in Carlsbad Caverns West quadrangle, New Mexico.

Named for exposures in Delaware Mountains, El Paso County, Tex.

Delaware River Flags[1]

Upper Devonian: Northeastern Pennsylvania.

Original reference: I. C. White, 1882, Pennsylvania 2d Geol. Survey Rept. G_6, p. 94, 99–101.

Bradford Willard, 1937, Pennsylvania Acad. Sci. Proc., v. 11, p. 32. Assigned to Catskill facies group.

Type region: Along Delaware River north of Hawks Nest, N.Y.

†Delaware River Gravels and Clays[1]

Pleistocene: Northern Delaware and southeastern Pennsylvania.

Original reference: C. E. Hall, 1881, Pennsylvania 2d Geol. Survey Rept. C_6.

Named for development along west side of Delaware River in northern Delaware.

Del Cuerto Formation (in Keller Group)

Pennsylvanian (Virgil Series): Central New Mexico.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 27 (table 2), 70 (fig. 7), 71–72. Term proposed for rocks of lower part of Keller group (new) between top of Story formation (new) and base of Moya formation (new). At type locality, formation is 81 feet thick and composed of irregularly bedded to nodular limestone, highly arkosic sandstone, limestone conglomerate, and gray and red shale. In other areas, formation generally is more highly clastic and thicker.

Type locality: Northeast side of Oscura Mountains in NE¼ sec. 31, T. 5 S., R. 6 E., and west-central part of sec 32, Socorro County. Name derived from Del Cuerto Spring on east slope of Oscura Mountains.

De Leon 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 a depth of 3,870–4,130 feet in type well. Underlies Sipe Springs formation (new); overlies Comyn formation (new).

Type well: Roxana Petroleum Co. Seaman No. 1, northwest Palo Pinto County. Name derived from town in northern Comanche County.

Delevanian Stage

Late Cretaceous: California.

P. P. Goudkoff, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 7, p. 960 (table 1), 993–994, 1006. Lowermost 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).

Stage embraces lower part of Yolo and whole thickness of Venado formations of Kirby (1943) and the lowest 14,000 feet of the Moreno surface section. Occurs below Cachenian stage (new).

Occurs in Great Valley in both surface and subsurface. Named after town of Delevan near Funks Creek, sec. 23, T. 17 N., R. 3 W., Colusa County.

Delhi Formation[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 Cape Horn slate and below Clipper Gap formation.

Typical exposures near Delhi mine, Nevada County.

Delhi Limestone[1] Member (of Columbus Limestone)

Middle Devonian: Central Ohio.

Original reference: N. H. Winchell, 1874, Ohio Geol. Survey, v. 2, p. 296–301.

J. W. Wells, 1947, Ohio Jour. Sci., v. 47, no. 3, p. 121 (fig. 3). Chart shows Delhi (Klondike) as uppermost member of Columbus.

R. C. Moore, 1948, Geol. Soc. America Bull., v. 59, no. 4, p. 309 (fig. 2). Shown on columnar section as uppermost member of Columbus formation; overlies Bellepoint member; underlies Delaware formation.

Named for exposures at Delhi, the old name for Radnor, Delaware County.

Delight Sand (in Trinity Group)

Lower Cretaceous (Comanche Series): Southwestern Arkansas.

R. W. Imlay, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 3. Proposed for sand lying between the Pike gravel and the Dierks limestone in Sevier, Howard, and Pike Counties. Sand is gray, generally fine grained and crossbedded, thick bedded, and interbedded with some clay and locally impregnated with asphalt. Attains thickness of at least 200 feet in area between Delight and Pike and thins westward.

Type locality: Asphalt quarry just west of Wolf Creek and about 3¾ miles northwest of Delight, Pike County.

Delleker Formation

Miocene, middle(?): Northeastern California.

Cordell Durrell, 1957, Pacific Petroleum Geologist, v. 11, no. 3, p. 3. Welded rhyolite tuff with gravel at base. About 350 feet thick; thickens to east and is probably equivalent to identical tuffs of early Miocene age, west of Pyramid Lake, Nev. Unconformable below Bonta formation (new); rests unconformably on Clover 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), 170–172. Consists mostly of biotite sanidine rhyolite tuff, but contains some gravel, mostly near base. Thickness 350 feet. Overlies Ingalls formation (new); in some areas, rests on both Ingalls and Lovejoy formations; underlies Bonta formation. Probably lower or middle Miocene; chart shows middle Miocene(?).

Named for recently abandoned sawmill community of Delleker which is partly on Blairsden and partly on Portola quadrangles; name appears only on the latter, edition of 1950. Most representative section is in Blairsden quadrangle in sec. 32, T. 23 N., R. 13 E., 2½ miles west of Delleker on east side of Willow Creek.

Dellet Sand Member (of Moodys Branch Marl)

Eocene (Jackson): Southwestern Alabama.

H. B. Stenzel, 1952, Mississippi Geol. Soc. [Guidebook] 9th Field Trip, p. 41, 58 (fig. 1), 59. Friable and slightly tough, light-greenish-gray when wet and fresh, for most part weathered to light grayish rust-brown, massive, argillaceous, glauconitic, fossiliferous, fine-grained sand at base of the Jackson. Thickness 2.2 feet. Disconformably overlies Gosport formation.

Name derived from Dellet mansion, a well-known landmark in old town of Claiborne, Monroe County.

Dellvale 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. Name applied to volcanic ash bed. Thickness at type locality 9½ feet; occurs within silts and sandy silts which overlie a thick fossiliferous sand and gravel bed. Lies stratigraphically above Fort Wallace ash bed (new) and below Reager ash bed.

Named from exposures in NW¼NW¼ sec. 2, T. 4 S., R. 24 W., southeast of Dellvale, Norton County.

Dellville Sandstone,[1] Shale, or Beds

Upper Devonian: Central Pennsylvania.

Original reference: E. W. Claypole, 1885, Pennsylvania 2d Geol. Survey Rept. F–2, p. 77–78, 394.

Bradford Willard, 1937, Pennsylvania Acad. Sci. Proc., v. 11, p. 33. Del[l]ville beds are a marine unit intercalated with Catskill continental facies in Perry County.

Bradford Willard, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 17 (table 5). Dellville shale and Kings Mill sandstone included in Damascus red beds of Catskill facies group.

Exposed at Dellville, Perry County.

Delmar Sand[1]

Delmar Sand Member (of La Jolla Formation)

Eocene or Eocene, middle: Southern California.

Original reference: M. A. Hanna, 1926, California Univ. Pub., 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. 65. Lowest member of La Jolla. Underlies Torrey sand member. Maximum thickness about 100 feet, base not exposed.

M. A. Keen and Herdis Bentson, 1944, Geol. Soc. America Spec. Paper 56, p. 21 (fig. 4). Listed on chart as member of La Jolla. Middle Eocene.

G. B. Oakeshott, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 2, p. 254 (table). Table lists Delmar sand (formation); underlies Torrey sand.

Named for exposures in sea cliff at town of Delmar, San Diego County.

Delmontian Stage[1]

Miocene, upper: 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. 131–135, figs. 4, 14 (correlation chart). Superjacent to Mohnian stage. Subjacent to "Lower Pliocene" stage. Contains *Bolivina obliqua* zone in lower part. Systematic catalogue.

Manley Natland, 1953, Pacific Petroleum Geologist, v. 7, no. 2, p. 2. Subjacent to Pliocene Repettian stage (new).

Type locality: At head of Canyon Segundo, south of Del Monte, Monterey County.

Delmore Formation

Pliocene, middle: Central Kansas.

C. C. Williams and S. W. Lohman, 1949, Kansas Geol. Survey Bull. 79, p. 56–59, pl. 1. Proposed for Pliocene sediments underlying area north and northwest of Canton and Galva, Delmore Township, McPherson County; beds were originally assigned to Emma Creek formation, type beds of which were considered to be Pliocene; on the basis of present study, beds at type locality of Emma Creek are assigned to Pleistocene and Emma Creek abandoned; the Delmore does not extend into type area selected for Emma Creek. Formation consists of calcareous gray to buff silt and clay, fine- to coarse-grained sand, and some gravel; locally the calcium carbonate has been concentrated and forms irregularly shaped nodules and thin layers within the silt. Maximum thickness about 75 feet as shown by test drilling. Underlies McPherson formation.

Type area: Secs. 24, 25, and 26, T. 18 S., R. 2 W., and along ravines in sec. 31, T. 18 S., R. 1 W., McPherson County.

DeLong Coal Member (of Spoon Formation)

Pennsylvanian: Western Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 33, 45 (table 1), 63, pl. 1. Name applied to thin unit formerly designated as Upper DeLong coal. Stratigraphically above Brush coal member (new), formerly designated as Middle DeLong coal, and below Seahorne limestone member. Presentation of new rock-stratigraphic classification of Pensylvanian of Illinois. Cyclical classification retained but is entirely independent of rock-stratigraphic classification.

Type locality: Along Brush Creek in secs. 6 and 8, T. 9 N., R. 2 E., Knox County. Named for village of DeLong about 1½ miles northeast of type outcrop.

DeLong cyclothem (in Spoon Formation)

DeLong cyclothems (in Tradewater Group)

Pennsylvanian: Northern, western, and southwestern Illinois.

Original reference: H. R. Wanless, 1931, Illinois Geol. Survey Bull. 60, p. 188, 192.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 63, 73–76, 191, 192, 198, 199, 200, 201, 202, 203, 204, 205. Occupies interval between Seville cyclothem below and Seahorne cyclothem above. Sequence includes three rudimentary cyclothems referred to as Lower, Middle, and Upper Delong cyclothems. Consists principally of underclay, with soft shale and from one to four coaly streaks or thin coals; locally one or two thin sandstones are present but no limestone. Type exposure and derivation of name.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 42, 52 (table 2), pl. 1. Name applied to cyclothem formerly called Upper DeLong. Above Brush cyclothem (new) and below Seahorne cyclothem. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type exposure: Along Brush Creek in secs. 5 and 8, T. 9 N., R. 2 E., Galesburg quadrangle, Knox County. Named for town of DeLong which is about 2½ miles northeast of type exposure.

†Delphi Black Shale[1]

Upper Devonian: Northern central Indiana.

Original reference: R. T. Brown, 1883, Indiana Dept. Geology and Nat. History 12th Ann. Rept., p. 84.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1754, chart 4. Assigned to the Naples and Chemung because of presence of three species of *Manticoceras*.

Named for Delphi, Carroll County.

†Delphi Dolomite[1]

Permian: Southwestern Oklahoma and northern Texas.

Original reference: C. N. Gould, 1902, Oklahoma Geol. Survey 2d. Bienn. Rept., p. 42, 56.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 107. Gould spelled his member name Delphi although he named it for village of Delhi, Beckham County. Name Delphi is preoccupied. If corrected to correspond with name of town, Delhi is also preoccupied. The unit is the Mangum dolomite.

Named for Delhi, Beckham County, Okla.

†Delphi Member (of Skaneateles Shale)[1]

Middle Devonian: Central New York.

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

G. A. Cooper, 1941, Washington Acad. Sci. Jour., v. 31, no. 5, p. 180. Name abandoned. Replaced by Delphi Station member.

Type section: Knights Falls, 1 mile east of Delphi.

Delphi Station Member (of Skaneateles Formation)

Middle Devonian: Central New York.

G. A. Cooper, 1941, Washington Acad. Sci. Jour., v. 31, no. 5, p. 180. Proposed to replace Delphi shale of Cooper, 1930 (not Brown, 1883, or Gould, 1902).

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Correlation chart shows Delphi Station shale and sandstone below Pompey shale and sandstone and above Mottville sandstone and limestone. Middle Devonian.

[G. A. Cooper], 1955, *in* New York State Geol. Assoc. [Guidebook] 27th Ann. Mtg., p. 10, 11. Basal member of formation. Dark shale grading upward into sandy mudstone and calcareous sandstone. Thickness 80 feet.

Type section: Knights Falls. Name is derived from Delphi Station, Cazenovia quadrangle, which is about 1½ miles northwest of Knights Falls.

†Del Rio Clay (in Washita Group)[1]

Upper Cretaceous (Comanche Series): Southern Texas.

Original references: R. T. Hill and T. W. Vaughan, 1898, U.S. Geol. Survey Geol. Atlas, Folio 42, p. 2; 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 2, p. 236–237.

W. S. Adkins, 1933 [1932], Texas Univ. Bull. 3232, p. 387. Considered synonym of Grayson formation.

L. W. Stephenson, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 10, p. 1538–1541. Discussion of fossils from limestone of Buda age in Denton County. If it is admitted that this limestone is a facies of Buda age in upper part of Grayson marl, then the Grayson is not exact equivalent of Del Rio but includes equivalents of both Del Rio and Buda.

A. P. Noyes, Jr., and Keith Young, 1960, Texas Jour. Sci., v. 12, nos. 1–2, p. 74 (fig. 5), 89–90. Described in Purgatory Creek area where it is as much as 30 feet thick, overlies Georgetown limestone and underlies Buda limestone. Upper Cretaceous.

Type locality: Low conical butte, Loma de la Cruz, and surrounding clay lowlands, 2 miles south of Del Rio, Valverde County.

Delta Glaciation

Pleistocene: East-central Alaska.

T. L. Péwé, 1952, (abs.) Geol. Soc. America Bull., v. 63, no. 12, pt. 2, p. 1289; T. L. Péwé *in* T. L. Péwé and others, 1953, U.S. Geol. Survey Circ. 289, p. 9, 13 (table 1). At least three major Quaternary glaciations recorded at north end of Delta River valley. Delta succeeded Darling Creek glaciation (new); preceded Donnelly glaciation (new). Trunk glacier in Delta Valley coalesced with smaller northward-flowing glaciers to form piedmont lobe spreading about 30 miles beyond front of Alaska Range. Moraines dissected and considerably subdued.

Named from Delta River, along the valley of which the glacier coursed; Big Delta area.

Del Valle Formation

Upper Cretaceous: Northern California.

C. A. Hall, Jr., 1956, Dissert. Abs., v. 16, no. 12, p. 2426. Incidental mention as overlying Niles Canyon formation (new).

C. A. Hall, Jr., 1958, California Univ. Pubs. Geol. Sci., v. 34, no. 1, p. 11–14, fig. 2, geol map. Proposed by Funkhouser (1948, unpub. thesis) for Upper Cretaceous rocks in Arroyo del Valle-Rocky Ridge area of northeastern part of La Costa Valley quadrangle, Alameda County. Name Del Valle formation is applied in this report to rocks along Sunol Ridge in northern part of Niles quadrangle and along western edge of Dublin quadrangle. Rocks along Sunol Ridge cannot be traced into type locality of formation, but they are similar to type section in lithology and age. Thickness along Sunol Ridge, where beds are commonly overturned, may be 3,500 feet; formation thins to the south along ridge. Characteristic lithology is a brown massive soft to hard occasionally concretionary sandstone interbedded with thinly bedded brown siltstone or shale; conglomerate along Sunol Ridge resembles conglomerate of type locality but occurs at top instead of middle of formation. At type locality, brown to reddish-brown hard concretions occur within the sandstone, and crossbedding and flow structures are common; individual sandstone beds at some localities are massive, whereas elsewhere they are 1 to 10 feet thick, interbedded with 1-inch to 4-foot layers of gray, greenish-gray, or brown shale; lenticular conglomerate near middle of formation is approximately 700 feet thick, thinning to the east. Conglomerate along west side of Sunol Ridge is approximately 600 feet thick; thickness is divided into 50- and 100-foot beds of alternating conglomerate and sandstone; this conglomerate unit was traced into Hayward quadrangle where it occurs below Upper Cretaceous rocks. Conformably overlies Niles Canyon formation; underlies Tolman formation. At type area, where maximum thickness is approximately 9,000 feet, formation is faulted against Franciscan group and Cierbo sandstone and is overlapped by Cierbo sandstone and Livermore gravels. Huey (1948) mapped rocks between Rocky Ridge and Arroyo del Valle as Panoche formation. Funkhouser renamed rocks Del Valle because type locality of Panoche is in Panoche Hills of Fresno County, nearly 100 miles from Arroyo del Valle; also Panoche is not a well-defined unit at its type locality.

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Type locality: Arroyo del Valle-Rocky Ridge area of northeastern La Costa Valley quadrangle, Alameda County, where it covers approximately 4 square miles; extends into Tesla quadrangle.

Delwood Coal Member (of Abbott Formation)

Pennsylvanian: Southern Ilinois.

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 below Murray Bluff sandstone member and above Finnie sandstone member. Thickness 3 feet in type section of formation. Term Finnie sandstone is applied to unit formerly termed Delwood sandstone in order to retain name Delwood for the coal. Name Delwood coal credited to J. M. Weller (1940, Illinois Geol. Survey Rept. Inv. 71). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: NW¼NW¼ sec. 3, T. 11 S., R. 6 E., Pope County.

Delwood cyclothem (in Abbott Formation)

Delwood cyclothem (in Tradewater Group)

Pennsylvanian: Southern Illinois.

H. R. Wanless, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 9, p. 1764 (table 2). Underlies Macedonia cyclothem and overlies Grindstaff cyclothem.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 9. Type locality designated.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 52 (table 2), 54 (table 3). In Abbott formation (new).

Type locality: Sec. 5, T. 11 S., R. 6 E., Pope County. Name derived from a crossroads village in northern part of county.

Delwood Formation or Sandstone (in Tradewater Group)

Pennsylvanian: Southern Illinois.

J. M. Weller, 1940, Illinois Geol. Survey Rept. Inv. 71, p. 16 (table), 39, 40, 41. Formation contains only one important sandstone and one coal and is considered to represent a single cycle of deposition. Basal sandstone is about 50 feet thick, generally massive and crossbedded and conspicuously micaceous; above the coal, formation consists of a succession of sandy shales and shaly to thin-bedded sandstones with a probable maximum thickness of 50 feet. Underlies Macedonia formation; overlies Grindstaff formation.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 9. Type locality designated.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 31. Replaced by Finnie sandstone.

Type locality: Sec. 5, T. 11 S., R. 6 E., Pope County. Name derived from a crossroads village in northern part of county.

Dement 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, 10, 16. Limestone, dolomitic, medium bedded, and nonshaly. Thickness about 7 feet. Shown on columnar section as underlying Walgreen member (new) of Grand Detour formation and overlying Briton member (new) of Mifflin formation.

Occurs in Dixon-Oregon area.

Demingian Series or Stage

Ordovician (Canadian): North America.

R. H. Flower, 1957, New Mexico Bur. Mines Mineral Resources Mem. 2, p. 18. Divisions within Canadian system favor natural division into four major units: Gasconadian, Demingian, Jeffersonian, and Cassinian. Demingian (Middle Canadian) beds in east are restricted and confined largely to *Lecanospira fauna*. In the west, a definite succession is known comprising the first endoceroid zone, first piloceroid zone, the oolite and succeeding gastropod beds of El Paso section in New Mexico, and F and lower G of Garden City sections.

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

Interval well developed in Cooks Range, Florida Mountains, N. Mex. Name derived from city of Deming, N. Mex.

†Demopolis (broad sense)[1]

Upper Cretaceous: Alabama.

Original reference: E. A. Smith, 1888, Alabama Geol. Survey Rept. Prog. 1884–1888, geographic map of Alabama.

Probably named for exposures at Demopolis, Marengo County.

Demopolis Chalk or **Formation** (in Selma Group)

Demopolis Chalk Member (of Selma Chalk)

†Demopolis division (narrow sense)[1]

Upper Cretaceous: Western Alabama and eastern Mississippi.

Original reference: E. A. Smith, 1903, 58th Cong., 1st sess., S. Ex. Doc. 19, p. 12–20, map.

W. H. Monroe, 1941, Alabama Geol. Survey Bull. 48, p. 64–73. Smith (1903) divided Selma chalk into three divisions: upper, or Portland; middle, or Demopolis; and lower, or Selma. Later workers did not follow Smith in his threefold division of Selma, but recent works show that subdivision of Selma is not only practicable but desirable. In present paper, Smith's Selma division is represented almost exactly by the unnamed lower marly member of Selma chalk, but because name Selma chalk has long been established for formation as a whole, its additional use to designate member of same formation would be confusing. Smith's Demopolis division is represented by Arcola limestone member and lower part of Demopolis member. Smith's Portland division is represented in western Alabama by upper part of Demopolis member, Ripley formation, and Prairie Bluff chalk, and in central Alabama by upper part of Demopolis member and lower part of Ripley formation. Specifically, in this report, Demopolis member of Selma chalk includes all chalky and marly beds between diastem above Arcola limestone member below and Ripley formation above. Estimated thickness about 490 feet (estimates from wells). In Montgomery County, member is split into two eastward-extending tongues by westward-extending tongue of Cusseta sand. Type locality stated.

H. R. Bergquist, 1943, Mississippi Geol. Survey Bull. 53, p. 15 (table), 26–31. Demopolis chalk member geographically extended into Mississippi. Thickness is about 410 feet in Clay County. Overlies Arcola member; underlies Ripley formation.

W. E. Belt and others, 1945, Geologic map of Mississippi (1:500,000): Mississippi Geol. Survey. Rank raised to formation in Selma group.

W. H. Monroe and D. H. Eargle, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 50. In southwestern part of Eutaw quadrangle, Alabama, overlies Arcola limestone member of Mooreville chalk.

W. H. Monroe, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 11, p. 2740–2742. Subdivided to include Bluffport marl member (new).

R. H. Hughes, Jr., 1958, Mississippi Geol. Survey Bull. 84, p. 46–59, pls. 1, 5, 6, 10. Demopolis chalk described in Kemper County where it includes Bluffport marl member at top. Thickness about 260 feet. Underlies Ripley formation; oldest deposit exposed in county. In east-central Mississippi, the Demopolis lies between Ripley formation above and Mooreville chalk below; in northern part of state, overlain by Owl Creek tongue of Ripley and underlain by Tupelo tongue of Coffee sand.

W. S. Parks, 1960, Mississippi Geol. Survey Bull. 87, p. 22 (table 2), 26 (fig. 4), 52–61, pl. 4. In this report [Prentiss County], Demopolis formation refers to those chalk beds between Coffee sand below and transitional clay of Ripley formation above. Thickness 230 to 235 feet.

Type locality: Bluff of chalk on Tombigbee River at Webb and Sons cotton warehouse in Demopolis, Marengo County, Ala.

Dempsey Marble[1] (in Talladega Series)

Pennsylvanian: Northeastern Alabama.

Original reference: G. I. Adams, 1933, Jour. Geology, v. 41, no. 2, p. 163.

T. N. McVay and L. D. Toulmin, 1945, Alabama Geol. Survey Bull. 55, p. 20. Present in upper part of Talladega series. Pennsylvanian.

Present in Clay County.

DeNay Limestone Member (of Francis Formation)[1]

DeNay Limestone Member (of Coffeyville Formation)

Pennsylvanian (Missouri Series): Central southern Oklahoma.

Original references: G. D. Morgan, 1922, Oklahoma Geol. Survey Circ. 12, p. 9, 10; 1924, [Oklahoma] Bur. Geology Bull. 2, p. 110–115.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped as basal member of formation.

W. F. Tanner, 1956, Oklahoma Geol. Survey Bull. 74, p. 62, 63, 64. Reallocated to member status in Coffeyville formation. Interval designated by Morgan (1924) as Francis formation is herein described under headings Coffeyville and Nellie Bly.

Named for typical development on side of an eastward-facing bluff in sec. 5, T. 4 N., R. 7 E., about one-fourth mile west of DeNay School, in Stonewall quadrangle, Pontotoc County.

†Denison Formation (in Washita Group)[1]

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

Original reference: R. T. Hill, 1889, Am. Jour. Sci., 3d, v. 37, p. 290.

B. F. Perkins, 1960, Geol. Soc. America Mem. 83, p. 9 (fig. 3), 12 (fig. 4), 29–41, pl. 1. Formation described in Fort Worth-Weatherford area, Texas, where it comprises (ascending) Denton marl, Weno marly limestone, Pawpaw shale, Main Street limestone, and Grayson marl members. Thickness about 245 feet. Overlies Fort Worth limestone; underlies Buda limestone. Washita group.

U.S. Geological Survey has abandoned the term Denison Formation and raised the members to formational status.

Named for exposures at Denison, Grayson County, Tex.

Denmar Formation

Middle Mississippian (Meramecian) : Southwestern West Virginia.

Dana Wells, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 5, p. 902–918. 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 in its type section; this stratigraphic and lithologic unit includes beds defined by Reger (1926) as Sinks Grove and Patton limestones. Thickness at type section 214 feet. Conformably overlies Hillsdale limestone from southern Mercer County to northern end of Pocahontas County; across remaining distance of latter county and for approximately 5½ miles into Randolph County, near Monterville, unconformably overlies thinning Maccrady; 1½ miles south of Monterville, the Maccrady disappears and the Denmar rests on the Pocono; throughout area investigated the Denmar underlies Reger's (1926) Taggard formation [shale]. 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 and lithologic 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 formations is without merit.

Type locality: On eastern slope of Droop Mountain along County Road 20 in Locust Creek valley, 0.7 mile south of junction with U.S. Highway 219, Little Levels district, Pocahontas County. Named for village of Denmar about 2½ miles southeast on Greenbrier River.

Denmark Formation

Denmark Member (of Sherman Fall Formation)

Middle Ordovician (Mohawkian) : Central and northern New York.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 267–268, pl. 4. Named as a member and defined as alternating shaly and coarse-textured limestones constituting larger part of the formation. Calcareous fucoidal claystones present in higher part. Thickness about 170 feet. Base tends to be more resistant than more shaly Shoreham member (new) below, but contact is indistinct; contact with overlying Cobourg formation poorly defined lithologically.

G. M. Kay, 1943, Am. Jour. Sci., v. 241, no. 10, p. 598, 599, 605. Rank raised to formation. Subdivided to include three new members in West Canada Creek area, in ascending order: Rathbun limestone, Poland limestone, and Russia limestone. Contains several metabentonites. Grades into Canajoharie black shale southeastward. Underlies Rust limestone member (new) of Cobourg formation; disconformably overlies Shoreham limestone.

P. A. Chenoweth, 1952, Geol. Soc. America Bull., v. 63, no. 6, p. 527–530. Stratigraphically restricted by reallocation of basal Rathbun member to underlying Shoreham formation. In northwestern New York, lower part is subdivided to include Camp member below and Glendale member above. In Black River valley, consists primarily of coarse-textured fossiliferous calcarenites, few intercalated finer grained calcisiltites, and calcilutites of the Glendale member. Poland and Russia members not recognizable in sections north of Trenton Falls.

Named for Denmark Township, Lewis County. Well displayed in Trenton Falls Gorge.

Denmarkian (Denmark) Stage or Substage

Middle Ordovician: Eastern North America.

Referred to as Denmark time. G. M. Kay, 1943, Am. Jour. Sci., v. 241, no. 10, p. 603.

Marshall Kay, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1414–1415. Middle Trentonian includes rocks equivalent to Shoreham and Denmark limestones of New York, or undivided Sherman Fall limestone. Denmarkian commonly has abundance of *Sinuites cancellatus* (Hall), but upper limit has been established only in New York and Ontario, where succeeded by late Trentonian Cobourg limestone; in central Pennsylvania, the Salona is overlain by Coburn limestone, the contact approximating top of Denmarkian. The Denmarkian has limestones west of Adirondack line, which have been shown to change through a succession of facies into Canajoharie black shale as they thicken and approach Adirondack line in New York.

Marshall Kay, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 7, p. 30. Suggested that term Shermanian stage be applied to Shorehamian and Denmarkian substages.

Name derived from Denmark Township, Lewis County, N.Y., for which Denmark formation was named.

Dennis Limestone[1] (in Kansas City Group)

Dennis Limestone (in Bronson Group)

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

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

M. C. Oakes, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 4, p. 723–724. Abandoned in Oklahoma in favor of Hogshooter limestone.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, p. 191–192. Included in Bronson group. Comprises (ascending) Canville limestone, Stark shale, and Winterset limestone members. Overlies Galesburg shale; underlies Fontana shale.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2031 (fig. 4). Formation included in Bronson subgroup of Kansas City group. Comprises Canville limestone, Stark shale, and Winterset limestone members. Overlies Galesburg formation; underlies Cherryvale formation.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 11–12. Formation redefined for Missouri to include Canville, Stark, and Winterset members.

T. L. Welp, L. A. Thomas, and H. R. Dixon, 1957, Iowa Acad. Sci. Proc., v. 64, p. 421. Thickness of formation in Madison County, Iowa, about 23 feet. Includes Canville, Stark, and Winterset members. Overlies Galesburg shale; underlies Cherryvale formation.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 27, fig. 5. Comprises (ascending) Canville limestone, Stark shale, and Winterset limestone members. Canville usually missing in Iowa sections. Underlies Cherryvale shale; overlies Galesburg shale. Kansas City group.

Named for exposures at railroad station at Dennis, Labette County, Kans.

Dennis Bridge Limestone Bed (in Hill Creek Member of Lazy Bend Formation)

Dennis Bridge Limestone Member (of Lazy Bend Formation)

Dennis Bridge Limestone (in Millsap Lake Formation)[1]

Dennis Bridge Limestone (in Rayville Formation)

Pennsylvanian: North-central Texas.

Original reference: E. H. Sellards, 1933, Texas Univ. Bull. 3232, p. 106, 107.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Rank raised to member of Lazy Bend formation. Occurs between Brannon Bridge limestone member (above) and Kickapoo Falls member (below).

M. G. Cheney, 1947, Jour. Geology, v. 55, no. 3, pt. 2, p. 210. Reallocated to Rayville formation (new).

Leo Hendricks, 1957, Texas Univ. Bur. Econ. Geology Pub. 5724, p. 14, fig. 3. Rank reduced to bed in Hill Creek member of Lazy Bend formation. Occurs at base of member. At type locality, overlain by 3 feet of shale; along strike, bed is covered by alluvium and Cretaceous rocks. Type locality established.

Type locality: Outcrops at end of bridge over Brazos River at Dennis in southwestern part of Parker County. Exposure extends westward along the Brazos for one-fourth mile to valley of tributary; basal 3 feet is exposed in small outcrop in stream bank one-half mile east of south end of bridge at Dennis; these are the only surface occurrences of the limestone.

Denny Formation

Pre-Tertiary: Central Washington.

R. J. Foster, 1957, Dissert. Abs., v. 17, no. 9, p. 1982; 1960, Geol. Soc. America Bull., v. 71, no. 2, p. 111, pl. 1. At type locality, consists of medium- to coarse-crystalline marbles interbedded with fine-grained hornfels. Thickness not estimated; deformation and metamorphism that accompanied emplacement of Snoqualmie granodiorite has obscured structure. Rocks were included in Guye formation by Smith and Calkins (1906). Field relationships show Denny to be pre-Snoqualmie granodiorite and probably in fault contact with other rocks. Probably pre-Tertiary.

Type locality: Snoqualmie Mountain saddle, central Cascades Mountains. Confined to two small areas on Denny and Snoqualmie Mountains with total extent of less than 2 square miles.

Dennys 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 Niagaran series [Middle Silurian].

Named for exposures near Dennysville, Washington County.

Densinyama Formation

Densinyama Beds

Eocene, upper: Mariana Islands (Saipan).

Risaburo Tayama, 1938, Geomorphology, geology, and coral reefs of Saipan Island. Tropical Industry Inst., Palau, South Sea Islands, Bull. 1 [English translation in library of U.S. Geol. Survey, p. 53–56]. Beds comprise four units (ascending): conglomerate containing felsite and limestone blocks with intercalated clays; conglomerate consisting largely of felsite pebbles with minor amounts of medium-sized limestone, liparite, andesite, and quartz pebbles; fine-grained conglomerate of felsite pebbles, sandstone, and tuff with two thin beds of yellow and pink clay (fuller's earth); well-stratified arenaceous limestone or calcareous sandstone. Thickness varies, about 60 to 100 meters at Densinyama; thins southward. Commonly in contact with Hagman andesite, with no intermediate Mantansya beds. Oligocene.

Josiah Bridge *in* W. S. Cole and Josiah Bridge, 1953, U.S. Geol. Survey Prof. Paper 253, p. 8–9. Referred to as formation. Miocene (Aquitanian).

P. E. Cloud, Jr., R. G. Schmidt, and H. W. Burke, 1956, U.S. Geol. Survey Prof. Paper 280–A, p. 51–56, pl. 2, chart 2. Formation, as herein described, comprises three facies (ascending): breccia, conglomerate-sandstone, and limestone-conglomerate. The conglomerate sandstone is subdivided into quartz-rich and quartz-poor facies. Thickness varies; aggregate at type section 730 feet; may exceed 800 feet in places; thins to disappearance. Upper Eocene. Type section designated. Difficult to distinguish some parts of Densinyama from Machegit conglomerate member (new) of Tagpochau limestone and from parts of Hagman formation.

Type section: Succession exposed along Talofofo Road that runs west and east from crest of Talofofo Ridge in north-central Saipan. Tayama gave as type locality ridge called Densinyama (radio hill) by Japanese, correct geographic name of which is Ogso Talofofo, or Talofofo Ridge.

Denton Clay (in Washita Group)

Denton Clay Member (of Denison Formation)[1]

Denton Formation (in Washita Group)

Denton Marl Member (of Denison Formation)

Denton Shale Member (of Georgetown Limestone)

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

Original reference: J. A. Taff, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 272.

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

D. L. Frizzell, 1960, Texas Univ. Bur. Econ. Geology Rept. Inv. 22, p. 27, table 4. Foraminifera of Denton formation described.

W. J. Fox and O. N. Hopkins, Jr., 1960, Baylor Geol. Soc. Guidebook 5th Field Trip, p. 88, 91. In central Texas, referred to as shale member of Georgetown limestone. Overlies Fort Worth limestone member; underlies Weno limestone. Thickness 3 to 5 feet. Predominantly marly shales containing two thin coquinoid limestone beds which are separated by about 1 foot of shelly marl.

B. F. Perkins, 1960, Geol. Soc. America Mem. 83, p. 9 (fig. 3), 12 (fig. 4), 30–32, 33 (fig. 13). In this report [Fort Worth-Weatherford area], Denton marl is used in sense intended by Taff; that is, member of Denison formation. In Tarrant County, consists of about 35 feet of gray marly limestone, gray marl, and weakly consolidated shell beds near top of member. Underlies Weno marly limestone member; overlies Fort Worth limestone.

Named for Denton Creek, Denton County, Tex.

Denver Formation[1]

Upper Cretaceous and Paleocene: Eastern Colorado.

Original reference: W. Cross, 1888, Colorado Sci. Soc. Proc., v. 3, pt. 1, p. 119–133.

C. H. Dane and W. G. Pierce, 1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 10, p. 1310 (fig. 2). Underlies Castle Rock conglomerate; overlies Arapahoe formation; southward merges into Dawson arkose.

R. W. Brown, 1943, Geol. Soc. America Bull., v. 54, no. 1, p. 71, 78 (table 2), 84. Denver formation has yielded invertebrates found only in Laramie formation in Denver basin. Proposed that Laramie be redefined to include Arapahoe formation as a member, basal part of Denver formation, and basal part of Dawson arkose. Paleocene.

J. T. Stark and others, 1949, Geol. Soc. America Mem. 33, p. 34 (table 7), 57–61, 62, pl. 1. Described in South Park area where it consists of gravel, conglomerate, sandstone, and sandy shale with interbedded agglomerate and tuff. Thickness as much as 8,000 feet, but it is possible that the formation or a part of it may have been repeated by step faulting, now hidden, or small-scale faulting. Unconformably overlies Laramie formation; underlies Balfour formation, but relation to Balfour nowhere exposed; hence, Balfour, as here defined, may prove to be topmost part of Denver; in southern part of the area, overlies Fox Hills formation, and along eastern side of Trout Creek valley, overlies Pierre shale; locally overlies Precambrian and Permian deposits. Eocene.

T. S. Lovering and E. N. Goddard, 1950, U.S. Geol. Survey Prof. Paper 223, p. 2, 40, 41, 42. Upper Cretaceous and Paleocene.

S. O. Reichert, 1956, Geol. Soc. America Bull., v. 67, no. 1, p. 107–112, pl. 1. Proposed that Arapahoe-Denver contact be placed at widespread erosional disconformity at base of lowest, thickest, and most prominent basalt-andesite pebble conglomerate bed in Denver area instead of at first appearance of andesitic debris as proposed by Emmons, Cross, and Eldridge (1896, U.S. Geol. Survey Mon. 27); also proposed that Denver formation be extended throughout Denver basin to include all dark clastic sediments derived from erosion of basic lavas as indicated by their mineral content. Denver formation (and Arapahoe herein also extended) would replace the "lower" Dawson of Dane and Pierce. Paleocene.

Named for exposures about city of Denver.

Denver Basin Group

See Basin Ridge Group.

Denzer Diorite[1]

Precambrian: South-central Wisconsin.

Original reference: J. T. Stark, 1932, Jour. Geology, v. 40, no. 2, p. 120, 121, 137.

Occurs in secs. 9 and 10, T. 10 N., R. 5 E., north and northwest of Denzer, Baraboo district.

Denzer Tuff[1]

Precambrian: South-central Wisconsin.

Original reference: J. T. Stark, 1932, Jour. Geology, v. 40, no. 2, p. 120, 121, 132.

Exposed in a ledge nearly 200 feet long and 5 to 10 feet wide on north bank of a small stream in SE¼ sec. 11, T. 10 N., R. 5 E., about 1½ miles northeast of Denzer, Honey Creek Township, Baraboo district.

Depass Formation[1]

Middle Cambrian: Western Wyoming.

Original reference: B. M. Miller, 1935, Geol. Soc. America Proc. 1934, p. 352.

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1096–1101, 1102–1104. Redefined to include all beds in type locality between Cambrian-Precambrian contact and base of Upper Cambrian Boysen formation (new). Middle-Upper Cambrian boundary cannot be drawn upon evidence of fossils. Top of Depass is arbitrarily placed at top of two thick beds of intraformational conglomerate, which lie upon a 14-inch shale zone containing new genera of Middle Cambrian trilobites, and 12 feet below lowest horizon containing *Arapahoia?* sp. and *Dicellomus?* sp. On basis of lithology, divided into basal Flathead sandstone member and upper Gros Ventre member. Thickness emended section 580 feet.

Type section: Wind River Canyon at eastern end of Owl Creek Range. Name is taken from "D" Pass (now spelled Depass) near eastern end of Bridger Range.

†Depauville (Depeauville) Waterlime[1]

Lower Ordovician: Central New York.

Original reference: E. Emmons, 1840, New York Geol. Survey, 4th Rept., p. 324.

The village name is spelled Depauville, Jefferson County.

Deputy Formation (in Hamilton Group)

Middle Devonian: Southeastern Indiana.

Guy Campbell, 1942, Geol. Soc. America Bull., v. 53, no. 7, p. 1060–1061. Blue to gray limestone weathering light gray; in fresh material difficult to distinguish from the Speeds formation except by fossils; has been included with the Speeds as a part of the Jeffersonville or Sellersburg. Underlies Silver Creek formation; overlies Speeds formation; at type section occurs between Speeds and Swanville formations.

J. B. Patton and T. A. Dawson *in* H. H. Murray. 1955, Indiana Geol. Survey Field Conf. Guidebook 9, p. 42, pl. 1. Deputy and Swanville "formations" appear to be only faunal facies of units previously recognized and names, or combinations of such units; they might better be called "zones" or "faunal facies" of Sellersburg (North Vernon) limestone.

Type section: On secondary road one-half mile east of its intersection with Highway 3, three-quarters mile south of Deputy, Jefferson County.

De Queen Limestone (in Trinity Group)

De Queen Limestone Member (of Trinity Formation)[1]

Lower Cretaceous (Comanche Series): Southwestern Arkansas and southeastern Oklahoma.

Original reference: H. D. Miser and A. H. Purdue, 1918, U.S. Geol. Survey Bull. 690, p. 19, 22.

R. W. Imlay, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 3. Rank raised to formation in Trinity group. Table shows unit as cropping out in Arkansas below the Paluxy sand and above the Holly Creek formation. Subsurface equivalents discussed.

L. V. Davis, 1960, Oklahoma Geol. Survey Bull. 86, p. 16 (table 5), 22–26, pl. 1. Crops out in McCurtain County just south of Holly Creek formation in narrow band ranging in width from several feet to more than half a mile. Outcrop extends from sec. 1, T. 6 S., R. 23 E., eastward to Arkansas State line. Thickness 38 feet in eastern part of outcrop; less than 1 foot in western extremity. Downdip attains maximum thickness of 190 feet at southeastern edge of county. Conformable to overlying Paluxy sand and to underlying Holly Creek formation. Unconformable to underlying Paleozoic rocks where Holly Creek is absent. Trinity group; Comanche series. Early Cretaceous.

Named for occurrence at De Queen, Sevier County, Ark.

Derby Dolomite (in Elvins Group)[1]

Derby Dolomite Member (of Elvins Formation)

Upper Cambrian: Eastern Missouri.

Original references: E. R. Buckley, 1907, Missouri Bur. Geology and Mines, v. 10, 2d ser., separate; H. A. Buehler, 1907, Missouri Bur. Geology and Mines, v. 6, 2d ser., p. 231.

Josiah Bridge, 1937, U.S. Geol. Survey Prof. Paper 186–L, p. 234 (table 1). Middle formation in Elvins group. Overlies Davis formation; underlies Doe Run dolomite. Upper Cambrian.

E. B. Branson, 1944, Missouri Univ. Studies, v. 19, no. 3, p. 27–30. Missouri Geological Survey uses compound term, Derby-Doe Run. Because Doe

Run was used as formation named by Frazer (1883) [for unit in Pennsylvania], it seems good usage to discontinue it as compound term. Term Derby formation is used in this report. Dominantly dolomite noncherty, gray to buff. Exposures of entire formation nowhere identified. Thicknesses of 75 feet near Potosi and 110 feet near St. Joe Lead Company mine are maximums that have been identified. Overlies Davis formation; underlies Potosi formation. Term Elvins group not recognized as valid in this report.

V. E. Kurtz, 1960, Dissert. Abs., v. 21, no. 3, p. 595. Referred to as member of Elvins formation. Overlies Davis member; underlies Doerun member. Derby and Doerun members become indistinguishable a short distance from their type localities.

Named for Derby mine (now Federal mine) near Elvins, St. Francois County.

Derry Series

Pennsylvanian: Central and southern New Mexico and western Texas.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 26–31. Term proposed for all rocks in the central to the extreme south-central areas of New Mexico between base of Pennsylvanian system and the basal part of Des Moines series. Composed largely of marine limestones, shales, conglomerates, and coarse sandstones; locally contains, especially in lower part, dark shales, sandstones, and thin coal beds. About 130 feet thick at type locality; thickens southward to slightly more than 600 feet in the Hueco Mountains of western Texas where it is composed almost entirely of marine limestones. Subdivided into two groups, Green Canyon below and Mud Springs (both new). At type locality, unconformably overlies Devonian Percha shale; elsewhere unconformably overlies rocks of Mississippian, Devonian, Cambrian(?), or Precambrian age. Overlain by Des Moines sediments referred to Armendaris group (new).

Type locality: West slope of hill about three-fourths mile east of center of Derry, near center of sec. 32, T. 17 S., R. 4 W. Named for village of Derry in Sierra County, N. Mex.

Descanso Granodiorite[1]

Late Mesozoic: Southern California.

Original reference: W. J. Miller, 1935, California Jour. Mines and Geology, v. 31, no. 2, p. 115–141, map.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 486, 487, table 4. Discussed under Late Mesozoic plutonics. Shown on table as older than La Posta quartz diorite and younger than Harbison quartz diorite.

Type occurrence in general vicinity of Descanso, southern Peninsular Range, San Diego and Imperial Counties.

†Deschutes Formation[1]

Pliocene, lower to middle: Central northern Oregon.

Original reference: I. C. Russell, 1905, U.S. Geol. Survey Bull. 252, p. 90–91.

R. W. Chaney, 1938, Carnegie Inst. Washington Pub. 476, p. 187–216. Flora and fauna indicate a lower to middle Pliocene age.

U.S. Geological Survey has abandoned the term Deschutes Formation.

Well exposed in wall of Deschutes River for at least 25 miles up stream from Crooked River.

Desecheo Stage[1]

Recent: Puerto Rico and Desecheo Island.

Original reference: B. Hubbard, 1923, New York Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, v. 2, pt. 1, p. 97.

J. D. Weaver *in* R. Hoffstetter and others, 1956, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2b, p. 324–325. Hubbard introduced term for post-Pleistocene beach sands and gravels in northern Puerto Rico and Desecheo Island. He recognized an Upper and Lower Desecheo stage in terms of elevation above sea level.

Deseret Limestone[1]

Lower and Upper Mississippian: Central northern Utah.

Original reference: J. Gilluly, 1932, U.S. Geol. Survey Prof. Paper 173.

H. T. Morris, 1957, Utah Geol. Soc. Guidebook 12, p. 15 (fig. 4), 18–19. Described in East Tintic Mountains where it replaces Pine Canyon limestone of Loughlin (1919). Consists of three members: basal phosphatic shale, lower limestone member, and an upper limestone member. Total thickness 900 to 1,200 feet. Overlies Madison limestone; underlies Humbug formation.

A. E. Disbrow, 1957, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–131. Mapped in Fivemile Pass quadrangle where it is predominantly medium-gray cherty limestone interbedded with buff to brown sandy or shaly limestone and dolomite; beds of black carbonaceous phosphatic shale at base. Thickness about 700 feet. Overlies Madison limestone equivalents; underlies Humbug formation.

H. J. Bissell, 1959, Utah Geol. Soc. Guidebook 14, p. 49–52, pl. 1. Gilluly (1932) assigned 650 feet of limestone to Deseret limestone. In this report [southern Oquirrh Mountains], the upper 350 feet of Gilluly's section are referred to the Deseret, and lower strata are included in Pine Canyon formation, largely the upper member. Restricted Deseret is mapped in Ophir Canyon and on crest of Ophir anticline where it crosses Mercur Canyon. Conformably underlies Humbug formation.

M. D. Crittenden, Jr., 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 63, 65–66, 69 (fig. 3), 70–71. Conformably overlies Gardison limestone (new) in Cottonwood, Provo, and Oquirrh Mountains areas.

Named for exposures at Deseret mine, Dry Canyon, Stockton quadrangle.

Desert Member (of Blackhawk Formation)

Upper Cretaceous (Montana): Central eastern Utah.

R. G. Young, 1955, Geol. Soc. America Bull., v. 66, no. 2, p. 183, 186, figs. 2, 3, pl. 3. Comprises a sandstone tongue and the overlying coal-bearing rocks which separate it from the Castlegate member of the Price River formation above. Basal unit of member is medium-grained buff sandstone with maximum thickness of about 70 feet; massive near top but grades downward into thinner beds and finally into Mancos shale which in turn disconformably overlies Grassy member (new) of Blackhawk formation; disappears eastward into Mancos shale at Saleratus Canyon.

About 50 feet of coal-bearing rocks is present at Desert, and it thins rapidly to southeast and is absent at Green River, where basal sandstone of the Castlegate rests directly on basal sandstone of Desert member.

Named for exposures in nearly vertical cliffs of Mount Elliot east of Desert, a siding of the D. & R. G. W. Railroad, Emery County.

Desert 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 Desert Cone. [See Timber Crater Basalt Flow.]

Howel Williams, 1942, Carnegie Inst. Washington Pub. 540, p. 27. Here considered to be pre-Mazama.

Desert Cone is in northwestern part of Crater Lake National Park.

Desert Peak Formation

Pliocene, lower: Western Nevada.

D. I. Axelrod, 1956, California Univ. Pubs. Geol. Sci. v. 33, p. 97–99, 139–141, figs. 5, 6, 8. Consists of two unnamed members: Lower member described as thick yellow-brown to tan shales, yellow-green basalt tuffs, thin basalt flows, and dense olive-gray basalt; thickness 850 feet; upper member described as white, creamy thin siliceous shales, chiefly opalized diatomite, some horizons breaking into conchoidal chips; higher parts grade northeastward to diatomite locally; basalt tuffs locally interbedded in section; thickness from 1,600 to 2,200 feet. Higher parts of formation grade upward into Truckee formation. Conformably overlies Chloropagus formation (new).

Type region at northern end of Hot Springs Range surrounding Desert Peak. Occurs also on far side of Carson Sink Basin in hills southwest of Fallon, as well as in Stillwater Range southeast of Stillwater.

De Smet Formation[1]

Precambrian: Southwestern South Dakota.

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

J. A. Noble and J. O. Harder, 1948, Geol. Soc. America Bull., v. 59, no. 9, p. 945. Does not maintain constant position; may be absent or occur at one or several positions. Name De Smet dropped as separate formation; unit included in Poorman formation.

Named for exposures around north end of main opencut southwest of De Smet shaft, Lead district, Lawrence County.

†De Smet Formation[1]

Upper Cretaceous to Eocene, lower(?): Northern Wyoming.

Original reference: N. H. Darton, 1906, U.S. Geol. Survey Prof. Paper 51, p. 13, 62–67.

R. L. Nace, 1936, Wyoming Geol. Survey Bull. 26, p. 26. Originally defined as formation. Has since been shown to be terrane and subdivided into more natural divisions.

Typically exposed at Lake De Smet, Fort McKinney quadrangle.

Des Moines Series

Des Moines Group[1]

Middle Pennsylvanian: Iowa, Arkansas, Kansas, Missouri, Nebraska, and Oklahoma.

Original reference: C. R. Keyes, 1893, Iowa Geol. Survey, v. 1, p. 86–114.

C. W. Wilson, Jr., and N. D. Newell, 1937, Oklahoma Geol. Survey Bull. 57, p. 19 (table 1). Group, in Muskogee-Porum district, comprises (ascending) Atoka formation, Hartshorne sandstone, McAlester shale, Savannah formation, and Boggy formation. Overlies Morrow group.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, p. 657–706, chart 6. In upward order, Midcontinent time-rock divisions of the Pennsylvanian are designated as Morrowan, Lampasan, Desmoinesian, Missourian, and Virgilian.

M. G. Cheney and others, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 2, p. 140 (chart 2). Chart shows classification and correlation of type Pennsylvanian section of eastern and western Pennsylvania with costandard sections of Appalachian and Midcontinent regions. Midcontinent region section comprises (ascending) Springer, Morrow, Lampasas, Des Moines, Missouri, and Virgil series. Des Moines series is equivalent to Allegheny series in Appalachian region and Allegheny River valley, western Pennsylvania. Costandard section shown as east-central Oklahoma and reference section as south Ardmore basin, Oklahoma.

R. C. Spivey and T. G. Roberts, 1946, Am. Assoc. Petroleum Geologists Bull., v .30, no. 2, p. 185. Atoka formation is elevated to Atoka series and defined to include all beds from top of Wapanucka limestone, Morrow series, to base of Hartshorne sandstone, Des Moines series. Term Atoka series replaces term Lampasas series.

C. A. Moore, 1947, Oklahoma Geol. Survey Bull. 66, p. 50. In present classification of Pennsylvanian rocks of Oklahoma, all strata between top of Morrow series and base of Missouri series are referred to Des Moines series. This classification places Atoka formation in Des Moines series.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2020, 2021 (fig. 1). In some parts of northern Midcontinent states, Desmoinesian deposits are separable from underlying pre-Desmoinesian Pennsylvanian rocks, but in large areas, especially in subsurface of northern Oklahoma and Kansas along Nemaha Ridge and bordering central Kansas uplift, Desmoinesian beds rest on pre-Pennsylvanian formations with angular unconformity. Upper boundary of series is defined by disconformity which is inconspicuous in most places but, on basis of paleontological changes, is judged to be division line of first-rank intra-systemic magnitude. Series designated paleontologically as zone of *Fusulina*. Comprises Cherokee and Marmaton groups. Spans interval between Atokan series and Missourian series. Oklahoma uses Des Moines series as extending downward to top of Morrowan beds.

R. C. Moore and M. L. Thompson, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 3, p. 286. Oklan series (new) comprises rocks assigned to Atokan and Desmoinesian stages.

M. C. Oakes, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 6, p. 1523–1526. Lower and middle part of Des Moines series in Oklahoma includes Krebs and Cabaniss groups (both new). These groups together are nearly but not quite the same, stratigraphically, as Cherokee rocks of southeastern Kansas.

W. V. Searight and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 12, p. 2747–2749. In classification adopted in northern Midcontinent, Desmoinesian stage is subdivided into Venteran substage below and Cygnian substage above. Desmoinesian comprises Krebs, Cabaniss, and Marmaton groups. Middle Pennsylvanian. Iowa does not fully concur in this classification.

W. B. Howe, 1956, Kansas Geol. Survey Bull. 123, p. 20–21, 22 (fig. 5). Term Cherokee revived for basal group of Des Moines. Terms Krebs and Cabaniss reduced to rank of subgroups within the Cherokee.

W. H. Bradley, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2284–2285. In Midcontinent region (including Arkansas, Iowa, Kansas, Nebraska, and Oklahoma), U.S. Geological Survey uses following series subdivision of the Pennsylvanian: Morrow, Atoka, Des Moines, Missouri, and Virgil. The Des Moines is Middle Pennsylvanian.

Named for exposures on Des Moines River, Iowa.

Desmoinesian Series or Stage

See **Des Moines Series.**

†De Soto Beds[1]

Pliocene, lower: Southern Florida.

Original reference: W. H. Dall, 1892, U.S. Geol. Survey Bull. 84, p. 126, 133, 141, 157, 158, 324.

Dessau Formation

Upper Cretaceous: South-central Texas.

C. L. Durham, Jr., 1955, Corpus Christi Geol. Soc. [Guidebook] Ann. Field Trip, Mar. 11–12, [p. 57], pl. 16. Consists of a basal glauconitic calcarenite which grades upward into a white calcilutite sequence. Approximately 70 to 90 feet thick in Travis County. Includes Pilot Knob tuff (new). Underlies Burditt marl (chalk); overlies disconformity at top of undifferentiated Austin. Name credited to Durham and Roux (unpub. ms.).

Type locality: On branch of Big Walnut Creek 7.6 miles north-northeast of State Capitol, Austin, Travis County.

Detonti Sand (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), 55–58, plates. Homogeneous sand unit containing some interbedded gray clay lenses and a prominent lignite bed at base. Best known from drill holes; as interpreted from logs thickness ranges from 207 to 412 feet. Unconformably overlies Saline formation (new); covered at many localities by deposits of gravel of late Tertiary age.

Type section: On east bank of first prominent gully west of Detonti on Detonti-Tull Road near center of NW¼NW¼NW¼ sec. 4, T. 3 S., R. 14 W., Saline County. Named for settlement of Detonti. Crops out in irregular northwestward-trending belt up to 3 miles wide and is probably continuous across bauxite region. Cut off at northeast by overlap of sediments higher in section and by Quaternary alluvial sediments of Arkansas River flood plain.

Detroit Glacial Stage

Detroit Till

Pleistocene: Northwestern Oregon.

T. P. Thayer, 1939, Oregon Dept. Geology and Mineral Industries Bull. 15, p. 20, 23–24. Stage defined as time during which Detroit till was deposited. All exposures of till are small.

Till crops out in North Santiam River just above bridge and on Quartzville Trail, in a roadcut one-half mile southwest of Berry, where highway crosses Breitenbush River southwest of Detroit, Marion County.

Detroit River Group

Detroit River Dolomite[1]

Middle Devonian: Southeastern Michigan and northern Ohio, and western Ontario, Canada.

Original reference: A. C. Lane and others, 1909, Geol. Soc. America Bull., v. 19, p. 555.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1754–1755, chart 4. Group, as now understood, includes Sylvania sandstone at base. Maximum thickness 1,000 feet in wells in central part of Southern Peninsula of Michigan; outcrop thickness commonly less than 200 feet. Wherever base of Sylvania is exposed, its contact with underlying rock is disconformable, and disconformity widens on leaving Michigan basin. In western Lake Erie region, the Sylvania lies on Bass Island[s] (Upper Silurian) beds, but unconformity includes at least part of Lower Devonian as indicated by Lower Devonian ostracoderms in pre-Sylvania stream deposit. If this disconformity is followed to farthest limits of Michigan basin province, the base of the "Sylvania" basal sand will rise in the column. This far-out "Sylvania" sand is probably to be found in Pendleton of Indiana, Hillsboro sandstone of southern Ohio, and Springvale sandstone in region around Cayuga, Ont. In first two cases, unconformity is so wide that it rests upon Niagaran limestones. Beds covering Detroit River vary in age from place to place, indicating disconformity at top, but not as great as one at base. Overlying rock at Sibley, Mich., northwestern Ohio, and Amherstburg, Ont., are of Dundee age; in Bruce and Huron Counties, Ont., overlying rock is lower Onondaga; on Mill Creek, Cheboygan County, Mich., group is said to contain a Schoharie fauna and is overlain by *Amphigenia*-bearing Mackinac breccia.

Wilber Stout, Karl Ver Steeg, and G. F. Lamb, 1943, Ohio Geol. Survey, 4th ser., Bull. 44, p. 127–128. Group, in Ohio, comprises Amherstburg and Lucas formations. Underlies Columbus formation; overlies Oriskany.

G. M. Ehlers *in* K. K. Landes, G. M. Ehlers, and G. M. Stanley, 1945, Michigan Dept. Conserv., Geol. Survey Div. Pub. 44, Geol. Ser. 37, p. 35 (table 1), 109–120. Discussion of geology of Mackinac Straits region. Detroit River strata are regarded as a group but not differentiated into formations. In southeastern Michigan, southwestern Ohio, and northwestern Ohio, Detroit River dolomites and Sylvania sandstone are underlain by Middle Devonian Dundee limestone. In Mackinac Straits area, the group is underlain by Bois Blanc formation (new). In Rogers City area and apparently elsewhere in northern part of Southern Peninsula, the group is overlain by Dundee limestone. Most of the rocks of the group in northern part of Southern Peninsula are covered with Pleistocene gravel several hundreds of feet thick. Thickness of group difficult to determine. Well records indicate thickness of about 700 feet in northern part of Southern Peninsula.

G. M. Ehlers, 1950, (abs.) Geol. Soc. America Bull., v. 61, no. 12, pt. 2, p. 1455–1456. Succession of Detroit River formations above Sylvania sandstone as given by Lane and others (1909) has been doubtful matter in mind of several geologists for many years. No evidence has been obtained to prove that Lane and his associates were incorrect in believing that the Sylvania is succeeded respectively by Flat Rock dolomite, Anderdon limestone, Amherstburg dolomite, and Lucas dolomite. Present studies indicate that oldest unit of the group, the Sylvania sandstone, is succeeded respectively by Amherstburg dolomite, Lucas dolomite, and Anderdon limestone. Flat Rock dolomite cannot be distinguished in outcrop or in well borings as distinct formation. Strata of this dolomite are part of Amherstburg dolomite. Term Flat Rock should be dropped from stratigraphic nomenclature. Middle Devonian.

K. K. Landes, 1951, U.S. Geol. Survey Circ. 133, p. 1–23. Correlation of outcropping rocks in type locality of Detroit River group with thick sequence of rocks in subsurface Michigan Basin. Surface nomenclature as revised by Ehlers (1950) is suggested for subsurface section in place of heterogeneous collection of names now used. Sylvania sandstone is placed in Detroit River group and reduced to member status in Amherstburg formation. Group comprises Amherstburg formation below and Lucas formation above. In subsurface, the group is overlain by Dundee formation except in southwestern Michigan where Dundee is absent. Overlies Bois Blanc formation except in western and southern Michigan where it overlies rocks of Silurian age. Anderdon limestone not identified in subsurface.

Named from exposures along Detroit River, Mich.

Devils Flow

Devils Hill Obsidian Flow

Recent: Southwestern Oregon.

E. T. Hodge, 1925, Oregon Univ. Pub., v. 2, no. 10, p. 56, 60 (fig. 44). Discussion of Mount Multnomah ancient ancestor of the Three Sisters. Name Devils flow applied to flow that extends eastward from Devils Hill and covers about one-fourth square mile.

Howel Williams, 1944, California Univ. Pub., Dept. Geol. Sci. Bull. 27, no. 3, p. 58. Referred to as Devils Hill obsidian flow in report on volcanoes of Three Sisters region. May be among youngest rocks of region.

Devils Hill is south of South Sister Mountain and between Le Conte and Cayuse Craters.

Devils Canyon Member (of Modin Formation)

Upper Triassic: Northern California.

A. F. Sanborn, [1953], Stanford Univ. Abs. Dissert, v. 27, p. 436. Middle member of formation. Underlies Kosk member (new); overlies Hawkins Creek member (new).

A. F. Sanborn, 1960, California Div. Mines Spec. Rept. 63, p. 6, 10–11, pl. 1. Formal proposal of name. Composed principally of massive dark-gray tuffaceous limestone, calcareous tuff, fine- to medium-grained calcareous sandstone, and nearly pure limestone lenses. Thickness 430 to about 1,000 feet. Overlies Hawkins Creek member; underlies Kosk member.

Type section: Devils Canyon, Big Bend quadrangle, Shasta County. Upper contact about one-half mile west of confluence of Devils Canyon and Alder Creek; lower contact three-quarters mile west.

Devils Den Limestone (in Graford Formation)[1]

Pennsylvanian: Central northern Texas.

Original reference: E. Böse, 1918, Texas Univ. Bull. 1758, p. 17.
Covers west side of Jim Ned Mountains, Wise County. Probably named for occurrence in Devils Den.

Devils Den Sandstone[1]

Upper Devonian or Mississippian: Northwestern Pennsylvania.

Original reference: G. H. Chadwick, 1935, Geol. Soc. America Bull., v. 46, no. 2, p. 332, 333 (footnote), 335, 336, 339.

Type locality not stated.

Devils Gate Limestone

Middle and Upper Devonian: Eastern Nevada.

C. W. Merriam, 1940, Geol. Soc. America Spec. Paper 25, p. 16–17. Name applied to upper 2,065 feet of Devonian strata exposed at Devils Gate and Modoc Ridge east of Yahoo Canyon. Overlies Nevada formation (restricted and redefined); underlies unit referred to as Diamond Peak series (includes Diamond Peak quartzite and White Pine shale).

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 48–52. Described in vicinity of Eureka where it consists largely of thick-bedded gray to blue-gray limestone that is cliff forming in most places. Thickness ranges from about 675 feet east of Phillipsburg mine in Diamond Mountains to 2,065 feet in combined sections at Devils Gate and Modoc Peak. On Newark Mountains and in southern end of Diamond Mountains, two members distinguished: Meister limestone below and Hayes Canyon limestone above. Overlies Nevada formation (Bay State member, new); underlies Pilot shale. In original description, formation was defined almost wholly on basis of faunas, lower boundary placed at top of zone containing *Stringocephalus*, and upper one marked by disappearance of *Crytospirifer* ("*Spirifer disjunctus*") fauna. Results of present study indicate there is adequate lithologic basis for establishing limestone as separate stratigraphic unit consistent with paleontologic definition. Middle and Late Devonian, time boundary apparently lies in upper half of Hayes Canyon limestone member.

Donald Carlisle and others, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 10, p. 2181 (fig. 3), 2184. In Sulphur Springs and Pinyon Ranges, overlies Telegraph Canyon member (new) of Nevada formation.

Type section: At Devils Gate, 8 miles northwest of Eureka, Eureka County.

Devils Glen Dolomite[1]

Upper Cambrian: Northwestern Montana.

Original reference: C. F. Deiss, 1933, Montana Bur. Mines and Geology Mem. 6, p. 40.

Charles Deiss, 1939, Geol. Soc. America Spec. Paper 18, p. 30, 46–47, 54 (fig. 6). Top of Middle Cambrian in area. Conformably overlies and is transitional into Switchback shale; underlies White Ridge limestone. Thickness at type locality 565 feet.

Charles Deiss, 1943, Geol. Soc. America Bull., v. 54, no. 8, p. 1131 (table 1), 1133–1134. In Sawtooth Range, consists of white-gray to pale-buff-gray, finely crystalline thick- and some thin-bedded dolomite; mottled salmon pink and coarser grained in upper part. Thickness 200 to 250 feet. Overlies Switchback shale. Unconformable below unnamed Devonian formations. Upper Cambrian.

Type locality: Northern spur of Monitor Mountain, south of North Fork of Dearborn River, in SW¼ sec. 6, NW¼ sec. 7, T. 17 N., R. 7 W., Lewis and Clark Range. Named from narrow and partly boulder filled section of North Fork of Dearborn River known as Devils Glen.

Devils Grave Sandstone (in Mancos Shale)

Upper Cretaceous: Northwestern Colorado.

R. E. Kucera, 1959, Rocky Mountain Assoc. Geologists [Guidebook] 11th Field Conf., Symposium, p. 41, 43, figs. 3, 4. Sequence of alternating yellowish-brown fine-grained sandstone and dark-brown sandy shale. Zone is 50 feet thick and lies 1,350 feet below top of Mancos shale.

Forms Devil's Grave, a conspicuous escarpment and mesa 3½ miles northwest of Yampa.

Devils Gulch Beds[1]

Miocene and Pliocene: Northwestern Nebraska.

Original reference: E. H. Barbour and H. J. Cook, 1917, Nebraska Geol. Survey, v. 7, pt. 19, p. 173.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 18, 35. Although this term has been less used, it precedes Valentine and was adequately defined, stratigraphically, from the first, in terms of what was then known; if redefined, it is available to replace Valentine formation, if the latter be considered preoccupied or unduly ambiguous.

Present in Brown County.

Devils Hill Pumice

Pleistocene to Recent: Southwestern Oregon.

B. N. Moore, 1934, Jour. Geology, v. 42, no. 4, p. 360 (fig. 1). Devil Hill pumice shown on map showing distribution of pumice sheets of Crater Lake region.

Howel Williams, 1942, Carnegie Inst. Washington Pub. 540, p. 70 (fig. 16). Devils Hill pumice shown on map showing distribution and thickness of Crater Lake pumice.

Devils Hill is north of Crater Lake.

Devils Hole Dolomite

Middle Silurian (Lockportian): Western New York.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser., no. 1. Eastwardly thinning wedge of dolomite carrying Guelph fauna. Underlies Oakfield limestone (new); overlies Eramosa dolomite. Replaces preoccupied Lower Shelby of Clarke (1903).

Type section: Devils Hole State Park, in Niagara Gorge.

Devils Hole Formation

Miocene(?): Southeastern Colorado.

E. H. Baltz, Jr., 1955, U.S. Atomic Energy Comm. Trace Elements Mem. Rept. TEM-929, p. 31. Incidental mention.

R. B. Johnson and G. H. Wood, Jr., 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 4, p. 719, fig. 2. Sequence of water-laid volcanic rocks; mainly of beds of light-gray conglomeratic tuff. Matrix is tuffaceous. Coarse material is poorly sorted mixture of pebbles and cobbles of pumice, perlite, gneiss, and schist. Beds generally lenticular and cross stratified. May be thin to massive bedded. Thickness ranges from 25 to 1,300 feet. Intertongues westward with red conglomeratic sandstone. Unconformably overlaps Farisita conglomerate (new) and older rocks of Cenozoic, Mesozoic, and Paleozoic age.

Named from exposures in Devil's Hole in north-central part of Huerfano Park. No type section described because of scarcity of and discontinuity of outcrops.

Devils Hollow Member (of Cynthiana Formation)

Devils Hollow division of (Lexington Limestone)

Devils Hollow facies (of Cynthiana Formation)

Middle Ordovician: North-central Kentucky.

A. C. McFarlan and W. H. White, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1640. Name proposed for the post-Woodburn "Perryville" of the upper Lexington limestone in the Frankfort-Versailles area. Term Perryville formerly applied to these beds is now considered a synonym of Benson. The 25 feet at type section includes 15 feet of the "Faulconer" rock and 10 feet of the "Salvisa." Regarded as a facies of the upper Woodburn and probably also lowermost Cynthiana.

F. H. Hall and W. N. Palmquist, Jr., 1960, U.S. Geol. Survey Hydrol. Inv. Atlas HA-23. Referred to as Devils Hollow facies of Cynthiana formation.

U.S. Geological Survey currently classifies the Devils Hollow as a member of Cynthiana Formation on basis of a study now in progress.

Type locality: Devils Hollow Road, a few miles west of Frankfort, Franklin County.

Devils Island Sandstone (in Bayfield Group)[1]

Precambrian: Northwestern Wisconsin.

Original reference: F. T. Thwaites, 1912, Wisconsin Geol. Nat. History Survey Bull. 25, p. 38.

G. O. Raasch, 1950, Illinois Acad. Sci. Trans., v. 43, p. 147. Thwaites' Chequamegon is considered to be Port Wing brownstone member of Orienta repeated by faulting. Contact of Chequamegon formation with supposedly underlying Devils Island formation is reported by Thwaites only from type locality, Devils Island. Beds here that Thwaites considered to be basal Chequamegon are believed to be part of the Devils Island.

Named for exposures on Devils Island, Ashland County.

Devils Kitchen Member (of Deese Formation[1] or Group)

Pennsylvanian (Desmoinesian) : Central southern Oklahoma.

Original reference: C. W. Tomlinson, 1928, Oklahoma Geol. Survey Bull. 40-Z, p. 14-15.

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), 31. Devils Kitchen member of Deese group, is about 500 feet thick. At base is medium-grained buff sandstone about 100 feet thick, locally split into two members separated by shale. Above this is shale interval from 100 to 200 feet thick, containing toward top 10 feet or more of fossiliferous impure limestone and calcareous shale. Above this is 200-foot sandstone which, near Ardmore, contains chert grains, and southeastward from Ardmore develops into a coarse conglomerate of angular to subangular chert pebbles. Overlies unnamed sandstone and shale below Arnold limestone. Desmoinesian.

Named for glen in sec. 10, T. 6 S., R. 2 E., Carter County.

Devils Lake Sandstone[1]

Upper Cambrian: Central southern Wisconsin.

Original reference: E. O. Ulrich, 1920, Washington Acad. Sci. Jour., v. 10, p. 74, 75.

F. T. Thwaites, 1943, Michigan Acad. Sci., Arts, and Letters, Papers, v. 28, p. 487. Reaffirms abandonment of name by Wanenmacher, Twenhofel, and Raasch (1934).

First described in vicinity of Devils Lake, Sauk County.

Devils Pocket Formation (in Big Snowy Group)

Pennnsylvanian: Central Montana.

H. D. Hadley and P. J. Lewis, 1956, Billings Geol. Soc. Guidebook 7th Ann. Field Conf., p. 143. Dolomite and limestone, partly sandy to siliceous, commonly red stained. Thickness ranges from 0 to 150 feet. Overlies Alaska Bench formation. Name credited to L. S. Gardner.

L. S. Gardner, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 2, p. 332 (fig. 2), 334 (fig. 3), 336 (fig. 4), 347-348. Included in Big Snowy group. Conformably succeeds Alaska Bench limestone; overlain with probable unconformity by rocks of unknown late Paleozoic or post-Paleozoic age. Formation was removed by pre-Ellis erosion nearly everywhere in central Montana, and has been recognized in outcrop only by vicinity of Stonehouse Ranch, sec. 32, T. 11 N., R. 21 E., where entire formation, 143 feet thick, is exposed, and at Durfee Creek dome where lower 71 feet remain. Type section designated.

Type section: In Road Canyon, sec. 31, T. 11 N., R. 21 E., about one-half mile west of Stonehouse Ranch. Name derived from Devils Pocket, an anticlinal valley on a long anticlinal nose breached by erosion in southeastern Big Snowy Mountains (T. 10 N., R. 21 E.), where formation is 141 feet thick.

Devils River Limestone[1]

Lower Cretaceous (Comanche Series) : Southwestern Texas.

Original reference: J. A. Udden, 1907, Augustana Lib. Pub. 6, p. 56.

R. G. Yates and G. A. Thompson, 1959, U.S. Geol Survey Prof. Paper 312, p. 8-9, pl. 1. Oldest rock exposed in Terlingua district. Consists of sequence of medium- to thick-bedded fine-grained limestone, light to dark gray on fresh surface and gray on weathered surface. Thickness more than 1,500 feet in cliffs of Mesa de Anguila, base not exposed. Conformably underlies Grayson formation. In rim of the Solitario where base is exposed, conformably overlies impure limestone containing Glen Rose fossils.

Named for exposures along entire length of Devil's River, Valverde County, from Camp Hudson down to the Rio Grande.

Devils Slide Syenite

Mississippian(?): Northern New Hampshire.

H. W. Jaffe, H. T. Evans, Jr., and R. W. Chapman, 1956, Am. Mineralogist, v. 41, no. 5–6, p. 474, 475–476, 485. Described as typically coarse-grained syenite. Includes a medium-grained subporphyritic greenish-gray to bluish-gray fayalite-quartz syenite. One of the major components of the Devil's Slide ring dike. Belongs to the White Mountain plutonic volcanic series.

Occurs northwest of the village of Stark, Percy quadrangle.

Devilwater Silt Member (of Monterey Formation)

Miocene, middle: Central California (subsurface and surface).

W. C. Bailey, 1939, California Oil Fields, v. 24, no. 3, p. 67. Devilwater silt shown on composite columnar section of Wasco oil field. Overlies Gould shale; underlies McDonald shale.

R. R. Simonson and M. L. Krueger, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 10, p. 1611 (fig. 2), 1616. Monterey shale in southern part of Temblor can be subdivided into three lithologic and faunal units, lowest of which is Devilwater-Gould member. At type area of Temblor formation, in vicinity of Chico Martinez Creek, the Devilwater silt, Gould shale, and "Buttonbed" sandstone lens are distinct faunal and lithologic units characterized, respectively, by the *Valvulineria californica*, *Valvulineria robusta*, and "*Scutella*" *merriami* faunal zones. In Recruit Pass area [this report], an interval of 1,850 feet of well-bedded siliceous light-brown shale, with minor amount of interbedded tan silt and lentils of massive buff limestone, comprise a single lithologic unit from which have been collected faunules common to both Gould shale and Devilwater silt as they are defined on Chico-Martinez Creek. This unit is referred to as Devilwater-Gould member of Monterey. Underlies McDonald shale; overlies Temblor-Vaqueros.

L. B. McMichael, chm., 1959, San Joaquin Geol. Soc. Guidebook Field Trip, May 9, Road log, topog. profile, chart, map. Devilwater silt member underlies McDonald shale member and overlies Gould shale member in Chico Martinez Creek area. Thickness about 1,180 feet.

Shown on stratigraphic column of Wasco oil field, Kern County, at depths of 11,300 to 11,500 feet.

Dewdney Formation[1]

Precambrian: Southern British Columbia, Canada, and northeastern Washington.

Original reference: R. A. Daly, 1912, Canada Geol. Survey Dept. Survey Mines Mem. 38, map 7.

Named for Dewdney Trail, British Columbia.

Dewdney Creek Formation or Group

Dewdney Creek Series[1]

Jurassic and Cretaceous: Southern British Columbia, Canada, and northeastern Washington.

Original reference: C. E. Cairnes, 1923, Canada Geol. Survey Summ. Rept. 1922, pt. A, p. 97, 111.

E. D. McKee and others, 1956, U.S. Geol. Survey Misc. Geol. Inv. Map 1–175, p. 5 (table 2). Termed a formation; geographically extended into northeastern Washington.

W. P. Popenoe, R. W. Imlay, and M. A. Murphy, 1960, Geol. Soc. America Bull. 71, no. 10, p. 1534, chart 10e (column 58). Formation was listed by McKee and others (1956) as partly of Jurassic age. In Princeton area of British Columbia (Rice, 1947, Canada Geol. Survey Mem. 243), the upper 7,200 feet of Dewdney Creek group contains fossils definitely of Early Cretaceous age.

First described in British Columbia.

Dewey Limestone[1] (in Skiatook Group)

Dewey Limestone Member (of Drum Limestone)

Pennsylvanian (Missouri Series): Northeastern, central, and central northern Oklahoma and eastern Kansas.

Original reference: D. W. Ohern, 1910, Oklahoma State Univ. Research Bull. 4, p. 30, 37.

M. C. Oakes, 1940, Oklahoma Geol. Survey Bull. 62, p. 51–56; 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 4, p. 720 (table 1), 725. Included in Skiatook group. Underlies Chanute formation; overlies Nellie Bly formation.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2030. Northward tracing proves that Dewey member of Drum is the same as limestone called Cement City in Kansas City area. Dewey has priority over Cement City and is recognized as a formational unit in Oklahoma. Kansas Geological Survey proposes to use Dewey in place of Cement City for lower member of the Drum. Other State surveys will continue Cement City until question of stratigraphic identity of the type of this unit (near Kansas City) and the Dewey is removed.

E. R. Ries, 1954, Oklahoma Geol. Survey Bull. 71, p. 68–72. Described in Okfuskee County where it consists of a lower limestone or arenaceous limestone member and an overlying shale. Base is about 40 feet above uppermost Nellie Bly sandstone. Type locality stated.

M. C. Oakes, 1959, Oklahoma Geol. Survey Bull. 81, p. 25–28. In a study of gas and oil fields of Indian Territory, the Drum limestone was traversed by G. I. Adams from outcrop west of Coffeyville to Bartlesville. It occurs on divide between the Verdigris and Caney, extending southward to Hogshooter Creek, thence northwestward to Bartlesville (Adams, Girty, and White, 1903, U.S. Geol. Survey Bull. 211). It is evident from text and map that Adams was following Hogshooter limestone from Kansas-Oklahoma line to SE cor. T. 26 N., R. 13 E., where he stepped up to the Dewey and followed it to Bartlesville. Sandstone and limestone conglomerate were erroneously shown on geologic map of Oklahoma (1926) as Dewey limestone from sec. 13, T. 28 N., R. 14 E., northeastward to Kansas-Oklahoma line across an area in which the Dewey was removed by pre-Chanute erosion. Thickness 20 to 50 feet in Creek County. Overlies Nellie Bly formation; underlies Chanute limestone. Skiatook group.

Type locality: In old quarry of Dewey Portland Cement Co., sec. 26, T. 27 N., R. 13 E., near Dewey, Washington County, Okla.

Dewey Bridge Dolomite

Upper Cambrian: East-central New York.

John Rodgers *in* M. P. Billings, John Rodgers, and J. B. Thompson, Jr., 1952, Geol. Soc. America Guidebook for Field Trips in New England, p. 35 (table 2), 53 (road log). Dark-gray crystalline and sandy dolomite; cryptozoon layers in upper part and thin sandstone at top. Thickness 200 feet. Underlies Whitehall formation; overlies Potsdam sandstone. Refers to R. H. Flower (unpub. ms.).

Occurs in Fort Ann quadrangle.

Dewey Lake Redbeds

Dewey Lake Formation

Permian: Subsurface and surface in western Texas and southeastern New Mexico.

L. R. Page, 1938, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 22, no. 12, p. 1709. Incidental mention as Dewey Lake redbeds.

L. R. Page and J. E. Adams, 1940, Am. Asoc. Petroleum Geologists Bull., v. 24, no. 1, p. 62–63. Formation consists of orange-red sandstones and silts. Overlies Rustler formation; underlies Tecovas silts. Occurs between depths of 1,155 feet and 1,407 feet in type well. No complete section found in outcrops hence named from subsurface. Triassic-Permian boundary occurs at top of formation.

P. B. King, 1948, U.S. Geol. Survey Prof. Paper 215, p. 91–92, 101 (fig. 12). Referred to as Dewey Lake red beds. Ochoa series.

G. E. Hendrickson and R. S. Jones, 1952, New Mexico Bur. Mines Mineral Resources Ground-Water Rept. 3, p. 23. In Eddy County, redbeds and sandstones correlated with Dewey Lake redbeds overlie Rustler formation.

Type section: In Penn's Habenstreit No. 1 well, near center sec. 47, Block 36, T. 3 S., Texas and Pacific Railroad Survey, Glasscock County, Tex. Name derived from Dewey Lake.

Dewitt Formation[1]

Miocene and Pliocene: Eastern Texas.

Original reference: A. Deussen, 1914, U.S. Geol. Survey Water-Supply Paper 335, p. 28, 74–76.

Named for Dewitt County.

Dexter Member (of Woodbine Formation)

Dexter Member (of Euless Formation)

Dexter Sand Member (of Woodbine Sand)[1]

Upper Cretaceous: Northeastern Texas.

Original reference: J. A. Taff, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 285–298.

R. T. Hazzard, B. W. Blanpied, and W. C. Spooner, [1947], Shreveport Geol. Soc. 1945 Ref. Rept., v. 2, p. 475, 476, 477. Dexter sand is basal member of newly defined Euless formation.

H. R. Bergquist, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 98. Termed Dexter member of Woodbine formation. In Cooke, Grayson, and Fannin Counties, stratigraphically restricted above to exclude 60 to 70 feet of sandstone and shale herein named Red Branch member. As restricted and redefined, Dexter member consists of 100 to 130 or 140 feet of nonmarine beds of white to ferruginous and siliceous sandstone with silty clay lenses, some carbonaceous clays at base, some scattered leaf and wood prints, and at top a persistent bed of varicolored clay. Overlies Grayson marl.

Named for exposures at Dexter, Cooke County.

Dexterville Shale Member[1] (of Chadakoin Formation)

Upper Devonian: Southwestern New York and northwestern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 63–66, table opp. p. 61.

I. H. Tesmer, 1955, New York State Mus. Sci. Service Circ. 42, p. 10 (fig. 1), 14. Gray sandstones and siltstones that underlie Ellicott member of Chadakoin and overlie Northeast shale member of Canadaway formation. Thickness in Cherry Creek quadrangle about 150 feet. Volusia shale, described by Chadwick (1923), bearing *Pugnoides duplicatus* is here included in the Dexterville. Lillibridge sandstone (Caster, 1934) member of Chadakoin is not a distinct lithologic unit and is abandoned.

Named for brick quarries, south of Chadakoin River in East Jamestown, a district formerly known as Dexterville, Chautaqua County, N.Y.

Deza Formation

Tertiary: Northwestern New Mexico and northeastern Arizona.

H. E. Wright, Jr., 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 8, p. 1830, 1831–1833, figs. 1, 2. Consists largely of sands with some layers of shale and clay and marked by a basal conglomerate. Color mostly white to buff and light green with a few beds of chocolate red clay. Appears to be largely an alluvial deposit. Thickness 250 feet in type area. Overlies Mesaverde group with angular unconformity and underlies Chuska sandstone.

Named for exposures 3 miles north of Tohatchi on south-facing scarp (Deza Bluffs) which lead up to the landslide-covered east foot-slope of Chuska Mountains, N. Mex.

Diablo Formation

Permian: Southwestern Nevada.

H. G. Ferguson, S. W. Muller, and S. H. Cathcart, 1953, Geology of the Coaldale quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ-23]; 1954, U.S. Geol. Survey Geol. Quad. Map. 45. Dolomite with varying amounts of basal conglomerate and locally fanglomerate. Along western border, largely dolomite, but conglomerate and grit form isolated hill southeast of Redlich; in Monte Cristo Range, basal conglomerate overlain by interbedded dolomite, grit, and conglomerate. To west, in Mina quadrangle, dolomite grades into sandstone and grit. Thickness in Monte Cristo Range probably about 500 feet. Elsewhere not over 300 feet; missing in places: unconformable contacts with Palmetto formation below and Candelaria formation above.

H. G. Ferguson and S. H. Cathcart, 1954, U.S. Geol. Survey Geol. Quad. Map GQ-40. Described and mapped in Round Mountain quadrangle where it is more than 3,000 feet thick in Toyabe Range. Underlies Pablo formation (new).

B. M. Page, 1959, Nevada Bur. Mines Bull. 56, p. 18–21, pl. 1. In Candelaria mining district, Mineral County, a thin grit bed, the Diablo formation, unconformably overlies Palmetto formation, angular unconformity ranging from 5° to 90°. Underlies Candelaria formation. Thickness as much as 30 feet.

Type locality: For sandstone, crest and west slope of Mount Diablo, 1 mile west of Candelaria, Mina quadrangle; for dolomite facies, 1 mile north of Columbus, Mina quadrangle.

Diablo Formation

Pliocene, lower: Northern California.

B. L. Clark, 1944, *in* C. E. Weaver and others, Geol. Soc. America Bull., v. 55, no. 5, p. 585, chart 11. Consists of coarse arkosic sandstones; a heavy conglomerate at base composed mostly of andesitic boulders with lenses of conglomerate higher up; also thin layers of shale carrying abundant leaf impressions. Thickness about 1,000 feet. Shown on chart as underlying Green Valley formation and overlying Neroly formation. Replaces name Alamo formation.

D. I. Axelrod, 1944, Carnegie Inst. Washington Pub. 553, p. 213. Derivation of name given.

Name derived from Diablo post office, Mount Diablo region.

†Diabolo Sandstone[1]

Precambrian: Western Texas.

Original reference: W. H. Von Streeruwitz, 1891, Texas Geol. Survey, v. 2, p. 682, 683.

Occurs along foot of southern cliffs of Sierra Diabolo, Sierra Diablo region.

Diamond Formation[1]

Pleistocene, upper, or Recent: Southeastern Oregon.

Original reference. W. D. Smith, 1926, Oregon Univ. Commonwealth Rev., v. 8, p. 207–214.

Typically exposed at Diamond Craters, Harney County.

Diamond Creek Sandstone

Permian: Northeastern Utah.

A. A. Baker and J. S. Williams, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 4, p. 623 (fig. 4), 625. Gray or buff to red, fine- to coarse-grained cross-bedded sandstone, in large part lime-cemented and friable but locally silica-cemented. Thickness 600 to 1,000 feet. Conformably underlies Park City formation; conformably overlies Kirkman limestone (new).

H. J. Bissell, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 4, p. 589. Described in Strawberry Valley quadrangle. Traced as almost continuous outcrop from southern Wasatch Mountains northward where it passes beneath Tertiary sediments in Strawberry Ridge; reappears in North Strawberry Valley as thin outcrop band and extends almost due northeast of and overlying Kirkman limestone from Willow Creek

Canyon to point near mouth of Right Fork of Strawberry River. From known maximum thickness of 1,140 feet in Spanish Fork Canyon near Castilla, thins northward to 165 feet in North Strawberry Valley.

Named for outcrops in sec. 22, T. 8 S., R. 4 E., near head of Little Diamond Creek, Utah County.

Diamond Head Black Ash

Recent: Oahu Island, Hawaii.

C. K. Wentworth, 1937, Jour. Sed. Petrology, v. 7, no. 3, p. 91–103. Black sandy vitric ash, pisolitic. Typical mantle bedding; very small proportion of bedding of clear, wind-produced or dune characteristics.

H. T. Stearns, 1940, Hawaii Div. Hydrog. Bull. 5, p. 53. Five distinct eruptions occurred along Kaimuki-Diamond Head rift, namely Mauumae basalt, Diamond Head ash, Kaimuki basalt, Black Point basalt, and Black Point ash. Eruption must have taken place in Recent time while sea was practically at its present level.

Type locality: On slopes and near base of Diamond Head. Crops out only in small area at southeast foot of Diamond Head tuff cone and on Black Point.

Diamond Head Talus Breccia[1]

Recent: Oahu Island, Hawaii.

Original reference: C. K. Wentworth, 1926, Bernice P. Bishop Mus. Bull. 30, p. 40, 43.

G. A. Macdonald and D. A. Davis, 1956, *in* Jacques Avias and others, Lexique Strat. Internat., v. 6 Océanie, fasc. 2, p. 80. Talus breccia composed of angular fragments of Diamond Head tuff cemented by calcareous cement into a porous fairly compact mass. Thickness commonly 5 to 25 feet, exceptionally up to 50 feet. Rests against and on Diamond Head tuff. No fossils. Some of it is older than Diamond Head black ash, but some of it is still forming.

Named for occurrence on slopes of Diamond Head.

Diamond Head Tuff[1] (in Honolulu Volcanic Series)

Pleistocene, upper: Oahu Island, Hawaii.

Original reference: C. K. Wentworth, 1926, Bernice P. Bishop Mus. Bull. 30, p. 40, 42.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 80–81. Palagonitized subaerial brown tuff containing many accessory and accidental ejecta including many fragments of reef limestone and some of Koolau basalt. Magma is nepheline basalt. Thickness about 900 feet. Rests on reef limestone believed to have been formed during plus 95-foot (Kaena) stand of sea; overlain locally by beach limestone of plus 25-foot (Waimanalo) stand. Overlain by Kaimuki and Black Point basalts.

Type locality: Diamond Head. Covers about 1.3 square miles on south coast of Oahu about 10 miles west of Makapuu Head.

Diamond Hill Felsite[1]

Carboniferous: Northeastern Rhode Island.

Original reference: C. H. Warren and S. Powers, 1914, Geol. Soc. America Bull., v. 25, p. 461.

Diamond Island Slate (in Casco Bay Group)[1]

Pennsylvanian(?): Southwestern Maine.

Original reference: F. J. Katz, 1917, Washington Acad. Sci. Jour. v. 7, p. 198.

Named for exposures on Great Diamond Island and Little Diamond Island in Casco Bay.

Diamond King Member (of Esmeralda Formation)[1]

Miocene, upper, and Pliocene, lower: Central Nevada.

Original reference: H. G. Ferguson, 1924, U.S. Geol. Survey Bull. 723.

Prominent on Diamond King Hill, Manhattan district.

Diamond Peak Formation

Diamond Peak Quartzite[1]

Diamond Peak Series or Beds

Upper Mississippian: Northern Nevada and eastern California.

Original reference: Arnold Hague, 1882, U.S. Geol. Survey 2d Ann. Rept., p. 28; 1883, U.S. Geol. Survey 3d Ann. Rept., p. 253, 268.

C. W. Merriam, 1940, Geol. Soc. America Spec. Paper 25, p. 8 (table 1), 43–46. Diamond Peak series used to apply to post-Devils Gate sedimentary rocks in Roberts Mountains region. Used in preference to extending Hague's White Pine shale and Diamond Peak quartzite into area. Further work in post-Devils Gate deposits may lead to redefinition of Diamond Peak formation and necessitate revised terminology for beds in Devils Gate area.

C. W. Merriam and C. A. Anderson, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1690–1691. Term Diamond Peak beds used to include not only original Diamond Peak quartzite of Diamond Peak (Eureka district) but also underlying black shales and sandy interbeds referred by Hague (1892, U.S. Geol. Survey Mon. 20) to White Pine shale. "Diamond Peak quartzite" included large percentage of conglomerate at Diamond Peak; hence, lithologic term is misleading. 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.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 57, 60–61. Proposed to use term Diamond Peak formation, in Eureka district, for the coarse clastic part of upper Mississippian sequence where it can be satisfactorily separated from underlying black shales and to adopt Spencer's name of Chainman shale for lower unit where it can be mapped separately. Hague characterized Diamond Peak as quartzite, but even at this type locality, unit contains large proportion of shale, conglomerate, and limestone; hence, term formation seems more appropriate. Formation mapped separately only south of Eureka, elsewhere equivalent beds are included in Chainman and Diamond Peak undifferentiated sequence. Thickness as much as 420 feet. Underlies Ely limestone. Discussion of problems of nomenclature and correlation of upper Mississippian sedimentary rocks in area.

Walter Sadlick, 1960, Intermountain Assoc. Petroleum Geologists 11th Ann. Field Conf., p. 84. Discussion of aspects of Chainman stratigraphy. The Chainman is recognized as valid stratigraphic unit. Diamond

Peak and Scotty Wash are referred to as facies within the Chainman. Term Illipah suppressed as synonymous with the Diamond Peak.

Named for exposures on flanks of Diamond Peak, Eureka district, Nevada.

Diamond Rock Quartzite[1]

Diamond Rock Quartzite Member (of Schodack Formation)

Lower Cambrian: Eastern New York.

Original reference: R. Ruedemann, 1914, New York State Mus. Bull. 169, p. 67–70.

Winifred Goldring, 1943, New York State Mus. Bull. 332, p. 64. Schodack formation, in Troy and Cohoes quadrangles, includes as members (ascending) Bomoseen grit, Diamond Rock quartzite, Troy shale and limestone, and Schodack shale and limestone.

D. W. Fisher, 1956, Internat. Geol. Cong., 20th, Mexico, Cambrian Symposium, pt. 2, p. 331. Dale's (1904, U.S. Geol. Survey Bull. 242) division G in Rensselaer County, was named by Ruedemann (1914) from type locality at Diamond Rock overlooking North Troy. Ruedemann states that formation occurs only at this locality, but Dale (1904) reported it farther east and west. In type area, the Diamond Rock is variable: hard quartzite with infrequent quartzite pebbles, lenses of a breccia of quartz pebbles in dark-gray matrix, rare thin beds of dolomite, a reddish- to orange-weathering sandstone with well-rounded frosted quartz grains in calcic or dolomite cement, and a yellow-stained calcareous sandstone with poorly preserved fauna tentatively identified as *Hyolithes*, *Paterina*, *Rustella*, *Microdiscus*, and olenellid fragments. Possibly beds are repeated due to faulting and (or) folding, so true thickness in indeterminable; probably no more than 50 feet. Whether Diamond Rock is correlate of Eddy Hill grit is conjecture.

Named for exposures at the "Diamond Rock," Lansingburgh (North Troy, N.Y.).

Diamond Valley Complex

Paleozoic and (or) Mesozoic: Southern California.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 477–479. Series of strongly metamorphosed sediments, with associated metatuffs, commonly injected lit-par-lit with granitic material. In type area, dips are steep, and strike is northwesterly over ridge; exposed thickness not accurately known, but is some thousands of feet.

Type area: Ridge 4 miles in length east and southeast of Winchester, Riverside County. Named for exposures on north side of Diamond Valley.

Diana Complex

Diana Syenite Complex[1]

Precambrian: Northwestern New York.

Original reference: A. F. Buddington, 1919, New York State Mus. Bull. 207, 208, p. 102–110, map.

A. F. Buddington, 1939, Geol. Soc. America Mem. 7, p. 73–109. Diana quartz syenitic complex consists of eight facies. In this report, they are discussed in detail in order of their occurrence from northwest to southeast, and which, on their interpretation as parts of a stratiform sheet, would be from bottom to top. Pitcairn gneiss (new) and Grenville limestone border main complex on northeast. Pyroxene quartz syenite outcropping in southeast part of Lowville quadrangle, and for an unknown distance to southeast, is mapped as part of the Diana, though it may belong with Santa Clara complex or may be a separate sheet.

Named from Diana Township, Lake Bonaparte quadrangle, within which the central part of the complex lies. Forms northwest border of Adirondack highlands, from Carthage to South Edwards.

Diana Formation

Silurian: Central Nevada.

Marshall Kay, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 12, p. 97 (fig. 3), 98 (fig. 4). Named on cross section and structure section in report on Paleozoic continental margin of central Nevada. Underlies Masket formation (new); overlies Antelope Valley formation.

Toquima Range, Nye County.

Diana Granite (in Cerbat Complex)

Precambrian: Northwestern Arizona.

B. E. Thomas, 1949, Econ. Geology, v. 44, no. 8, p. 666, fig. 2. Coarsely porphyritic granite which occupies core of a distinctive anticline preserved in schists of Cerbat complex (new).

B. E. Thomas, 1953, Geol. Soc. America Bull., v. 64, no. 4, p. 400–401, pl. 1. Rock is medium gray on fresh fracture and weathers light to moderate brown. Many outcrops show weak foliation, and some exposures are highly gneissic or mylonitic. Porphyritic texture with medium-grained groundmass. Body is roughly circular, with diameter of about 1¾ miles.

Named from Diana (Arizona Magma) mine, which is approximately in center of the exposure, in western half of Chloride district, Cerbat Mountains, Mohave County.

Diboll Member[1] (of Jackson Formation)

Eocene: Southeastern Texas.

Original reference: I. R. Sheldon, 1933, Am. Assoc. Petroleum Geologists Bull., v. 17, no. 7, p. 819, 820, 822.

In Driscoll pool, Duval County.

Dick Rhyolite

Precambrian: West-central Arizona.

C. A. Anderson, E. A. Scholz, and J. D. Strobell, Jr., 1955, U.S. Geol. Survey Prof. Paper 278, p. 12, pl. 3. Porphyritic rock containing quartz phenocrysts in microcrystalline groundmass. Forms intrusive masses. Locally is foliated, becoming a quartz-sericite schist. Distinguished from King Peak rhyolite (new) by presence of phenocrysts in Dick rhyolite. Probably younger than King Peak rhyolite. Intrudes Bridle formation and Butte Falls tuff (both new). Pattern of outcrops indicates that it also intrudes King Peak rhyolite.

Large mass is exposed on Dick Peak, for which the rock has been named, in south-central part of Bagdad area, Yavapai County. This mass, more than 2,000 feet wide, has been mapped for distance of 1 mile. and extends southward beyond the mapped area.

Dickerson Formation (in Millsap Lake Group)

Dickerson Member (of Millsap Lake Formation)[1]

Pennsylvanian (Strawn Series): North-central Texas.

Original reference: E. H. Sellards, 1933, Texas Univ. Bull. 3232, p. 106, 107.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Rank raised to formation. Basal formation of group. Underlies Kickapoo Falls member of Lazy Bend formation; overlies unnamed subsurface units.

M. G. Cheney and others, 1945, Am. Assoc. Petroleum Geologists Bull., v. 45 ,no. 2, p. 163. Kickapoo Falls limestone may well be classified as top member of Dickerson formation in harmony with common practice in this region [Texas] of placing an important limestone at top of formation.

Exposed in Brazos River valley.

Dickinson Group

Precambrian: Northern Michigan.

R. W. Bailey, 1956, Dissert, Abs., v. 16, no. 8, p. 1426. Name used in discussion of lower Precambrian rocks of Lake Mary quadrangle, Iron County. Composed chiefly of metavolcanic schist. Underlies core area of Holmes Lake anticline, which is flanked by steeply dipping Middle Precambrian (Huronian) formations. Major unconformity separates Dickinson group from overlying Middle Precambrian rocks.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 27 (table 1), 31. Name applied to a sequence of lower Precambrian rocks—Archean of older reports—consisting of metamorphosed sedimentary and volcanic rocks. Strata unconformably overlie older granite gneiss and have been invaded by granitic rocks of batholithic dimensions. In central Dickinson County, group is divided into three formations: East Branch arkose (oldest), Solberg schist, and Six-Mile Lake amphibolite. Rocks are steeply dipping or vertical and sequence is believed to be conformable. Separated by covered interval from strata of group is newly defined Hardwood gneiss, which may be in part or wholly equivalent in group.

Named for Dickinson County where group occurs in an easterly trending belt about 4 miles wide in central part of T. 42 N., R. 28, 29, and 30 W.

Dicksburg Hills Sandstone

Upper Pennsylvanian: Southwestern Indiana.

C. A. Malott, 1939, (abs.) Indiana Acad. Sci. Proc., v. 48, p. 114. Overlies Hazleton Bridge formation (new).

C. A. Malott, 1947, Indiana Acad. Sci. Proc., v. 57, p. 131, 133 (fig. 2), 134 [1948]. Massive coarse-grained micaceous friable crossbedded sandstone. Thickness at type locality 50 feet. Unconformably overlies Hazelton Bridge formation; underlies Parkers formation. To the south, the sandstone was mapped as a part of Fuller's Inglefield formation (Ditney and Patoka folios of U.S. Geological Survey). Type locality designated.

Type locality: In "The Rock Bluffs," SW¼ sec. 18, T. 1 N., R. 10 W., in northeastern part of the western hill of the Dicksburg Hills, Knox County.

Dicks River facies (of New Providence Formation)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 77, 117–119. Predominantly shale with a middle zone of massive cliff-forming siltstone, Gum Sulphur siltstone member (new), up to 40 or more feet thick. Average thickness of facies about 125 feet. Merges with Junction City facies (new) on west and with Boone Gap facies (new) on east. Underlies Brodhead formation (new) [Irvine facies]; overlies New Albany black shale.

Typical section: Along steep slope at north side of Dicks River valley, immediately west of confluence with East Fork, half a mile north of Brodhead, Rockcastle County. Named for Dicks River in northwestern part of county.

Dierks Limestone (in Trinity Group)

Dierks Limestone Lentil (of Trinity Formation)[1]

Lower Cretaceous (Comanche): 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. Rank raised to formation in Trinity group. Underlies Holly Creek formation; overlies Delight sand (new). Subsurface equivalents discussed.

Named for exposures near Dierks, Howard County.

Difficulty Creek Latite[1]

Miocene or Pliocene: Southwestern Colorado.

Original reference: W. Cross and E. Howe, 1907, U.S. Geol. Survey Geol. Atlas, Folio 153.

Cut by wild canyon of Difficulty Creek, Ouray region.

Dighton Conglomerate[1]

Pennsylvanian or Permian(?): Southeastern Massachusetts and Rhode Island.

Original reference: J. B. Woodworth, 1899, U.S. Geol. Survey Mon. 33, p. 134, 184–187, pl. 17.

N. E. Chute, 1950, Bedrock geology of the Brockton quadrangle, Massachusetts: U.S. Geol. Survey Geol. Quad. Map [GQ–5]. Permian(?).

Named for occurrence in Dighton, Mass.

Dike Lake Slate

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, 1038 (fig. 4). Finely banded and laminated slate containing numerous beds of graywacke and lenses of black cherty slate. Thickness about 1,000 feet. Overlies Saddlebag Lake conglomerate [table and map show Moose Lake conglomerate at this horizon]; unconformable below rocks of Ogishke group.

Occurs in vicinity of Dike Lake, Kekequabic-Ogishkemuncie area.

Dilco Coal Member (of Crevasse Canyon Formation)

Dilco Coal Member (of Mesaverde Formation)[1]

Upper Cretaceous: Northwestern New Mexico.

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

J. E. Allen and Robert Balk, 1954, New Mexico Bur. Mines Mineral Resources Bull. 36, p. 90, 92, pl. 1. Reallocated to member status in Crevasse Canyon formation (new). Underlies Dalton sandstone member. Overlies Gallup sandstone. In area of this report [Fort Defiance-Tohatchi quadrangle], consists of 240 feet of silty shale, laminated siltstone, thin coal, and thin- to medium-bedded fine-grained sandstone, the latter being more abundant toward top. Thins toward south to about 81 feet.

Named for Dilco, McKinley County.

Dillard Limestone Member (of Chimneyhill Limestone)

Lower Silurian: South-central Oklahoma.

R. A. Maxwell, 1936, Northwestern Univ. Summ. of Doctoral Dissert., v. 4, p. 132, 133. Defined as uppermost unit of Chimneyhill. Consists of two lithologic units, a basal shale, 1 to 2 feet thick, and an upper limestone unit 15 to 18 feet thick. Overlies Cochrane limestone member (new); underlies Henryhouse formation.

T. W. Amsden, 1957, Oklahoma Geol. Survey Circ. 44, p. 19. Replaced by Clarita member; name Dillard preoccupied. States Maxwell's type locality for Dillard.

Type locality: E½W½SW¼ sec. 8, T. 1 S., R. 8 E. [Coal County.].

†Dillard Series[1] or Formation

Jurassic: Southwestern Oregon.

Original reference: G. D. Louderback, 1905, Jour. Geology, v. 13, p. 522–555.

N. L. Taliaferro, 1941, Geol. Soc. America Bull., v. 52, no. 12, p. 1957. Dillard, as originally defined, includes Knoxville (Upper Jurassic) sediments and possibly infolded Lower Cretaceous, but most of unit is to be correlated with Franciscan.

N. L. Taliaferro, 1942, Geol. Soc. America Bull., v. 53, no. 1, p. 71–112. Generally accepted correlations of Jurassic of southwestern Oregon and California are: Galice and Mariposa, Dothan and Franciscan, Myrtle and Shasta. Dothan is stated to be younger than Galice. Has been stated that the Dillard, the lower part of the original Myrtle, is the equivalent of the Franciscan. Since the Dillard unconformably overlies the Dothan and Galice, it is clear that one or other of these correlations must be erroneous. Evidence is presented in present report to show that the Dothan is older than the Galice and cannot be same age as the Franciscan. Dillard, as originally defined, includes Knoxville (Upper Jurassic) sediments and possibly infolded Lower Cretaceous, but bulk of Dillard is to be correlated with Franciscan. It would be unsafe to state that the beds in vicinity of Dillard, Oreg., were Lower Cretaceous on basis of *Aucella "crassicollis."* Lower Cretaceous beds may be present in area covered by Louderback's (1905) Dillard group, but unquestionably the great bulk of Dillard series and that part of Diller's (1907, Am. Jour. Sci., 4th, v. 23) Myrtle in this locality are lithologically identical with Franciscan of Coast Ranges of

California. Discovery of fossils, nearly all species of *Aucella* formerly regarded as indicative of Lower Cretaceous, is not sufficient justification for including beds in vicinity of Dillard, Oreg., (Louderback's Dillard series) in the Myrtle and regarding them as Lower Cretaceous. The Myrtle as mapped and defined, includes beds of both Upper Jurassic and Lower Cretaceous and at least one important unconformity; the Myrtle either should be redefined and restricted or the name abandoned.

R. W. Imlay, 1952, Geol. Soc. America Bull., v. 63, no. 9, chart 8C (column 97). Shown on correlation chart as Upper Jurassic.

Named for village of Dillard in Roseburg quadrangle.

Dillon Granite Gneiss

Precambrian (pre-Beltian): Southwestern Montana.

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, the Dillion granite gneiss, widespread in Beaverhead and Madison Counties.

Robert Scholten, K. A. Keenmon, and W. O. Kupsch, 1955, Geol. Soc. America Bull., v. 66, no. 4, p. 351–352, pl. 1. Introduced by Heinrich (1953) to replace term Blacktail previously used for same unit (Heinrich, 1950) because latter term is preoccupied. A plutonic complex of granite gneisses, pegmatites, aplites, quartz masses, and hybrid gneisses. Most common rock type is a reddish-brown feldspar-quartz gneiss in which bands of pink feldspar and quartz alternate with dark bands of mafic minerals. Complex is most widespread of the pre-Beltian metamorphic rocks. Intrudes rocks of both Pony and Cherry Creek groups.

Crops out over large areas of Blacktail and Tendoy Ranges and of the mountain north of Armstead, Beaverhead, and Madison Counties.

Dilworth Sandstone Member (of McElroy Formation)

Dilworth Sand[1]

Eocene, upper: Southeastern Texas.

Original reference: A. C. Ellisor, 1933, Am. Assoc. Petroleum Geologists Bull., v. 17, no. 11, p. 1302, 1311.

W. L. Russell, 1955, Gulf Coast Assoc. Geol. Soc. Trans., v. 5, p. 166–171. In Grimes and Manning Counties, unit termed Dilworth by Renick (1936, Texas Univ. Bull. 3619) on assumption that it was equivalent to Dilworth of Gonzales County, is here named Tuttle sandstone member of Manning formation.

D. H. Eargle, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 11, p. 2626 (table 1), 2630–2631. Termed sandstone and reallocated to member status in McElroy formation (redefined). Overlies Manning clay member; underlies Conquista clay member (new).

Named for exposures about 1 mile east of Dilworth, Gonzales County.

Dime Box Member (of Yegua Formation)

Eocene (Claiborne): Southern Texas.

H. D. McCallum, 1947, South Texas [Geol. Soc. Guidebook] 14th Ann. Mtg. Field Trip, p. 4. Consists of red sand. Basal member of formation; underlies Cistern member (new).

Named after Dime Box, a small settlement in Lee County.

Dimple Limestone

Pennsylvanian: Southwestern Texas.

Original reference: J. A. Udden, C. L. Baker, and E. Böse, 1916, Texas Univ. Bur. Econ. Geology and Tech. Bull. 44, p. 46.

R. C. Moore and M. L. Thompson, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 3, p. 289 (fig. 1). Included in Morrowan stage of Ardian series (new).

T. S. Jones, 1953, Stratigraphy of the Permian basin of West Texas: West Texas Geol. Soc., p. 23. Here included in Bend (Atoka) series.

Named for exposures in and near Dimple Hills, Pecos County.

Dingess Limestone (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. 165.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 12). Shown on correlation chart in Kanawha group.

Named for Dingess, Mingo County.

Dingess Sandstone (in Kanawha Formation)[1]

Pennsylvanian: Southern West Virginia.

Original reference: R. V. Hennen and D. D. Teets, Jr., 1919, West Virginia Geol. Survey Rept. Fayette County, p. 926–928.

At Dingess, Mingo County.

Dingess Shale (in Kanawha Formation)[1]

Pennsylvanian: Southern West Virginia and Kentucky.

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

Occurs in Kanawha, Fayette, Nicholas, Boone, Logan, and Mingo Counties, W. Va., and in Kentucky.

Dingus Limestone (in Pottsville Formation)[1]

Pennsylvanian: Northeastern Kentucky.

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

Probably named for Dingus, Morgan County.

Dinosaur Canyon Sandstone Member (of Moenave Formation)

Dinosaur Canyon Sandstone

Upper Triassic(?): Northeastern Arizona and southern Utah.

E. H. Colbert and C. C. Mook, 1951, Am. Mus. Nat. History Bull., v. 97, art. 3, p. 151–153. Proposed for the orange-red sandstone, about 200 feet thick, that overlies the Chinle and underlies about 140 feet of the so-called Wingate below the Kayenta. Contains *Protosuchus*.

Paul Averitt and others, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 12, p. 2517, 2519. Rank reduced to member status in Moenave formation. Basal member of formation; underlies Springdale sandstone member. Geographically extended into southern Utah.

J. W. Harshbarger, C. A. Repenning, and J. H. Irwin, 1957, U.S. Geol. Survey Prof. Paper 291, p. 3 (fig. 2), 13–16, 63. At type locality, consists of sequence of lenticular units predominantly of fluvial origin but which also include large amount of eolian sandstone. Thickness at type locality 202 feet; 307 feet at Moenave; 321 feet at Kachina Point; thins northeast from type locality to 110 feet at Navajo Creek, 28 feet at Piute Canyon, and 47 feet at Steamboat Canyon. At type locality, unconformably overlies Chinle formation; in Navajo Creek area, Arizona, overlies Lukachukai member of Wingate sandstone.

Type locality: Dinosaur Canyon, which joins valley of Little Colorado to east of Cameron, Ariz. Completely exposed in cliffs of Kachina Point, 40 miles northwest of Winslow, Navajo County, Ariz.

†Dinsmore Limestone Bed (in Monongahela Formation)[1]

Pennsylvanian: Southwestern Pennsylvania and southeastern Ohio.

Original reference: W. T. Griswold and M. J. Munn, 1907, U.S. Geol. Survey Bull. 318, p. 69–70.

Named for town of Dinsmore, Washington County, Pa.

Dinwoody Formation[1]

Dinwoody Formation (in Chugwater Group)

Lower Triassic: Western Wyoming, southeastern Idaho, southwestern Montana, and northeastern Utah.

Original reference: D. D. Condit, 1916, U.S. Geol. Survey Prof. Paper 98, p. 263.

E. B. Branson and C. C. Branson, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 134. Lowermost formation in Chugwater group. Underlies Red Peak formation.

N. D. Newell and Bernhard Kummel, 1942, Geol. Soc. America Bull., v. 53, no. 6, p. 940–945, pl. 1, strat. sections. As originally defined [authors refer to Blackwelder, 1918, Washington Acad. Sci. Jour., v. 8], formation comprised 200 feet of gray and olive-gray shaly siltstones and shales, with thin brown limestones near base. Limits of formation were defined by Phosphoria limestone below and bright red shales and siltstones of Chugwater formation above. Present study reveals that change from gray to red beds does not follow stratigraphic plane but varies in position from place to place, even within a few hundred yards in Dinwoody Canyon. Since color boundary between Dinwoody and Chugwater is not useful or natural boundary, it is proposed to restrict Dinwoody at type locality to include only dominantly silty strata between Phosphoria and top of resistant siltstones about half way toward summit of original Dinwoody. Restricted Dinwoody is 90 feet thick at type locality. Thickness: less than 40 feet southwest of Lander to 120 feet at northwest end of Wind River Mountains; 650 to 700 feet in deeper parts of geosyncline near Afton and Cokeville, Wyo., and Montpelier, Idaho. Three major divisions recognized: basal siltstone; *Lingula* zone, characterized by thin dense limestone and dark-olive shales; and *Claria* zone, characterized by calcareous olive-buff siltstones, with some interbedded hard gray limestones. Successively higher divisions of Dinwoody are progressively more extensive toward north and east across southwestern Wyoming. If upper part of *Claria* zone corresponds to Thomas' (1934) Little Medicine tongue, equivalents of *Claria* zone can be recognized as far to east as southeastern Wyoming. Dinwoody is probably time equivalent of lower part of red-beds section in type area of the Woodside. In much of western Wyoming, Dinwoody is overlain by several hundred feet of red shaly siltstones and sandstone, variously called lower Chugwater, Red Peak, and red Woodside; these red beds belong to same facies as type Woodside but apparently correspond stratigraphically only to about upper half of typical Woodside as defined in Park City area. These red beds between the Dinwoody and Thaynes are regarded as northeastern tongue of 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.

H. A. Tourtelot, 1953, U.S. Geol. Survey Oil and Gas Inv. Map OM-124. In Badwater area, is 10 to 80 feet thick; overlies Phosphoria formation; underlies Chugwater formation. Little Medicine tongue extends eastward into Big Horn Mountains.

Bernhard Kummel, 1954, U.S. Geol. Survey Prof. Paper 254-H, p. 166 (fig. 18), 167–170. Discussion of Triassic stratigraphy of southeastern Idaho and adjacent areas. In southeastern Idaho, Dinwoody is 700 to 2,400 feet thick and includes beds both older and younger than those at type locality. In southeastern Idaho, southwestern Montana, and western Wyoming, Dinwoody is bounded below by Phosphoria and above by Woodside or Thaynes. Relationship of Dinwoody and Woodside to Phosphoria not completely understood. Areas discussed in detail.

V. E. McKelvey and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 12, p. 2836–2837 (fig. 4). Chart shows Dinwoody overlies Ervay member of Park City formation, and Retort phosphatic shale and Tosi members (both new) of Phosphoria formation. Column 15 shows Dinwoody in Crawford Mountains, Utah.

Named for Dinwoody Canyon in Wind River Mountains near Dubois, Wyo.

Dip Creek Formation

Paleocene: West-central California.

N. L. Taliaferro, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 4, p. 450, 512–517. Name proposed for Paleocene beds in central and south Santa Lucia Range. Consists of coarse cobble and boulder conglomerates and coarse to fine-grained arkose sandstones, commonly filled with carbonized plant remains. Thickness about 1,320 feet. Unconformably underlies pre-Vaqueros landlaid redbeds and marine Vaqueros sandstones; overlies Asuncion formation [group].

Type locality: In west part of sec. 30, T. 25 S., R. 10 E., Adelaida quadrangle, Santa Lucia Range.

Dipping Vat Formation

Eocene: Central Utah.

D. P. McGookey, 1959, Dissert, Abs., v. 19, no. 12, p. 3278; 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 5, p. 591, 592–593 (fig. 2), 594, 607, 608–610. Proposed for light-gray to white coarse tuffaceous sandstone that rests conformably on, and is possibly gradational with, beds of Bald Knoll formation and is overlain disconformably by Bullion Canyon volcanics. Thickness about 208 feet.

Type section: Upper 208 feet of section measured along line starting in cutbank on west side of Lost Creek in sec. 1, T. 23 S., R. 1 W., and ending in NE¼ sec. 11, T. 23 S., R. 1 W., Sevier County. Named from exposures in canyon of Dipping Vat Creek just above confluence with Little Lost Creek in sec. 30, T. 23 S., R. 1 E.

Dirty Creek Sandstone Member (of Atoka Formation)[1]

Middle Pennsylvanian: Eastern Oklahoma.

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

C. W. Wilson, Jr., and N. D. Newell, 1937, Oklahoma Geol. Survey Bull. 57, p. 29–30. Thickness 5 to 20 feet in type area. Separated by unnamed shale intervals from overlying Webbers Falls sandstone member and underlying Georges Fork sandstone member.

Named for exposures west of Dirty Creek in secs. 11 and 14, T. 12 N., R. 19 E., Muskogee County.

Disappointment Mountain Greenstone Conglomerate

Precambrian (Knife Lake Series): Northeastern Minnesota.

J. W. Gruner, 1941, Geol. Soc. America Bull., v. 52, no. 10, p. 1583 (table 1), 1592. Name applied to a conglomerate consisting mostly of fragments of greenstone with a few fragments of jasper. Average thickness at Disappointment Mountain about 1,200 feet; south of Moose Lake, only a few feet to 300 feet thick and grades into graywacke and slate. Overlies or surrounds Ely greenstone. In this report, the Knife Lake series is divided into 20 members. Table of approximate chronological sequence (ascending) shows Disappointment Mountain and Moose Lake greenstone as unit 3 occurring above unnamed flinty slates and below Jasper Lake greenstone conglomerate or agglomerate.

Report covers a belt in eastern part of Vermilion district more or less parallel to international boundary.

Dismal Conglomerate Lentil (in Dismal Formation)[1]

Pennsylvanian: Southwestern Virginia and southern West Virginia.

Original reference: M. R. Campbell, 1897, U.S. Geol. Survey Geol. Atlas, Folio 44.

Named for exposures on Dismal Creek, Buchanan County, Va.

Dismal Formation[1]

Pennsylvanian: Southwestern Virginia and southern West Virginia.

Original reference: M. R. Campbell, 1897, U.S. Geol. Survey Geol. Atlas, Folio, 44.

Named for exposures on Dismal Creek, Buchanan County, Va.

†Dismal Swamp Formation[1]

Pleistocene: North Carolina and Virginia.

Original reference: C. K. Wentworth, 1930, Virginia Geol. Survey Bull. 32, p. 691.

Dismal Swamp area.

Ditney Formation[1]

Upper Pennsylvanian: Southwestern Indiana.

Original reference: M. L. Fuller and G. H. Ashley, 1902, U.S. Geol. Survey Geol. Atlas, Folio 84.

C. A. Malott, 1948, Indiana Acad. Sci. Proc., v. 57, p. 126 (fig. 1), 128–129, Ditney formation (restored) underlies Merom sandstone and overlies West Franklin limestone.

Caps Big Ditney and Little Ditney Hills, Warren County.

Divide Andesite[1]

Miocene, upper(?): Southwestern Nevada.

Original reference: A. Knopf, 1921, U.S. Geol. Survey Bull. 715, p. 151, 155.

Occurs southeast of Tonopah Divide mine. Forms main bulk of largest and highest mountainous area in district and is well exposed at highest point on Tonopah-Goldfield Road, Divide district.

Divide cyclothem

Pennsylvanian: Southern Illinois.

J. R. Ball, 1943, Illinois Acad. Sci. Trans., v. 36, no. 2, p. 147, 150. Named in list of cyclothems in the late Pennsylvanian (McLeansboro) rocks in Carlinville quadrangle. Approximate thickness 9 feet. Occurs above Livingston cyclothem. Text (p. 150) refers to the Divide(?) cyclothem and states that this is probably a channel sandstone because it includes only sandstone and shale.

C. L. Cooper, 1946, Illinois Geol. Survey Bull. 70, p. 13. Studies by E. S. Ekblaw in south-central Illinois led to tentative recognition of six cyclothems, of which the Divide is second in sequence (ascending). Occurs above the LaSalle and below the Effingham (new). If the Greenup and Omega limestones are not equivalent, a single standard reference section would include 14 cyclothems; the Divide would be seventh in sequence (ascending) and would occur below the Effingham and above the Cohn.

Present in Carlinville quadrangle, northeast corner of which is about one-half mile east of Virden and 20 miles south of Springfield.

Divide Peak Andesite[1]

Cenozoic: Northern California.

Original reference: Howel Williams, 1932, California Univ. Pub., Bull. Dept. Geol. Sci., v. 21, no. 5, p. 71 (map).

O. P. Jenkins, 1943, California Div. Mines Bull. 118, p. 676. Cenozoic.

Occurs in Mount Lassen region.

Divine Limestone[1]

Upper Ordovician: Northeastern Illinois.

Original reference: J. E. Lamar and H. B. Willman, 1931, Illinois Geol. Survey Rept. Inv. 23, passim.

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 the Maquoketa formation, but it appears that none of these, except possibly the Divine limestone, are consistent stratigraphic units.

Named for exposures in vicinity of Divine Station, on Elgin, Joliet & Eastern Railroad, Grundy County.

Dixie shale[1]

Lower Cretaceous: Southeastern Arizona.

Original reference: C. R. Keyes, 1935, Pan-Am. Geologist, v. 64, no. 2, p. 129, 138, 139.

Named for Dixie Canyon, near Bisbee, Cochise County.

Dixie Valley 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]. Conglomerate grading locally to fanglomerate, sandstone and shaly limestones and dolomites. Forms massive steplike ledges, prevailingly yellowish to brownish red or maroon. Maximum thickness about 600 feet; 280 to 300 feet at south end of Tobin Range. Underlies Favret formation (new), contact gradational; overlies Tobin formation (new).

Type locality: Northwest part of Augusta Mountain, north end of Dixie Valley.

†Dixon chalk or limestone[1]

Upper Cretaceous: Nebraska and western Iowa.

Original reference: C. R. Keyes, 1925, Pan-Am. Geologist, v. 44, p. 147–149.

Dixon Earthy Limestone Member (of Wayne Formation)[1]

Dixon Formation (in Wayne Group)

Middle Silurian: West-central Tennessee.

Original reference: A. F. Foerste, 1903, Jour. Geology, v. 11, p. 566, 578–582, 681, 694.

H. D. Miser, 1921, Tennessee Div. Geology Bull. 26, p. 20. Referred to as Dixon earthy limestone member of Wayne formation.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 244, 253–256, figs. 2, 76, 80. Dixon formation included in Wayne group. Consists of an alternation of several lithologic types, all of which are argillaceous; these include beds of calcareous shale as much as 5 feet thick, massive calcareous mudstone averaging about 5 feet in thickness but being locally as much as 10 or 15 feet thick, earthy limestone, and uniformly bedded, argillaceous limestone containing disseminated silt; this latter type is ordinarily concentrated near base of formation and represents the gradation between the Lego and Dixon. Western part of formation (fig. 76) is usually brick red; the eastern part is usually gray, commonly greenish gray; color change is commonly quite rapid and may locally occur with distance of 1 mile. Thickness varies owing to gradation into underlying Lego; average thickness about 38 feet where overlain by Beech River formation. Locally overlain unconformably by Pegram formation or Chattanooga shale.

T. W. Amsden, 1949, Yale Univ. Peabody Mus. Nat. History Bull. 5, p. 10. Discussed as Dixon formation underlying Brownsport formation.

Named for Dixon Spring, Decatur County.

†Dixon 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. 81. Highest Pennsylvanian formation in western Kentucky. Includes beds younger than Lisman formation. Consists of (descending) Mount Gilead sandstone, Mount Gilead shale, Vanderburg sandstone, Bald Hill shale, and Dixon sandstone.

Named for exposures east of Dixon, Webster County.

Dixon Granite

Precambrian (Proterozoic): Central northern New Mexico.

Evan Just, 1937, New Mexico School Mines Bull. 13, p. 13 (table 1), 24–25, 45, pl. 2. Typically is fairly coarse grained but varies a good deal in both texture and composition from place to place. In gorge of Rio Pueblo, it is mainly even-grained pink and gray biotite granite. Intrudes all older Proterozoic rocks in area. Intruded during Pueblo revolution.

Arthur Montgomery, 1953, New Mexico Bur. Mines Mineral Resources Bull. 30, p. 37. Preoccupied name Dixon replaced by term Embudo granite.

Conspicuous in hills to west and south of Harding mine and exposed along Rio Pueblo from Dixon almost to Picuris. Also occurs in belt extending from foot of mountain slope northeast of Picuris nearly to Talpa and other smaller outcrops in Picuris area, Rio Arriba County.

Dixon Sandstone

Ordovician: Oklahoma.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 100. Abandoned by Oklahoma Geological Survey. Eldridge (1901, U.S. Geol. Survey 22d Ann. Rept., pt. 1, p. 227) states that he named unit for the Indian upon whose allotment the rock occurs. Sandstone is probably in Oil Creek formation. If restored, name would invalidate well known Dixon limestone, Silurian, of Tennessee, named in 1903. Name has also been used for a Kentucky Pennsylvanian sandstone, a schist in New York, and an Upper Cretaceous chalk in Nebraska.

†Dixon Sandstone (in Henshaw Formation)[1]

Dixon Sandstone Member (of Dixon Formation)

Pennsylvanian: Western Kentucky.

L. C. Glenn, 1912, Kentucky Geol. Survey Rept. Prog. 1910 and 1911, p. 26. Fine-grained sandstone of variable character, 10 to 25 feet thick; locally 50 to 60 feet; forms basal member of Dixon formation.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 81. Basal member of Dixon formation.

Named for exposures near Dixon, Webster County.

Dixon Schist[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 Hague gneiss and below Faxon limestone.

Type locality: Dixon mine, Hague Township, Warren County.

Dixon Mountain Member (of Wilhite Formation)

Precambrian (Ocoee Series): Southeastern Tennessee.

P. B. King and others, 1958, Geol. Soc. America Bull., v. 69, no. 8, p. 955 (table 1), 962. Dominantly siltstone, mostly micaceous and sandy, containing much carbonate that is mainly concentrated along certain laminae; some interbedded sandstone. About 1,500 feet thick. Underlies Yellow Breeches member (new).

Named for Dixon Mountain west of Jones Cove, Sevier County.

†Dixons Group[1]

Upper Cretaceous: Eastern Nebraska and western Iowa.

Original reference: I. N. Nicollet, 1843, Rept. intended to illustrate map of hydrographical basin of Upper Mississippi River: 26th Cong., 2d sess., S. Ex. Doc. 237, p. 35, 37.

Named for the fact that divisions A, B, and C compose Dixon's bluff, in Dixon County, Nebr., about 12 miles above Sioux City, Iowa.

Dobbs Valley Sandstone (in Millsap Lake Formation)[1]

Pennsylvanian: Central northern Texas.

Original reference: F. B. Plummer and J. Hornberger, Jr., 1936, Texas Univ. Bull. 3534, p. 163.

Crops out north of Dobbs Valley, Brazos River region.

Dock Street Clay Member (of Four Mile Dam Formation)

Dock Street Clay[1]

Middle Devonian: Northeastern Michigan.

Original reference: A. W. Grabow, 1902, Rept. Michigan State Board of Geol. Survey for 1901, p. 178, 192.

A. S. Warthin and G. A. Cooper, 1942, *in* G. A. Cooper and others, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1744. Above Alpena (restricted) are 8 feet of blue clay shale, the Dock Street clay of Grabau, a lens confined to east side of Alpena, and classified with the Alpena limestone.

A. S. Warthin, Jr., and G. A. Cooper, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 5, p. 588. Considered member of Four Mile Dam. At type section of Four Mile Dam, consists of bluish-gray calcareous mudstone about 7½ feet thick; near base of formation. Contains well-preserved echinoderms.

First described from test well on Dock Street, Alpena. Well exposed at type section of Four Mile Dam, Thunder Bay quarries, SE¼ sec. 14, T. 31 N., R. 8 E., Alpena County.

Dockum Group[1] or Formation

Upper Triassic: Western Texas, Colorado, Kansas, Oklahoma, and New Mexico.

Original reference: W. F. Cummings, 1890, Texas Geol. Survey 1st Ann. Rept., p. 189.

J. W. Stovall and D. E. Savage, 1939, Jour. Geology, v. 47, no. 7, p. 759–766. Skull of phytosaur *Machaeroprosopus* discovered in Sloan Canyon formation, confirms Triassic age of rocks lying beneath Exeter (Jurassic) in valley of dry Cimarron River in Union County, N. Mex., and Cimarron County, Okla. Underlying red beds, the Sloan Canyon formation, and Sheep Pen Canyon formation form continuous and conformable succession of strata. These three units should be included in Dockum group.

R. E. King and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, p. 556. Upper Triassic red shales and sandstones of terrestrial origin overlie

Permian throughout much of South Permian basin. They are placed in Dockum group and divided into (ascending) Tecovas shale, Santa Rosa sandstone, and Chinle shale.

G. E. Hendrickson and R. S. Jones, 1952, New Mexico Bur. Mines Mineral Resources Ground-Water Rept. 3, p. 23–24. Group, in Eddy County, overlies Rustler formation. Consists of redbeds and sandstones. Lower part of these beds has been considered Permian and correlated with Dewey Lake redbeds by some geologists. Total thickness of group east of Artesia is about 1,000 feet. Formations exposed are Pierce Canyon redbeds, Santa Rose sandstone, and redbeds that possibly represent the Chinle formation. Triassic.

C. E. Stearns, 1953, Geol. Soc. America Bull., v. 64, no. 4, p. 463 (fig. 2), 467. Glorieta sandstone, in Galisteo-Tonque area, New Mexico, is overlain by about 800 feet of red and variegated sandstone and shale. These beds are generally correlated with Dockum group of eastern New Mexico.

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

Brewster Baldwin and W. R. Muehlberger, 1959, New Mexico Bur. Mines Mineral Resources Bull. 63, p. 34–42, pl. 1d. Group, as used in this report, includes all beds of Triassic age exposed in Union County. With only one or two exceptions, exposures of the Dockum are restricted to drainage area of Dry Cimarron, where group is divided into four formations (ascending): Baldy Hill (new), Travesser (new), Sloan Canyon, and Sheep Pen. Unconformably underlies Exeter sandstone. Thickness about 900 feet.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. Dockum group shown on chart with statement that some part of Triassic section is believed to crop out in small area in Morton County.

Named for Dockum, Dickens County, Tex.

Dodds Creek Sandstone Member (of Coffeyville Shale)

Dodds Creek Sandstone[1] Member (of Galesburg Shale)

Pennsylvanian (Missouri Series): Eastern Kansas.

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

R. C. Moore and others, 1937, Kansas Geol. Soc. 11th Ann. Field Conf. Guidebook, p. 40 (table), 42. Included in Coffeyville shale (restricted) in northeastern Oklahoma.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 83, 87. Massive to thin-bedded sandstone, seemingly of deltaic origin; thickness as much as 40 feet.

Occurs in Galesburg shale in southern Kansas.

Named for Dodds Creek, Labette County, Kans.

Dodge gypsum[1]

Upper Cretaceous or Miocene(?): Iowa.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 219, pls. 25, 26, fig. 3.

Fort Dodge, Webster County.

Dodge shale[1]

Upper Cretaceous or Miocene(?): Western Iowa.

Original reference: C. R. Keyes, 1912, Iowa Acad. Sci. Proc., v. 19, p. 148, 154.

Probably named for Fort Dodge, Webster County.

Dodson Member (of Cook Mountain Formation)

Eocene (Claiborne): Central Louisiana.

J. Huner, Jr., 1939, Louisiana Dept. Conserv. Geol. Bull. 15, p. 87–91, 92, pl. 3. Term proposed for the basal fossiliferous glauconitic, clayey sands which underlie the Milams member and overlie the Sparta sands. As defined, the Dodson includes the lower 17 feet of the Milams member as defined by Ellisor (1929). Thickness 4 to 25 feet.

Name derived from town of Dodson in sec. 27, T. 13 N., R. 3 W., north-central Winn Parish. This is nearest geographical name to any of the typical localities described.

Doe Creek Sandstone Member (of Marlow Formation)

Permian: Northwestern Oklahoma.

O. F. Evans, 1954, Oklahoma Acad. Sci. Proc., v. 33, p. 196–197. Name applied to a sandstone, 6 to 36 feet thick, exposed in a line of disconnected hills that extend southwest from about 15 miles west of Alva, to near Woodward, a distance of about 40 miles. Sandstone is hard, highly cemented, fossiliferous. Considered younger than Verden sandstone although some workers have suggested that it is an extension of the Verden; both units are included in the Whitehorse [group].

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped as sandstone member of Marlow formation.

C. C. Branson, 1955, Hopper, v. 15, no. 12, p. 137. Doe Creek lies within the Marlow formation at a higher level than the Verden sandstone. The original Whitehorse sandstone of the Whitehorse Springs locality is the Doe Creek; name Whitehorse has been applied to the group consisting of the Marlow formation and Rush Springs sandstone. Derivation of name given.

Named for Doe Creek in T. 25 N., R. 18 W., Woodward County. Type section not designated; perhaps in Doe Creek mounds, which are buttes along valley of Doe Creek. Occurs in Cleveland Hills, Whitehorse mounds, Wildcat mounds, Woods County; Doe Creek mounds and vicinity of Woodward, Woodward County.

Doe Run Dolomite (in Elvins Group)[1]

Doe Run Member (of Elvins Formation)

Upper Cambrian: Eastern Missouri.

Original references: E. R. Buckley, 1907, Missouri Bur. Geology and Mines, v. 10, 2d ser., separate; H. A. Buehler, 1907, Missouri Bur. Mines, v. 6, 2d ser., p. 231.

Josiah Bridge, 1937, U.S. Geol. Survey Prof. Paper 186–L, p. 234 (table 1). Uppermost formation in Elvins group. Overlies Derby dolomite; underlies Potosi dolomite. Upper Cambrian.

E. B. Branson, 1944, Missouri Univ. Studies, v. 19, no. 3, p. 27–30. Missouri Geological Survey uses compound term Derby-Doe Run. Because

Doe Run was used as formation name by Frazer (1883) [for unit in Pennsylvania], is seems good usage to discontinue it as compound term with Derby. Term Derby formation is used in this report. Term Elvins not recognized as valid in this report.

V. E. Kurtz, 1960, Dissert. Abs., v. 21, no. 3, p. 595. Doerun referred to as member of Elvins formation.

Named for Doe Run Lead Co., which owns land in St. Francois County, upon which type section occurs.

Doe Run Limestone[1]

Precambrian: Southeastern Pennsylvania.

Original reference: P. Frazer, 1883, Pennsylvania 2d Geol. Survey Rept. C_4, p. 70, 304, 307.

Extends more than 1 mile in southwest direction parallel to valley of Doe Run, from near Doe Run village to vicinity of Passmore's mill, Chester County.

Dog Bend Limestone (in Mineral Wells Formation)[1]

Dog Bend Limestone Bed (in Salesville Formation)

Dog Bend Limestone Member (of Salesville Formation)

Pennsylvanian (Canyon): 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). Salesville is raised to formation rank and expanded below to base of Lake Pinto sandstone. Chart shows Dog Bend limestone member above Lake Pinto member; underlies unnamed sandstones and limestone below Turkey Creek sandstone member of Keechi Creek formation.

Leo Hendricks, 1957, Texas Univ. Bur. Econ. Geology Pub. 5724, p. 24, pl. 1. Referred to as limestone bed in Salesville formation. As used in this report [Parker County], it is lower part of unnamed shale member that overlies Lake Pinto sandstone member. Bed is continuous with bed mapped and named Dog Bend in Palo Pinto County.

Probably named from exposures in the Dog Bend of Brazos River 5 miles west of Mineral Wells, Palo Pinto County.

†Dog Canyon Limestone[1]

Permian: Southeastern New Mexico.

Original reference: W. B. Lang, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 7.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 588 (footnote). Abandoned in favor of Goat Seep limestone (new).

Exposed on western flank of Guadalupe Mountains, in Dog Canyon.

Dog Creek Shale (in Nippewalla, El Reno, or Pease River Group)

Dog Creek Shale (in Cimarron Group)[1]

Dog Creek Shale (in Double Mountain Group)

Permian: Central southern Kansas, western Oklahoma, and western Texas.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 3, 39.

D. A. Green, 1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 11, p. 1469. In central and west-central Oklahoma, in areas where Blaine formation can be identified, Dog Creek shale lies between it and Marlow formation. Thickness about 150 feet at Mountain View; more than 200 feet in Canadian County where it contains several continuous thin dolomites in basal 50 feet.

N. H. Darton, L. W. Stephenson, and Julia Gardner, 1937, Geologic map of Texas (1:500,000): U.S. Geol. Survey. Mapped in Double Mountain group in northwestern Texas. Includes Childress dolomite member at top.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 98. Top formation of El Reno group on east side of Permian basin. Overlies Blaine gypsum; underlies Whitehorse group. El Reno appears to be better term than recently suggested San Andres group. Leonard series.

R. L. Clifton, 1942, Jour. Paleontology, v. 16, no. 6, p. 685–699. Includes (ascending) unnamed shales, Guthrie member, unnamed shales, Aspermont member, unnamed shales and gypsums, and Childress member. Overlies Blaine; underlies Whitehorse. Faunas discussed.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, pl. 2. Included in El Reno group. Double Mountain group abandoned.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, p. 158, 161 (fig. 4). Uppermost formation in Nippewalla group. Consists of maroon shale, sandstone, thin layers of dolomite, dolomitic sandstone, and gypsum. Thickness 14 to 53 feet; average 35 feet. Overlies Blaine formation. Underlies Whitehorse sandstone. In Kiowa County overlapped by Cretaceous sandstone (Cheyenne).

Robert Roth, 1945, Geol. Soc. America Bull., v. 56, no. 10, p. 893–907. Pease River group includes San Angelo, Flowerpot, Blaine, and Dog Creek formations as exposed in Texas. Chart shows Pease River group as Guadalupe.

G. L. Scott, Jr., and W. E. Ham, 1957, Oklahoma Geol. Survey Circ. 42, p. 17 (fig. 3), 19 (fig. 4), 28–30, pl. 1. As classified in this report [Carter area], Dog Creek overlies Van Vacter gypsum member (new) of Blaine formation and underlies Marlow formation of Whitehorse group. Thickness 80 feet. In El Reno group.

A. J. Myers, 1959, Oklahoma Geol. Survey Bull. 80, p. 24 (fig. 6), 34–36, pl. 1. Described in Harper County where it conformably overlies Blaine formation and is unconformable below Whitehorse formation. Consists of reddish-buff gypsiferous shale with thin beds of red sandstone and gypsum. Thickness 25 to 50 feet. Uppermost formation of El Reno group; Guadalupian. [Page 36 refers to El Reno group, Leonardian series.]

Named for Dog Creek, Barber County, Kans.

Dog Gulch Formation[1]

Tertiary: Southwestern New Mexico.

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

Named for exposures in upper part of Dog Gulch, Mogollon district.

Dogs Head Andesites

Quaternary: Southwestern Washington.

Jean Verhoogen, 1937, California Univ. Dept. Geol. Sci. Bull., v. 24, no. 9, p. 286. Dark reddish tough andesite which carries abundant gabbroic inclusions. Overlain by succession of thin sheets of basalt separated by clinkery layers of cinders and thin beds of ash.

Occurs in vicinity of Mount St. Helens on western slope of Cascade Range, 40 miles north of Columbia River. Dogs Head is prominent escarpment that rises over east end of Forsythe glacier.

Dolet Hills Formation (in Wilcox Group)

Dolet Hills Member (of Logansport Formation)

Paleocene: Northwestern Louisiana.

D. P. Meagher and L. C. Aycock, 1942, Louisiana Dept. Conserv. Geol. Pamph. 3, p. 13. Named in a stratigraphic summary of Louisiana lignite district. Name credited to G. Murray, Jr.

G. E. Murray, Jr., and E. P. Thomas, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 1, p. 48 (fig. 2), 57. In type area, consists of about 100 feet of rather massive sand; lithologically cannot be differentiated from other sands in Midway-Wilcox complex. Interfingers along strike with overlying and partially equivalent Cow Bayou member and is gradational from underlying Naborton formation.

G. E. Murray, 1948, Louisiana Dept. Conserv. Geol. Bull. 25, p. 105–110. Overlies Chemard Lake lignite lentil of Naborton formaton. Midway group.

H. V. Andersen, 1960, Louisiana Dept. Conserv. Geol. Bull. 34, p. 53–54. Rank raised to formation in report on Sabine Parish. Term Logansport discontinued. Overlies Naborton formation; underlies Cow Bayou formation. Wilcox group. Subsurface.

Type area: Dolet Hills south of Naborton, especially exposures along road from Grove Hill Church and Cemetery to Naborton and adjacent ravines in sec. 6, T. 11 N., R. 11 W., in sec. 1, T. 11 N., R. 12 W., and sec. 36, T. 12 N., R. 12 W., De Soto Parish.

Dolgeville Shale[1]

Dolgeville facies (of Denmark Formation)

Dolgeville facies (of Sherman Fall Formation)

Middle Ordovician: Eastern New York.

Original reference: H. P. Cushing, 1909, New York State Mus. Bull. 126, p. 20.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 271. Facies of Sherman Fall formation.

Marshall Kay, 1953, New York State Mus. Bull. 347, p. 57. Name Dolgeville was proposed for interbedded rather than barren limestones and dark shales that lie between fossiliferous Trenton limestones and black shales near Dolgeville. In type locality, these overlie Shoreham limestone and underlie uppermost Canajoharie (Fort Plain zone of Fairfield member). Rocks of this lithology grade into Poland member of Denmark formation along lower West Canada Creek, and in southeastern exposures at Stony Creek there is limited representation of typical Poland lithology. Thus, it is certain that lower part of type Dolgeville corresponds to Poland limestone. Rocks having stratigraphic position of Russia member of Denmark in vicinity of Middleville are wholly of

Dolgeville facies and are succeeded by black shales bearing same fauna as type Dolgeville. It is probable that the higher type Dolgeville is equivalent to most of the Russia. Thus, typical Dolgeville is equivalent to near the whole of the Denmark.

Well exposed in banks of East Canada Creek, just below Dolgeville, Herkimer County.

Dolls Run Sandstone (in Washington Formation)[1]

Permian: Northern West Virginia.

Original reference: E. L. Core, 1929, West Virginia Acad. Sci. Proc., v. 3, p. 204.

Occurs in region near Core, Monongalia County.

Dolores Formation[1]

Upper Triassic: Southwestern Colorado.

Original reference: W. Cross, 1899, U.S. Geol. Survey Geol. Atlas, Folio 57.

A. L. Bush, C. S. Bromfield, and C. T. Pierson, 1956, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–96. Mapped as Upper Triassic. In Placerville quadrangle, consists of red siltstone, sandstone, shale, and a few thin limestone-pebble conglomerate layers; quartz-pebble conglomerate or grit at base; locally includes thin Wingate sandstone equivalent of Triassic age at top. Unconformable above Cutler formation and below Entrada sandstone.

Named for typical exposures in valley of Dolores River.

†Doloresian series[1]

Upper Triassic: Colorado, Arizona, New Mexico, and Utah.

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

Dome Limestone

Dome Formation[1]

Dome Limestone (in Ophir Group)

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. 1134–1135, 1141 (fig. 5), 1145. At emended section formation is 310 feet thick and consists of black and dark-gray thick- and thin-bedded fine-grained limestone which contains drab-tan and maroon clay flakes, laminae, and nodules in lower two-thirds and dull-gray argillaceous pure limestone in upper third. Conformably overlies Howell limestone (emended); underlies Swasey limestone (emended). Forms part of continuous emended Cambrian section for region.

H. E. Wheeler, 1948, Nevada Univ. Bull., Geology and Mining Ser., no. 47, p. 38–39, fig. 5. Geographically extended into Nevada where it is same as units D-E of Highland Peak limestone as described by Wheeler and Lemmon (1939). Unconformably overlies Burnt Canyon limestone (new); unconformably underlies Condor member (new) of Swasey limestone.

R. E. Cohenour, 1959, Utah Geol. and Mineralog. Survey Bull. 63, p. 35, 45–46, pl. 1, measured sections. Included in Ophir group in Sheeprock

Mountains, where it overlies Burnt Canyon limestone and underlies Condor formation. Thickness 37 to 81 feet.

R. A. Robison, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 49, 50 (fig. 4), 51. Wheeler's terminology in House Range revised. Term Burnt Canyon replaced by Chisholm formation, and Condor member of Swasey limestone replaced by Whirlwind formation (new). Hence, Dome overlies the Chisholm and underlies the Whirlwind. In Wah Wah Range, the Dome lies between the Chisholm and the Whirlwind.

Type locality: Head of Dome Canyon, House Range, Millard County, Utah. Emended section measured on north side of Marjum Canyon, House Range.

Dome Canyon Limestone[1]

Middle Cambrian: Western Utah.

Original reference: C. D. Walcott, 1912, U.S. Geol. Survey Mon. 51, p. 157.

U.S. Geological Survey has abandoned the term Dome Canyon limestone in favor of Dome limestone, the more widely used term.

Type locality: Dome Canyon, House Range, Utah.

Domengine Formation[1] or Sandstone

Domengine Stage

Eocene, middle: Southern California.

Original reference: F. M. Anderson, 1905, California Acad. Sci. Proc., 3d ser., v. 3, p. 167–168.

B. L. Clark and H. E. Vokes, 1936, Geol. Soc. America Bull., v. 47, no. 6, p. 853 (fig. 1), 861–863. West Coast Eocene comprises (ascending) Martinez, Meganos, Capay, Domengine, Transition, and Tejon stages. For the Martinez, Capay, and Domengine, there is fairly good faunal evidence for general correlation.

R. T. White, 1938, (abs.) Geol. Soc. America Proc. 1937, p. 256–257. Domengine formation in Tumey Hills overlies Lodo formation (new).

H. E. Vokes, 1939, New York Acad. Sci. Annals, v. 38, p. 13 (table 1), 15–16. Name Domengine was first used (as Domijean) by Anderson (1905) to designate a sandstone member in Eocene north of Coalinga, the upper part of which included Domengine formation as recognized in this report but lower part of which included the white sandstones of Arroyo Hondo formation (new). Formation is described in areas designated as follows: type section of Domengine, including region from Oil City north to Cantua Creek; Vallecitos section, including Vallecitos syncline; Coal Mines section between the overlaps north of Alcade Creek and south of Los Gatos Creek; and Reef Ridge section, including area from Garza Creek to point about 2 miles south of Big Tar Canyon. Domengine (restricted) occurs as almost continuous line of outcrop throughout entire area included in this report. Only interruptions of any extent occur between north end of Reef Ridge section near Zapato Creek and southern part of Coal Mine section and southern part of type section in vicinity of Los Gatos Creek. In both areas, the Domengine is overlapped by Etchegoin formation. Thickness about 140 feet in type area. In some areas, overlies Cantua sandstone member of Arroyo Hondo formation; underlies Kreyenhagen formation. Domengine stage is younger than Capay stage.

Boris Laiming, 1940, 6th Pacific Sci. Cong., v. 2, p. 535–568. Discussion of character and distribution of smaller foraminifera in marine Eocene deposits of California and correlation of foraminiferal zones with faunal "stages" already established by paleontologists on basis of mollusca. Correlation chart shows 12 foraminiferal zones in Eocene as compared to 6 stages on basis of mollusca. Foraminiferal zones (ascending) B–1 and B–1A correlate with Domengine stage of Clark and Vokes (1936).

R. T. White, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 10, p. 1747–1750. Domengine sandstone, as redefined by Clark (1926, California Univ. Pub. Bull. Geol. Sci., v. 16, no. 5), is well-defined mappable unit, and north of Coalinga overlies Yokut sandstone (new); underlies Kreyenhagen shale.

I. F. Wilson, 1943, California Jour. Mines and Geology, v. 39, no. 2, p. 209–210. In San Benito quadrangle, Domengine sandstone occurs on both sides of Butts Ranch syncline, from eastern edge of quadrangle to Salt Creek, where it is overlapped by Etchegoin group and San Benito gravels. Thickness about 200 feet. On south side of syncline, rests on Yokut sandstone; on north side of syncline, rests alternately upon Butts Ranch shale and Call sandstone member (both new) of Panoche group. Middle Eocene.

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 17 (table 3), 56–59, pls. Domengine sandstone widely distributed in all quadrangles mapped in this report [Coast Ranges immediately north of San Francisco Bay region] except Point Reyes, Petaluma, and Santa Rosa. Exposed in eight areas and attains maximum thickness of 2,200 feet; average thickness less than 200. Overlies Capay shale; underlies Markley sandstone.

Ralph Stewart, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 34. Overlies Hawkhill formation (new).

M. B. Payne, 1951, California Div. Mines Spec. Rept. 9, p. 6 (fig. 2), 8 (fig. 4), 12 (fig. 6), 13, 15, 16 (fig. 9). Formation is defined in this paper [area of type Moreno] as beds stratigraphically below glauconite at base of Kreyenhagen shale and above Lodo formation. Includes gray foraminiferal shale and underlying gray sands down to base of Panoche bed which rests unconformably on Lodo formation in southeastern part of Panoche Hills. This is sequence of sediments except for the restricted area where Chaney Ranch sandstone (new) is found in outcrop and another area just north of Cantua Creek where basal Kreyenhagen glauconitic sand lies directly on Yokut sand. Comprises (ascending) Nonada sand and Capita shale members (both new). In some areas, overlies Laguna Seca formation (new). Name Domengine is undesirable in time stratigraphic sense.

J. E. Schoellhamer and D. M. Kinney, 1953, U.S. Geol. Survey Oil and Gas Inv. Map OM–128. As used in this report [Panoche Hills, Fresno County], Domengine sandstone includes fossiliferous sandstone that directly overlies Lodo formaiton or White's Yokut sandstone, where it is present, and underlies Kreyenhagen shale. Crops out discontinuously from Tumey Gulch northward until it is overlapped by Tulare(?) formation in NW¼ sec. 5, T. 15 S., R. 12 E., at north edge of area. Thickness 125 to 250 feet.

G. B. Oakeshott, 1958, California Div. Mines Bull, 172, p. 22 (fig. 2), 58–59, pl. 1. In current usage, Domengine is stage name applied to rocks of middle Eocene age. It is also commonly used in many parts of California for mappable units in which middle Eocene microfauna or megafauna has been recognized. Formation crops out in San Fernando quadrangle south of San Gabriel fault and covers area of about 0.1 square mile in Elsmere Canyon. Exposed thickness about 650 feet, but beds are cut off by Whitney fault. Unconformable below Elsmere sandstone member of Repetto.

Named for exposures in vicinity of Domijean or Domengine Ranch, in NE¼ sec. 17, north of Coalinga, Fresno County.

Domenigoni Granodiorite

See **Domenigoni Valley Granodiorite.**

Domenigoni Valley Granodiorite

Cretaceous: Southern California.

E. S. Larsen, Jr., and N. B. Keevil, 1947, Geol. Soc. America Bull., v. 58, no. 6, p. 488. Named Domenigoni granodiorite in a report on a study of the batholith of southern California.

E. S. Larsen, Jr., 1948, Geol. Soc. America Mem. 29, p. 69, pl. 1. Described as several bodies of rock that range from tonalite to granodiorite. Crops out as light-colored boulders of disintegration. Derivation of name given.

Well exposed on both sides of Domenigoni Valley, southeastern part Elsinore quadrangle.

†Domijean Sands[1]

Eocene, middle: Southern California.

Original reference: F. M. Anderson, 1905, California Acad. Sci. Proc., 3d ser., v. 3, p. 167–168.

Named for development in vicinity of Domijean or Domengine Ranch, in NE¼ sec. 17, north of Coalinga, Fresno County.

Don Limestone[1]

A name applied by geologists of mining companies, in their company reports, to upper 260 feet of Syrena Formation (Pennsylvanian) of Santa Rita district, New Mexico.

See Humboldt Formation, New Mexico.

Dona Ana Member (of Lake Valley Formation)

Mississippian (Osage): Central southern New Mexico.

L. R. Laudon and A. L. Bowsher, 1941 (abs.) Tulsa Geol. Soc. Digest, v. 9, p. 73–75; 1941, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 25, no. 5, p. 935; no. 12, p. 2116, 2136–2138, fig. 8. Thin- to massive-bedded gray to brown coarsely crystalline very cherty crinoidal limestone. Normally interbedded with dark crinoidal marl beds. Normal even bedding complicated by local small bioherm masses. Basal part contains more soft marly material than central part. Upper part filled with large masses of light-colored chert. In some sections, uppermost 10 feet of member made up almost entirely of chert. Thickness of 60 feet in type section; thins northward and is missing entirely in northern part of Sacramento Mountains. Maximum thickness of 175 feet in San Andreas Canyon; thins abruptly to south and is absent in southern part of range. Thickness dependent to great extent on amount of pre-Pennsylvanian erosion in area where section is being measured. Upper member of formation. Conformably overlies Arcente member (new); unconformably underlies widely varying members of Pennsylvanian formations.

L. R. Laudon and A. L. Bowsher, 1949, Geol. Soc. America Bull., v. 60, no. 1, p. 11 (fig. 4), 15. Geographic distribution given.

Type section: At head of Deadman Canyon, Sacramento Mountains, in south center sec. 3, T. 17 S., R. 10 E., Otero County. Named from Dona Ana County. Occurs only in Sacramento Mountains and in central part of San Andres Mountains.

Donaher sandstones[1]

Precambrian (Belt Series): Central western Montana.

Original reference: C. R. Keyes, 1925, Pan-Am. Geologist, v. 44, p. 215.

Mission Range.

Donald quartzites[1]

Precambian: Montana.

Original reference: C. R. Keyes, 1925, Pan-Am. Geologist, v. 44, p. 217.

Derivation of name not stated.

Donegal Limestone (in Sumner Group)[1]

Permian: Northeastern Kansas.

Original reference: R. C. Moore, 1936, Jour. Geology, v. 44, no. 1, p. 5–9.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 30. Term Wellington is used for the 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.

Doneley Limestone Member (of Savanna Formation)

Pennsylvanian (Des Moines Series): Northeastern Oklahoma and southeastern Kansas.

C. C. Branson, 1954, Oklahoma Acad. Sci. Proc., v. 33, p. 192, 193 (table 1); C. C. Branson, 1955, *in* E. W. Reed, S. L. Schoff, and C. C. Branson, Oklahoma Geol. Survey Bull. 72, p. 67–68. Defined as the uppermost of three persistent "brown limes" of Savanna formation. At type section, calcareous clay ironstone 3 inches thick, lying 8 inches above a thin coal and its underclay. Lies 70 feet below base of Bluejacket sandstone; overlies Rowe coal, which is above Sam Creek limestone. Name credited to L. P. Chrisman (unpub. thesis).

Type section: One mile north of school building in NW¼ sec. 16, T. 26 N., R. 20 E., Craig County, Okla., in south bank of creek which crosses north-south section line road. Exposure is about 100 feet east of road. Name derived from Doneley School, which is shown on U.S. Geological Survey topographic map of Vinita quadrangle in NW¼ sec. 27, T. 26 N., R. 20 E. This school has been replaced by Pleasant Hill School which is at same location.

Doniphan Shale 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),

153. Doniphan shale member of Lecompton formation; underlies Big Springs limestone member; overlies Spring Branch 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. Thickness 4 to 5 feet in Iowa and Nebraska and 5 to 10 feet in Kansas. Type locality stated.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 66. Notes thickness in Kansas as 5 to 34 feet. Contains some red shale and prominent sandstone beds in southern Kansas.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 20, fig. 5. Dark-gray to buff, calcareous shale with beds of fossiliferous nodular limestone. Thickness 3 to 6 feet. Underlies Big Springs limestone member; overlies Spring Branch limestone member.

Type locality: In Missouri River bluffs, northeastern Doniphan County, Kans.

Donkey Fanglomerate

Pliocene(?) : Southern central Idaho.

C. P. Ross, 1947, Geol. Soc. America Bull., v. 58, no. 12, pt. 1, p. 1095, 1122–1123, pl. 1. Defined to include partially cemented material of alluvial character which is older than the alluvium of the modern valleys. Composed almost exclusively of rounded to subangular poorly sorted gravel in an abundant cemented matrix composed largely of angular pebbles, sand, and dirt held in a mixture of quartz and calcite. Locally porous calcareous material so predominates in cement that material resembles caliche. Forms hills and spurs in and on sides of valleys, and recent alluvium laps up against it. Attains thicknesses upward of 1,000 feet. Rests on and contains pebbles of Challis volcanics.

Named for Donkey Hills where it is exceptionally well displayed. Principal exposure is west of Donkey Creek in western part of T. 11 N., R. 24 E., Borah Peak quadrangle.

Donkey Creek Glaciation or **Drift**

Pleistocene, upper: South-central Utah.

R. F. Flint and C. S. Denny, 1958, U.S. Geol. Survey Bull. 1061–D, p. 117 (fig. 25), 125, pl. 6. Southern part of Fish Creek-Grover drift lobe composed of drift assigned to Donkey Creek and Blind Lake (new) glaciations. Near Hickman Pasture, Donkey Creek drift narrows to width of less than 1,200 feet, probably because of massive slumping on eastern side of valley. Eastern lateral moraine of the drift is cut by an earthflow near Hickman Pasture. Pinedale(?) stage.

Mapped on flanks of Boulder Mountain, including the course of Donkey Creek on north flank of Boulder Mountain; Wayne and Garfield Counties.

Donley Limestone Member (of Greene Formation)[1]

Permian: Southwestern Pennsylvania and eastern Ohio.

Original reference: W. T. Griswold and M. J. Munn, 1907, U.S. Geol. Survey Bull. 318, p. 77.

Exposed in vicinity of Donley, Donegal Township, Washington County, Pa.

Donnay (Donny)

See **Donni Sandstone Member** (of Tagpochau Limestone).

Donnelly Glaciation

Pleistocene: East-central Alaska.

T. L. Péwé, 1952, (abs.) Geol. Soc. America Bull., v. 63, no. 12, pt. 2, p. 1289; T. L. Péwé *in* T. L. Péwé and others, 1953, U.S. Geol. Survey Circ. 289, p. 9, 13 (table 1) At least three major Quaternary glaciations recorded at north end of Delta River valley. Donnelly succeeded Delta glaciation (new). Extended about 15 miles north of Alaska Range. Distinct terminal bulbs spread northward onto plain from Little Delta River, Delta Creek, Granite Creek, Gerstle River, and Johnson River. Well-preserved end moraines with many lakes and fresh knob-and-kettle topography at base of range. Glacier split into major and minor lobe near Donnelly Dome and partially surrounded the dome.

Named after Donnelly Dome, a prominent rock knob 25 miles south of Big Delta.

Donnelly iron ore[1]

Silurian: Central New York.

Original reference: G. H. Chadwick, 1918, Geol. Soc. America Bull., v. 29, p. 327–368.

Donni Sandstone Member (of Tagpochau Limestone)

Donni Tuff

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. 61–63]. Donny beds include alternating tuff, sandstone, and shale beds. Lower part consists of alternating fine-grained conglomerate, sandstone, shale, and tuff with limestone blocks and lenses; middle part, alternating sandstone, sandy shale, and shale; upper, alternating shale, arenaceous shale, and marl. Well stratified. Thickness appropriate 100 to 200 meters at Donny and Tarohoho; 30 centimeters on sea-cliff of Naftan Peninsula. On north wall of valley east of Saipan Institute, exposed in thin calcareous seam between Laulau limestone and Tappocho limestone.

Josiah Bridge *in* W. S. Cole and Josiah Bridge, 1953, U.S. Geol. Survey Prof. Paper 253, p. 10–11. Donni tuff is brilliantly colored and well-stratified formation consisting of beds of conglomerate, tuff, sandstone, and shale. Rests unconformably on Sankakuyama rhyolite, Hagman andesite, and tuffs of Densinyama formation, and grades laterally into Laulau and Tagpochau limestones; disconformably overlain by Naftan and Mariana limestones. Miocene (Aquitanian).

P. E. Cloud, Jr., R. G. Schmidt, and H. W. Burke, 1956, U.S. Geol. Survey Prof. Paper 280–A, p. 68–71, pl. 2, chart 2. Reduced to member status in Tagpochau limestone. Comprises thinly bedded and well-bedded, soft, tuffaceous, marine sandstone, siltstone, marl and shaly beds, and pebble and granule conglomerates. Average thickness 100 feet; may be as much as 200 feet. Although at any given place the Donni may lie relatively above, below, or within the local Tagpochau succession, its general distribution pattern suggests that it properly occupies a position near middle of formation. Type section designated.

Type section: Between I Hasngot Ravine and I Pitot Ravine. Its base is west of junction of Cross-Island Connecting Highway and East Coast Highway and its top along East Coast Highway about 800 feet east-southeast of junction.

Donny Sandy Tuff

See **Donni Sandstone Member** (of Tagpochau Limestone).

Donovan Formation

Lower Jurassic: East-central Oregon.

R. L. Lupher, 1941, Geol. Soc. America Bull., v. 52, no. 2, p. 227 (table 1), 229–235. Consists principally of hard green and gray noncalcareous sandstone, sandy shale, red sandstone, and yellowish calcareous sandstone. Thickness 2,241 to 2,500 feet. Underlies Mowich group; appears to be oldest Jurassic formation in central Oregon; Jurassic sequence lies with high-angle discordance upon a basement of highly folded strata which are in part of Mississippian and Upper Triassic age.

Exposures occupy less than one-half square mile in secs. 5, 6, 7, and 8, T. 20 S., R. 30 E., 19 miles north of Burns and 10 miles west of Crow Flat Ranger Station. Named for Tim Donovan Ranch, in sec. 7, T. 20 S., R. 30 E., Crook County.

Dooley Rhyolite Breccia[1]

Miocene(?): Northeastern Oregon.

Original reference: J. Gilluly, 1937, U.S. Geol. Survey Bull. 879.

Named for exposures on Dooley Mountain and in Stices Gulch and Mill Creek, Baker quadrangle.

Dora Dolomite Member (of Bluebell Formation)

Silurian: Central Utah.

Paul Billingsley, 1933, *in* J. M. Boutwell, Internat. Geol. Cong. 16th, [United States] Guidebook 17, Excursion C–1, p. 110 (fig. 14). Name appears on stratigraphic column of Tintic district. Overlies Beecher member (new); underlies Noah member (new).

T. S. Lovering and others, 1949, Econ. Geology Mon 1, p. 7 (table 1). Upper 10 feet gray wavy thin-bedded ("Curley") dolomite; remainder of unit dominantly fine-grained blue-gray dolomite containing a few light-gray nearly lithographic dolomite beds. Thickness 212 feet.

H. J. Bissell, 1959, Utah Geol. Soc. Guidebook 14, p. 144. Dora dolomite (in part at least) should be termed Sevy.

Type locality and derivation of name not stated.

Dorado Basalt (in Hinsdale Series)

Pliocene: Central northern New Mexico.

Fred Barker, 1958, New Mexico Bur. Mines Mineral Resources Bull. 45, p. 3, 38, 51, 53, pl. 1. Flows of olivine basalt, basalt, and quartz basalt. Appears partly to wholly crystalline, fine grained, and porphyritic in thin section. Thickness from at least 40 to about 100 feet. Younger than Cisneros basalt (new); unconformably overlies Cordito member (new) of Los Pinos formation. Name credited to Butler (unpub. dissert.).

Name applied to basalt that caps Petaca Mesas. Particularly well exposed in Dorado Canyon, northeast of Petaca.

Dorans Cove Sandstone[1]

Mississippian: Northeastern Alabama.

Original reference: J. J. Stevenson, 1903, Geol. Soc. America Bull., v. 14, p. 76.

Well exposed in Madison, just west from Jackson. Named for Dorans Cove, Jackson County.

Dorcheat Member (of Schuler Formation)

Upper Jurassic: Subsurface in Arkansas, northern Louisiana, and eastern Texas.

F. M. Swain, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 5, p. 578 (table 1), 597, 602–609. Upper member of formation. Defined as including the nearshore pastel, varicolored shales, and sandstones, and the equivalent offshore dark-gray fossiliferous shales, sandstone, and limestones between the base of the Hosston formation and the top of the red-green shales, sandstones (nearshore facies), and marine rocks (offshore facies) of the Shongaloo member (new). Locally, dark-gray, glauconitic, fossiliferous shale, herein named the Wesson tongue, occurs near the top of the nearshore facies of the member. Occurs between depths of 6,420 to 7,510 feet in type well. Attains its greatest thickness of 1,200 feet or more near Arkansas-Louisiana State line and on the Monroe uplift, in Morehouse Parish, La., south of which it thins gradually. In most areas, the Dorcheat is overlain with regional conformity by the Hosston formation; in central part of Monroe uplift, overlain by late Upper Cretaceous chalk; in East Texas basin, the contact is unconformable; generally the Dorcheat conformably overlies the Shongaloo; in Nevada County, Ark., it overlaps the Shongaloo and rests directly on the Smackover limestone; in Bowie County, Tex., it overlaps the Shongaloo and rests on Paleozoic sandstone.

Type section: Atlantic Refining Co.'s Pinewoods Lumber Company No. 1, C., NE¼NE¼ sec. 16, T. 18 S., R. 22 W., Columbia County, Ark.:; Dorcheat Field discovery well.

Dorchester Slate Member (of Roxbury Conglomerate)[1]

Devonian or Carboniferous: Eastern Massachusetts.

Original reference: W. W. Dodge, 1881 and 1882, Boston Soc. Nat. History Proc., v. 21, p. 208–210.

Named for Dorchester district of Boston, where it is exposed at several places.

Dorena Welded Tuff

Tertiary: Western Oregon.

D. M. Hausen, [1954], Mississippi Acad., Sci. Jour., v. 5, p. 212–216. Consists, locally, of five mappable units ascending): crystal and vitric tuff, pumice tuff, dacite tuff, pumice tuff, and crystal and vitric tuffs. Overlies and underlies pumice tuff units.

Type locality: Near Dorena, Lane County.

Dornick Hills Formation[1]

Dornick Hills Group

Pennsylvanian: Central southern Oklahoma.

Original reference: J. A. Waters, 1927, Jour. Paleontology, v. 1, p. 129.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 37). Dornick Hills group comprises (ascending) Jolliff, Otterville, Bostwick, Lester, and Frensley limestones, and Pumpkin Creek beds. Overlies Springer group; underlies Deese group. Morrow-Lampasas 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), 138–143. Group redefined and subdivided into three formations (ascending): Golf Course (new), Lake Murray (new), and Big Branch. Golf Course formation includes the Primrose at base and the Otterville at top. Primrose sandstone and shale between the Primrose and Otterville are transferred from Springer group to Dornick Hills. Overlies Springer group; underlies Deese group. Pennsylvanian (Morrow, Atoka, Des Moines).

Named for Dornick Hills north of Ardmore, Carter County.

Dorothy Limestone and Shale (in Kanawha Formation)[1]

Pennsylvanian: Southern West Virginia.

Original references: C. E. Krebs and D. D. Teets, Jr., 1916, West Virginia Geol. Survey Raleigh and western Mercer and Summers Counties, p. 353.

Exposed at Dorothy, Raleigh County.

Dorr Run Shale Member (of Allegheny Formation)

Pennsylvanian: Eastern Ohio.

M. T. Sturgeon and W. M. Merrill, 1949, Ohio Jour. Sci., v. 49, no. 1, p. 1–11. Proposed for fossiliferous shale overlying the Lower Freeport coal in an exposure on southwest side of Dorr Run valley 1.6 miles northwest of junction of road along Dorr Run with Logan-Nelsonville road. Typically gray to dark-gray or even black argillaceous carbonaceous fossiliferous marine shale; in vicinity of Downhour School in Ward Township, member is light gray and argillaceous. Average thickness 17 inches.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 48 (table 7), 83–84. Member of Lower Freeport cyclothem in report on Athens County. Allegheny series.

Type section: In abandoned strip mine in SW¼NW¼ sec. 31, Ward Township, Hocking County; entire section includes strata exposed along side road in SE¼NW¼ sec. 31.

Dorset Limestone[1]

Cambrian and Ordovician: Southwestern Vermont.

Original reference: C. H. Hitchcock, 1860, Boston Soc. Nat. History Proc., v. 7, p. 237.

Dorset Mountain, Rutland and Bennington Counties.

Dorton Shale (in Crooked Fork Group)

Pennsylvanian (Pottsville Series): Eastern Tennessee.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [folio], p. 4–6, pls. 2, 3. Name applied to shale between top of Rockcastle conglomerate and base of Crossville sandstone. Thickness commonly 50 to 80 feet; at type locality approximately 35 feet; in Crooked Fork section 42 feet; maximum thickness 115 feet occurs on Cumberland block. Contains Rex coal near base and thin Potters Falls coal near top. Name Duskin Creek was previously used for beds presumably overlying the Rockcastle, and including Dorton shale of this report. Type section of Duskin Creek consists of beds of the Vandever formation that actually underlie the Rockcastle. This error is believed due to failure to identify the Rockcastle because of its local shaly character.

Named from exposure near Dorton, Dorton quadrangle, Cumberland County.

Dorwin Sandstone Member (of Amsden Formation)[1]

See **Darwin Sandstone Member** (of Amsden Formation), correct spelling.

Dosados Sand and 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, 22, pls. 2, 3. Thickness about 200 feet. Underlies Tierra Loma shale member (new); unconformably overlies Panoche formation. 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, Panoche Hills, Fresno County. Name is contraction of Spanish dos a dos. Escarpado Canyon is 6 miles south of Moreno Gulch and 2 miles north of Panoche Creek.

†Dos Alamos Gypsum Member (of Delaware Mountain Formation)[1]

Permian: Western Texas.

Original reference: P. B. King and R. E. King, 1929, Am. Assoc. Petroleum Geologists Bull., v. 13, p. 922, 925.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 570 (footnote). Term Dos Alamos gypsum abandoned because the gypsum layers are included in the newly defined Cutoff shaly member of Bone Spring limestone.

Named for exposures near Dos Alamos, or Cottonwood Wells, due west of Guadalupe Point, on west side of Salt Flat, Hudspeth County.

Dos Palmas Rhyolite

Miocene(?): Southern California.

T. W. Dibblee, Jr., 1954, California Div. Mines Bull. 170, chap. 2, p. 24, 25 (fig. 3), pl. 2. Thickness as much as 400 feet. Rests directly on much older crystalline rocks. Southeast of Box Canyon, underlies Canebrake conglomerate (new).

Crops out in Mecca Hills, Imperial County, 8 miles S. 30° E. of Mecca.

Dos Palos Shale Member (of Moreno Formation)

Upper Cretaceous and Paleocene(?): Southern California.

M. B. Payne, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1953; 1951, California Div. Mines Spec. Rept. 9, p. 6 (fig. 2), 8 (fig. 4), 9, 22, pls. 2, 3, 4, 5. Consists principally of brown shale. Thickness 900 to 1,045 feet; includes the 60-foot Cima sandstone lens (new) 185 feet below its top. Discomformably underlies Paleocene glauconitic sandstone; overlies Marca shale (new). On basis of this mapping, it is concluded that Anderson and Pack (1915) show base of Moreno formation in Ortegalita Creek some 1,800 feet stratigraphically lower than in their type Moreno in Moreno Gulch.

Type locality: Escarpado Canyon, secs. 7 and 8, T. 15 S., R. 12 E., Panoche Hills, Fresno County. Named for town of Dos Palos. Escarpado Canyon is 6 miles south of Moreno Gulch and 2 miles north of Panoche Creek.

Dos Picachos Gravels

Pleistocene and Recent: West-central California.

N. L. Taliaferro, [1946?], Geologic map of the Hollister quadrangle, California (1:62,500): California Div. Mines Bull. 143, pl. 1 [preprint?]. Shown on map legend as coarse cemented gravels.

Exposed along Dos Picachos Creek, northeast Hollister.

Dot Limestone, Dolomite, or **Formation**

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). Dolomitic limestone weathering yellow or red and with characteristic rounded surfaces in lower part; tan dense fine-grained limestone in upper part; normally contains no zones of chert nodules, but locally one or more zones of chert nodules are present near top; prominent conglomeratic zone of chert and dolomite pebbles at base. Thickness 120 to 193 feet. Unconformably underlies Poteet limestone (new); unconformably overlies Mascot dolomite. Dot limestone and Poteet 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), 33–37, 93, 96, 100–102, pl. 1. Further described and type section given. Dot seems to correlate with zones 1 and 2 of Blackford formation as used by Cooper (1944) in Burkes Garden quadrangle. Summary of conflicts in nomenclature of Middle Ordovician formations in Lee County.

Type section: In cut of Louisville and Nashville Railroad spur at Hagan, Lee County. Name derived from settlement of Dot, which is at junction of U. S. No. 58 and State Route 66 in eastern part of Jonesville district. Limestone crops out in two continuous belts on opposite sides of main anticlinal axis of Jonesville district.

Dothan Formation[1]

Upper Jurassic: Southwestern Oregon and northern California.

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

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

F. G. Wells and G. W. Walker, 1953, Geology of the Galice quadrangle, Oregon: U.S. Geol. Survey Geol. Quad. Map [GQ–25]. Consists largely of sandstone, siltstone, and shale, with a few chert lenses, lenticular beds of conglomerate, and layers of volcanic rocks. Crops out in western part of quadrangle; distance across strike is 12 miles, 7 within and 5 without the quadrangle. Thickness difficult to determine due to thickening by folding and repetition of beds; stratigraphic thickness may be 10,000 to 18,000 feet. Present study shows Dothan is right side up and stratigraphically below volcanic rocks of Rogue formation (new). Dothan is assumed to be older than Galice.

F. W. Cater, Jr., and F. G. Wells, 1953, U.S. Geol. Survey Bull. 995–C, p. 84–86, pl. 11. Geographically extended into Gasquet quadrangle, California, where it consists of about 15,000 feet of graywacke, sandstone, shale, chert, and conglomerate. In northwest corner of quadrangle, Dothan rocks plunge southward under, and are generally conformable with, the peridotite sheet of Josephine Mountains; to the south, on Middle Fork of Smith River, the peridotite in turn underlies southward-plunging metavolcanic rocks of Galice formation that are known to be in normal position; hence, it is assumed Dothan underlies Galice, and although older than Galice, is still probably no older than Late Jurassic.

R. W. Imlay and others, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2778. Myrtle formation in southwestern Oregon is herein rank raised to group and subdivided into Riddle and Days Creek formations. Some of Myrtle formation as mapped by Diller is excluded from Myrtle group and reassigned to Dothan formation. Riddle formation rests on Rogue formation near Days Creek and in valley of Myrtle Creek, Douglas County; on Dothan formation in Dutchman Butte quadrangle and in southwestern part of Roseburg quadrangle in Douglas County; on Dothan formation in Dutchman Foggy Creek area of Bone Mountain quadrangle in Coos County. Contact with these underlying formation is angular unconformity.

Named for Dothan post office on Cow Creek, Douglas County, Oreg.

†Dothan Limestone (in Moran Formation)[1]

Dothan Limestone (in Moran Group)

Permian: Central northern Texas.

Original reference: F. B. Plummer, 1919, Am Assoc. Petroleum Geologists Bull., v. 3, p. 133–145.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Rank raised to formation in the Moran herein raised to group status. Underlies Horse Creek formation; overlies Camp Colorado formation in Pueblo group.

M. G. Cheney, 1948, Abilene Geol. Soc. [Guidebook] Spring Field Trip, June 11–12, p. 5. Replaced by Ibex limestone (new). Term Dothan preoccupied.

Crops out near Dothan, Callahan County.

Dotsero Formation

Dotsero Dolomite

Upper Cambrian: Central northwestern Colorado.

C. F. Bassett, 1939, Geol. Soc. America Bull., v. 50, no. 12, pt. 1, p. 1855–1858. Dotsero dolomite consists of beds of gray dolomite and limestone with partings and thin beds of shale. Some beds intraformational conglomerates and breccias. In some beds, the included pebbles are gray, whereas in others they are red. Dolomites and limestones are of shallow-water origin as indicated by presence of ripple marks, rain prints, and other markings. Thickness in a bluff along road, 2.35 miles west of Garfield-Eagle County line, is 269 feet. Overlies Sawatch quartzite and underlies Parting quartzite member of Chaffee formation.

N. W. Bass and S. A. Northrop, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 5, p. 896–904. Redefined as formation, which includes only the lower part (Late Cambrian) of the former Dotsero dolomite. Comprises the sequence of beds, 96 to 106 feet thick, directly above Sawatch quartzite. Contains considerable amounts of glauconite in many beds. Subdivided into two new members (ascending): Glenwood Canyon and Clinetop algal limestone. Underlies Dead Horse conglomerate member (new) of Manitou formation.

Named for good exposures in northeastern end of Glenwood Canyon near Dotsero, about 100 miles west of Denver.

Dotson Black (sheety) Shale[1]

Mississippian: Northwestern Arkansas.

Original reference: D. D. Owen, 1858, First Rept. Geol. Reconn. northern counties of Arkansas, p. 101–102.

Exposed on Wharton Creek at Dotson's Farm, Madison County.

Dotson Sandstone[1]

Dotson Sandstone (in Kanawha Group)

Pennsylvanian (Pottsville Series): Southern West Virginia and southwestern Virginia.

Original reference: M. R. Campbell, 1897, U.S. Geol. Survey Geol. Atlas, Folio 44.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey Greenbrier County, p. 215, 221, 222. In Greenbrier County, Dotson sandstone (Campbell, 1897) is 20 to 65 feet thick. Underlies Gilbert coal; overlies Douglas coals. Lower Dotson sandstone (Hennen, 1919) is 10 to 25 feet thick. Overlies Douglas shale; separated from overlying Dotson sandstone by Douglas coals. Both sandstones included in Kanawha group, Pottsville series.

Named for occurrence at Dotson, McDowell County, W. Va.

Double Crater Volcanics

Quaternary: Southwestern Alaska.

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

Mapped on summit of Double Crater in vicinity of Pavlof Volcano, Alaska Peninsula.

Doublehorn Shale Member (of Houy Formation)

Upper Devonian and Lower Mississippian(?) : Central Texas.

P. E. Cloud, Jr., V. E. Barnes, and W. H. Hass, 1957, Geol. Soc. America Bull., v. 68, no. 7, p. 807, 810, 811, pl. 3 (fig. 1). A black fissile radioactive spore-bearing shale from which, at places, large silicified pieces of wood of *Callixyon* have weathered free. Maximum thickness 15 feet; thins to disappearance. Principal unit of the Houy; overlies Ives breccia member; underlies unnamed phosphoritic member, or locally, Chappell limestone. Remnants of Doublehorn are found only along eastern side of Llano region.

Type section: Along Burnam Branch where it enters Doublehorn Creek and on Rubin Houy Ranch along Doublehorn Creek just down stream from Houy Branch, Burnet County.

Double Horseshoe cyclothem (in Carbondale Group)

Pennsylvanian: Eastern Illinois and western Indiana.

J. W. Alexander, 1943, Illinois Acad. Sci. Trans., v. 36, no. 2, p. 141–143. Composed of two limestones, both of which are thin and discontinuous. Upper is limestone conglomerate which has light-gray limestone matrix and contains black pebbles; maximum thickness 6 inches. Lower is light-gray lithographic slightly septarian limestone; maximum thickness 14 inches. Occurs below St. David limestone and above Summum cyclothem.

Well exposed in "Double Horseshoe" region on Little Vermilion River at Illinois-Indiana border.

†Double Mountain Formation[1] or Group

Permian: Central northern and central Texas.

Original reference: E. T. Dumble and W. F. Cummins, 1890, Texas Geol. Survey 1st Ann. Rept., p. lxx, 187, 188, pl. 3.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 668. Name Double Mountain group abandoned; part of former unit now classed under Whitehorse group.

Named for Double Mountains, Stonewall County.

Double Point Dacite

Quaternary, middle: Southwestern Alaska.

G. L. Snyder, 1959, U.S. Geol. Survey Bull. 1028–H, p. 177–180, pl. 23. Flows of light- to dark-gray glassy to lithoidal rocks containing many small plagioclase phenocrysts ordinarily visible in hand specimen. Rocks commonly irregularly vesicular, the vesicles commonly being lined with sugary-textured altered glass, tridymite, or both. Although classified as high-silica dacite, composition ranges into rhyodacite. Contains many round inclusions of miarolitic andesite. Flows form volcanic pile 3,000 feet high. Younger than Williwaw Cove (new), Sitkin Point (new), and East Point (new) formations. Underlies Patterson Point formation (new).

Named for exposures north of Double Point in southwest coast of Little Sitkin Island, in Rat Islands group of Aleutian Islands. Largest outcrop area extends from Double Point northeastward to drainage of Williwaw Cove stream and includes present caldera scarp.

Doublian series[1]

Permian: Texas.

Original reference: C. R. Keyes, 1929, Pan-Am. Geologist, v. 57, p. 337, 350–356.

Dough Hills Member (of Fleming Formation)

Miocene: Central Louisiana.

H. N. Fisk, 1940, Louisiana Dept. Conserv. Geol. Bull. 18, p. 118 (fig. 26), 158–161, geol. map. Consists primarily of a thick group of silty clays with calcareous beds near the center; lower beds are yellow silty clays carrying localized opaline nodules. Thickness 85 to 135 feet. Contact with underlying Carnahan Bayou member (new) arbitrarily taken as a tuffaceous clay bed which outcrops near center of NW¼ sec. 12, T. 4 N., R. 5 W.; contact with overlying Williamson Creek member (new) arbitrarily drawn on the appearance of numerous sand lentils in the clayey-silt sequence overlying the calcareous clay beds.

Crops out in Dough Hills, centrally located in T. 4 N., Rs. 4 and 5 W., Rapides Parish.

Doughnut Formation

Upper Mississippian: Central northern Utah.

M. D. Crittenden, Jr., B. J. Sharp, and F. C. Calkins, 1952, Utah Geol. Soc. Guidebook 8, p. 10–11, pl. 1. Includes parts of Morgan formation as defined by Calkins (1943, U.S. Geol. Survey Prof. Paper 201). Formation consists of dark rocks that are relatively unresistant. Lowest beds which are well exposed at south end of Doughnut Cliffs, are resistant, more or less sandy and siliceous, tawny-weathering rocks, in sharp contrast to the blue limestones of upper part of Humbug formation. Next 50 to 100 feet is black shale. Upper part consists of about 200 feet of thin-bedded limestone, blue black on fresh fractures but gray to buff on weathered surfaces. Underlies Morgan(?) formation.

M. D. Crittenden, Jr., 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 69–70, 71–72, 73. Overlies Humbug formation. Underlies Round Valley limestone (called Morgan? by Calkins and Butler, 1943, U.S. Geol. Survey Prof. Paper 201). Thickness at type locality 400 feet. This unit [Doughnut] can be traced over much of Cottonwood area, from near Neff Canyon near Salt Lake, south to Charleston Thrust, and east to Park City. East of there, bedrocks are covered by volcanics and younger sediments, but they reappear about 2½ miles east of Kamas where this unit consists largely of black shale. It has been called Manning Canyon shale by Sadlick (1955, Wyoming Geol. Assoc. Guidebook 10th Field Conf.; 1956, Intermountain Assoc. Petroleum Geologists Guidebook 7th Ann. Field Conf.) but fauna is virtually identical with Doughnut formation. Proposed that black shale unit of western Uinta Mountains be called Doughnut formation.

Type sections: In Cliffs east of Doughnut Falls, in Mill D South Fork, a tributary of Big Cottonwood Canyon, in Wasatch Mountains, east of Salt Lake.

Douglas Amygdaloid[1] (in Central Mine Group)

Precambrian (Keweenawan): Northern Michigan.

Original reference: R. D. Irving, 1883, U.S. Geol. Survey Mon. 5, pl. 18.

Named for occurrence in Douglas mine, Houghton County.

Douglas Flow[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Paper 144 (chart compiled by M. G. Wilmarth).

Copper district of Keweenaw Point.

Douglas Group[1]

Douglas 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, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2034, 2035 (fig. 5). As now recognized, group comprises strata. almost exclusively clastic occurring between disconformity at base of Virgilian series and base of Oread formation. Overlies Pedee group; underlies Shawnee group. Includes Stranger formation below and Lawrence formation above.

Named for Douglas County, Kans.

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

Pennsylvanian (Pottsville Series): Southern West Virginia.

Original reference: R. V. Hennen and R. M. Gawthrop, 1915, West Virginia Geol. Survey Rept. Wyoming and McDowell Counties, p. 183.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey Greenbrier County, p. 215, 222. Underlies Lower Dotson sandstone; overlies Upper Nuttall sandstone. Thickness about 25 feet. Included in Kanawha group, Pottsville series.

Named for exposures at Douglas Railroad Station, McDowell County.

Douglas Canyon Formation[1]

Miocene, upper: Central Washington.

Original reference: A. D. Hoffman, 1932, Jour. Geology, v. 40, no. 8, p. 735–738.

Exposed in Douglas Canyon, one of side canyons of Moses Coulee, above and below waterfalls about one-half mile from canyon mouth, NW¼SW¼ sec. 30, T. 23 N., R. 24 E., Douglas County.

Douglas County traps[1]

Precambrian (Keweenawan): Northwestern Wisconsin.

Original reference: R. D. Irving, 1874, Am. Jour. Sci., 3d, v. 8, p. 46–56.

Douglas and Bayfield Counties.

Douglas 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 brown sandstone and gray shale with a few thin beds of oolites and algae. Thickness 430 to 470 feet. Underlies Garden Gulch members; overlies Wasatch formation. Douglas Creek, Garden Gulch, and Parachute Creek members interfinger with a unit referred to as lower sandy member of Green River. Eocene.

F. M. Swain, 1956, Intermountain Assoc. Petroleum Geologists [Guidebook] 7th Ann. Field Conf., p. 128, 130. In this report, the shales, sandstones, and oolitic limestones which Bradley placed in Douglas Creek member are referred to the Colton-Green River transition beds.

C. W. Cline, 1957, Brigham Young Univ. Research Studies, Geology Ser., v. 4, no. 3, p. 1–46. Discussed in detail in Piceance Creek basin, Colorado. Age of Green River given as upper middle Eocene.

Well exposed at head of Douglas Creek in E½ of T. 5 S., R. 102 W., Garfield County, Colo.

Douglas Hills member (of Fleming Formation)

A lapsus for Dough Hills.

Douglas Island Volcanic Group[1]

Jurassic(?) to Lower Cretaceous(?): Southeastern Alaska.

Original reference: G. C. Martin, 1926, U.S. Geol. Survey Bull. 776, p. 255–256, chart opposite p. 247, p. 270.

T. G. Payne, 1955, U.S. Geol. Survey Misc. Geol. Inv. Map I–84. Age shown on chart as Jurassic.

Fred Barker, 1957, U.S. Geol. Survey Geol. Quad. Map GQ–100. On northeast limb of Shelter syncline. Thickness estimated to be at least 5,000 feet and probably 10,000 feet in Juneau (B–3) quadrangle. Jurassic(?) to Early Cretaceous(?).

Forms main mountain mass of Douglas Island, Juneau region.

Douglas Lake Member (of Lenoir Limestone)

Middle Ordovician: Eastern Tennessee.

Josiah Bridge, 1955, Geol. Soc. America Bull., v. 66, no. 6, p. 727–729. Proposed for beds overlying Mascot dolomite and underlying typical nodular member of the Lenoir in Douglas Lake area. Member is composed of several rock types including rubble conglomerate. chert conglomerate, and black dolomite; the chert conglomerate overlies the rubble conglomerate (that occurs in depressions or sinks on upper surface of the Mascot) and at other places forms the lower part of the member; the black fine-grained thick-bedded dolomite, as much as 30 feet thick at the two large sinks, grades upward almost imperceptibly into typical Lenoir limestone; the Douglas Lake, therefore, is regarded as a discontinuous member of the formation.

R. B. Neuman, 1955, U.S. Geol. Survey Prof. Paper 274–F, p. 145 (table), 147. In Tellico-Sevier belt, eastern Tennessee, the Douglas Lake is basal member of the Lenoir. Underlies Mosheim member.

Type locality: On north shore of Douglas Lake, 1½ miles northeast of Douglas Dam, Jefferson County.

Douglass[1] (shales)

Lower Cretaceous: Montana.

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

Derivation of name not given.

†Douty Gravel[1]

Pleistocene (pre-Wisconsin?): Western Washington.

Original reference: B. Willis, 1898, Geol. Soc. America Bull., v. 9, p. 111.

D. R. Crandell, D. R. Mullineaux, and H. H. Waldron, 1958, Am. Jour. Sci., v. 256, no. 6, p. 395. According to Willis (1898), deposits of Vashon age include Vashon drift, Osceola till, Osceola clays, and Douty gravels. Osceola till of Willis is now known to be a postglacial mudflow deposit from Mount Rainier. Osceola clays and Douty gravels of Willis are glacial drift of Vashon age, and the two names are thereby abandoned.

Named for Douty Station, in canyon near Carbonado, Pierce County.

Dover Limestone Member (of Stotler Limestone)

Dover Limestone (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.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 15. Consists of thin fossiliferous limestone and some shale. Thickness 2 to 4 feet in Nebraska, southeastern Iowa, and northwestern Missouri; thicker in southern Kansas. Underlies Dry formation; overlies Langdon formation.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2274 (fig. 1), 2275. Rank reduced to member status in Stotler limestone (new). Underlies Dry shale member; overlies Pillsbury shale (new).

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 12, fig. 5. Consists of two limestone beds separated by thin bed of gray shale. Upper limestone is dense, gray, unfossiliferous, and weathers buff; lower limestone is dark gray to black, weathering to nodular form with many white fragments of *Derbyia*, *Chonetes*, and *Crurithyris*. Thickness about 3 feet. Underlies Dry shale; overlies Table Creek shale. Wabaunsee group.

Named for exposures near Dover, Shawnee County, Kans.

Dover Shale and Sandstone (in Wabaunsee Group)[1]

Pennsylvanian: Northeastern Kansas.

Original reference: J. W. Beede, 1898, Kansas Acad. Sci. Trans., v. 15, p. 31.

Named for Dover, Shawnee County.

Dowell Hill facies[1] (of New Providence Formation)

Lower Mississippian: Southern Indiana.

Original reference: P. B. Stockdale, 1931, Indiana Dept. Conserv., Div. Geology Pub. 98, p. 77, 95, 102–103.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 127–128, pl. 1. Mississippian facies nomenclature discussed. Correction chart lists Dowell Hill as facies of New Providence formation.

Described in Brown and Bartholomew Counties. Name derived from Dowell Hill in NE¼ sec. 25, T. 9 N., R. 4 E., 5½ miles west of Columbus, Bartholomew County.

Dowelltown Member (of Chattanooga Shale)

Dowelltown Formation (in Chattanooga Shale)

Upper Devonian: Central Tennessee.

Guy Campbell, 1946, Geol. Soc. America Bull., v. 57, no. 9, p. 883–884, 885. In type area and adjacent territory, consists of lower and upper member, each with a lower bed of fissile black shale and an upper bed with interbedded layers of gray and black shale; near crest of Nashville Dome, formation is a poorly fissile soft dull-black shale that shows a blending of the black and gray shale elements into a shale intermediate in character; lower member pinches out and is represented at Nashville only by a foot of sandstone. A layer of sandstone which is correlated with the Hardin sandstone occurs at base of Dowelltown at Celina. Thickness varies; 22 to 29 feet in type area; 8 to 12 feet in Macon and Clay Counties; 15 to 19 feet in Sumner County. Lies between Trousdale formation below and Gassaway shales (new) above and is basal part of the Chattanooga in most of central Tennessee. Devonian.

S. G. Conrad, R. T. Elmore, Jr., and S. W. Maher, 1954, (abs.) Geol. Soc. America Bull., v. 65, no. 12, pt. 2, p. 1358. Termed Dowelltown member of Chattanooga shale. Within Flynn Creek structure, Jackson County, maximum thickness of Dowelltown is 166.4 feet.

W. H. Hass, 1956, U.S. Geol. Survey Prof. Paper 286, p. 12 (table 1), 16–20. In this report, considered a member of the Chattanooga shale. Underlies Gassaway member and in some areas overlies Hardin sandstone member. Where well developed, it is between 10 and 17½ feet thick and consists of two persistent units; lower one, which is predominantly black shale, and upper, which is primarily a grayish mudstone near the top of which is a bentonite bed about 0.1 foot thick. On west flank of Cincinnati anticline, Dowelltown is commonly a sandy black shale as much as 17 feet thick. Wedges out in Sequatchie Valley of eastern Tennessee and has not been recognized in south-central Tennessee or north-central Alabama.

Type sction: Outcrop 1½ miles east of Dowelltown, DeKalb County. Hass did not find Campbell's type section at designated distance but considered an exposure 3.1 miles east of Dowelltown on an abandoned part of Tennessee Highway 26 as Campbell's type locality.

Downeys Bluff Member (of Renault Formation)

Mississippian (Chester Series): Southern Illinois and northern Kentucky.

Elwood Atherton, 1947, Illinois Acad. Sci. Trans., v. 40, p. 129, 130 (fig. 7), 131 (fig. 8). Frank Tippie (unpub. ms.) correlated upper part of the Renault with the 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 Shetlerville member. Thickness about 40 feet. At type locality, underlies Bethel sandstone.

J. M. Weller and others, 1952, Illinois Geol. Survey Bull. 76, p. 62–63. In fluorspar district, consists predominantly of limestone with small amounts of shale occurring as partings; limestones are commonly gray or bluish gray and crystalline to more or less fine grained. Thickness about 30 feet. Overlies Shetlerville member; at Downeys Bluff, contact is unconformable and at most places separation of the two units is difficult, especially where shale is not abundant in Shetlerville; underlies Bethel sandstone.

Type locality: Downeys Bluff, NW¼SE¼ sec. 5, T. 13 S., R. 8 E., Hardin County, Ill.

†Downs Limestone (in Greenhorn Limestone)[1]

Upper Cretaceous: North-central Kansas.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 50.

Quarried near Downs, Osborne County.

Dox Sandstone (in Unkar Group)[1]

Precambrian (Grand Canyon Series): Northern Arizona.

Original reference: L. F. Noble, 1914, U.S. Geol. Survey Bull. 549.

Charles Keyes, 1938, Pan-Am. Geologist, v. 70, no. 2, p. 107 (table), 110. Top formation in Grand Canyon series. Thickness over 3,000 feet in Unkar Valley. Underlies Cardenas lava series (new).

Named for Dox Castle, in Shinumo quadrangle, underneath which a typical section is found below Tonto group, which makes the castle.

Doxey Member (of Quartermaster Formation)[1]

Permian: Western Oklahoma.

Original reference: H. L. Griley, 1933, Pan-Am. Geologist, v. 59, no. 3, p. 234.

D. A. Greene, 1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 11, p. 1473, 1474. Doxey shale is 160- to 200 feet thick in Washita and Beckman Counties; near middle of unit are several bench-forming beds of siltstone. Underlies Elk City member, contact irregular; overlies Cloud Chief member.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Quartermaster formation includes Doxey and Elk City members. Cloud Chief mapped as formation.

Quartermaster formation is noted as occurring in Beckham, Caddo, Custer, Grady, and Washita Counties.

Doyle Shale (in Chase Group)[1]

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

Original reference: C. S. Prosser, 1902, Jour. Geology, v. 10, p. 715.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 39, p. 80. Restored to formal nomenclature and considered as consisting of (ascending) Holmesville shale, Towanda limestone, and Gage shale members, which had heretofore been given formational rank. Overlies Barneston limestone; underlies Winfield limestone.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 115–116. Subdivided into (ascending) Holmesville shale, Towanda limestone, and Gage shale members. Members recognized in Kansas, southeastern Nebraska, and northern Oklahoma where they have been identified in Kay and Osage Counties. Members cannot be differentiated in Pawnee County. Thickness 103 to 118 feet in Kay County; 125 to 135 feet in Osage County. Thickness difficult to determine in Pawnee County; electric logs show about 150 feet. Overlies Fort Riley limestone; underlies Winfield limestone. Wolfcamp series.

Named for exposures on Doyle Creek, southwest of Florence, Marion County, Kans.

Doylesburg Member (of Shippensburg Formation)

Middle Ordovician (Bolarian): South-central Pennsylvania.

L. C. Craig, 1949, Geol. Soc. America Bull., v. 60, no. 4, p. 715 (fig. 1), 727–731. Name proposed for uppermost member of formation. Described at type locality as massive-bedded white-weathering dove calcilutite with dark-gray fine-grained platy limestone at top. In western belts of outcrop, two locally intertonguing lithofacies recognized: calcilutite facies and platy limestone facies with heavy interbeds of medium-gray to dove limestone conglomerate. Facies variations distributed in northeast-trending belts. Thickness 6 to 40 feet. Conformably overlies Fannettsburg member (new); disconformably underlies Mercersburg formation.

Type section: Exposure on south side of U.S. Route 30, 1 mile southwest of St. Thomas, Franklin County. Named for exposure at Binkley and Ober quarry at Dry Run, 4 miles southwest of Doylesburg in Path Valley.

Dozier Sandstone Member (of Rush Springs Formation)

Dozier Sandstone Member (of Peacock Formation)[1]

Permian: Western Texas.

Original reference: J. W. Beede, 1907, Kansas Univ. Sci. Bull., v. 4, no. 3, p. 142.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, pl. 2. Reallocated to member status in Rush Springs formation.

U.S. Geological Survey has abandoned the term Peacock Formation.

First described on western side of "Dozier Mountains," east of Mr. Caperton's place (then Dozier post office), 15 miles south or southwest of Shamrock, Collingsworth County.

Dozier Mounds Dolomite

Dozier Mounds Dolomite Member (of Custer Formation)

Triassic: Texas.

Robert Roth, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 4, p. 422, 438, 439, 450–457. Referred to as Dozier Mounds dolomite and Dozier Mounds dolomite member of Custer formation. When Custer was originally defined (Roth, 1932), base of Dozier Mounds dolomite was chosen as base of Custer because Dozier Mounds dolomite [Roth did not use formal name Dozier Mounds in his 1932 report] and Verden channel dolomite of Oklahoma were considered the same. Present study shows that Dozier Mounds dolomite is not always at base of Custer. Interval between Dozier Mounds dolomite and base of Custer increases as section is traced southwestward from Collingsworth County. First description of unit credited to Gould (1906, U.S. Geol. Survey Water-Supply Paper 154), who described unit near middle of Quartermaster as ledge of rather hard red or pinkish more or less oolitic sandstone, which on weathering gives rise to a number of flat-topped buttes and ridges. One of most typical [buttes] is Dozier Mounds, near Dozier post office. [On plate 8, Gould showed a hill in Rocking Chair Mountains capped by Dozier sandstone.]

Type locality: NE¼NE¼NE¼ sec. 28, Blk. 16, H. and G. N. Survey, Collingsworth County. Named for Dozier Mounds.

Dracut Diorite[1]

Upper Carboniferous or post-Carboniferous: Northeastern Massachusetts and southeastern New Hampshire.

Original reference: B. K. Emerson, 1917, U.S. Geol. Survey Bull. 597, p. 221–223, map.

M. P. Billings, 1956, Geology of New Hampshire, pt. 2, Bedrock geology: Concord, New Hampshire State Plan. Devel. Comm., p. 66. Not mapped by name in New Hampshire.

Named for occurrence at Dracut, north of Lowell, Middlesex County, Mass.

Dracut Norite[1]

Post-Cambrian and pre-Carboniferous: Northeastern Massachusetts.

Original reference: E. E. Fairbanks, 1927, Boston Soc. Nat. History, v. 38, p. 397–407.

W. H. Dennen, 1943, Econ. Geology, v. 38, no. 1, p. 27, 29, 32–34, 35–41. Contains many inclusions of Merrimack quartzite which it intrudes. Typical texture is holocrystalline. Cut by Andover granite and a few diabase dikes. Post-Cambrian and pre-Carboniferous.

Occurs at Dracut, Middlesex County.

Dragonian 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 Dragon local fauna in North Horn formation, Dragon Canyon, Emery County, Utah, principally from western half of sec. 8, T. 19 S., R. 6 E. Covers interval between Paleocene Puercan (older) and Torrejonian ages. Definition of 18 provincial time terms, based on mammal-bearing units, for North American continental Tertiary. [For sequence see under Puercan.]

†Dragoon Quartzite[1]

Middle Cambrian: Southeastern Arizona.

Original reference: E. T. Dumble, 1902, Am. Inst. Mining Engineers Trans., v. 31, p. 696–715.

Dragoon Mountains.

Dragoonan series[1]

Cambrian: Arizona and New Mexico.

Original reference: C. R. Keyes, 1915, Conspectus of geologic formations of New Mexico. Des Moines, Robert Henderson, State Printer, p. 4, 6.

Named for Dragoon Mountains, southeastern Arizona.

Draney 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, 83.

R. E. Peck, 1941, Jour. Paleontology, v. 15, no. 3, p. 285–286. Considered Lower Cretaceous on basis of faunal studies.

L. S. Gardner, 1944, U.S. Geol. Survey Bull. 944–A, p. 7. In Irvine quadrangle, Idaho, 245 feet thick; overlies Bechler shale and underlies Bear River formation.

A. Moritz, 1953, Intermountain Assoc. Petroleum Geologists [Guidebook] 4th Ann. Field Conf., p. 65 (table 1), 67 (fig. 2), 68. In Gannett Hills area, western Wyoming, overlies Bechler formation (shale or conglomerate); underlies a discontinuous unnamed red bed unit below Bear River formation. Tygee sandstone is here included in Bear River formation.

H. R. Wanless, R. L. Belknap, and Helen Foster, 1955, Geol. Soc. America Mem. 63, p. 56, pl. 21. Referred to as member of Gannett group in Jackson Hole area. Consists of about 55 feet of limestone. Underlies Tygee sandstone member; overlies Bechler conglomerate member.

Named for exposure on top of ridge about 1¼ miles east of Draney Ranch, on Tygee Creek, sec. 10, T. 8 S., R. 46 E., Boise meridian, Idaho.

Draper Dolomite Member (of Nittany Formation)

Lower Ordovician (Canadian): Western Virginia.

B. N. Cooper, 1939, Jour. Geology, v. 47, no. 5, p. 511 (footnote). Name applied to upper member of formation; overlies Oglesby member (new). Thickness approximately 350 feet.

B. N. Cooper, 1939, Virginia Geol. Survey Bull. 55, p. 19–20, pls. 1, 3. Formally proposed as Draper dolomite member. Composed of medium-bedded light-gray dolomitic limestone and dolomite; most beds are siliceous and slightly argillaceous; bedding is uniform in lower part of member but irregular in upper part. Thickness as much as 475 feet. Conformably underlies Bellefonte formation. Type locality stated.

Type locality: In Draper Mountain area, south of Lee Highway about three-fourths mile southwest of Draper School, near Draper, Pulaski County.

Draytonville Conglomerate Member (of Kings Mountain Quartzite)[1]

Ordovician to Mississippian: Northwestern South Carolina and southern North Carolina.

Original reference: A. Keith and D. B. Sterrett, 1931, U.S. Geol. Survey Geol. Atlas, Folio 222.

U.S. Geological Survey currently designates the age of Draytonville as Ordovician to Mississippian on the basis of a study now in progress.

Named for exposures on Draytonville Mountain, Cherokee County, S.C.

Dresbach Group

Dresbach Sandstone[1] or Formation

Upper Cambrian: Southern Minnesota, northwestern Illinois, northeastern Iowa, and western Wisconsin.

Original reference: N. H. Winchell, 1886, Minnesota Geol. Nat. History Survey 14th Ann. Rept. p. 334-337.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 9, 28 (table 4), 29–35. Formation described in southeastern Minnesota where it includes (ascending) Mount Simon, Eau Claire, and Galesville members. Underlies Franconia formation. At type section, includes Galesville member, 24 feet, and Eau Claire member about 128 feet. St. Croixian series.

H. B. Willman and J. N. Payne, 1942, Illinois Geol. Survey Bull. 66, p. 54. Classified as group consisting of Mount Simon, Eau Claire, and Galesville formations.

R. R. Berg, 1953, Jour. Paleontology, v. 27, no. 4, p. 555. Underlies Woodhill member of Franconia formation.

R. R. Berg, C. A. Nelson, and W. C. Bell, 1956, Geol. Soc. America Guidebook for Field Trips Minneapolis Mtg., Field Trip 2, p. 6–8. No exhaustive study of Dresbach formation has been published, and distribution of its members and faunas is poorly known. Internally, Dresbach contains three distinguishable but genetically and gradationally related rock types: (1) medium- to coarse-grained quartzose sandstone that characterizes near-shore transgressive (Mount Simon member) and regressive (Galesville member) phases of cycle, (2) shaly sandstone and very fine grained quartzose sandstone that characterizes offshore (Eau Claire member) phase, and (3) red shale phase of Eau Claire identified in wells. Dresbach is topped by disconformity. At type section, uppermost 35 feet of Eau Claire member is composed of thin-bedded very fine grained sandstone, siltstone, and shale. Overlying 93 feet of Galesville member is massive- to crossbedded fine- to medium-grained sandstone. This subdivision of type section differs from previous descriptions in which most of Galesville sandstone was included in Eau Claire member.

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

Named from town of Dresbach in Winona County, Minn.

†Dresbach Shale[1]

Upper Cambrian: Southeastern Minnesota.

Original reference: N. H. Winchell, 1888, Minnesota Geol. Nat. History Survey Final Rept., v. 2, p. 364.

At Dresbach, Winona County.

Dresbachian 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 Dresbachian includes three faunal zones: *Cedaria*, *Crepicephalus*, and *Aphelaspis*.

C. A. Nelson, 1956, Internat. Geol. Cong. 20th Mexico, Cambrian symposium, pt. 2, p. 421–425. Dresbachian stage consists, by definition, of *Cedaria*, *Crepicephalus*, and *Aphelaspis* zones, which in turn occur within middle Eau Claire member of Dresbach formation. Hence, it is likely that Dresbach formation and Dresbachian stage will maintain nomenclatorially coincident boundaries in upper Mississippian Valley. However, *Cedaria* and *Aphelaspis* zones have their minimum expression in type Dresbachian area because of hiatuses associated with unconformities that bound Dresbach formation. Consequently, concept of Dresbachian will have to be expanded in area where sedimentary record is more complete and where its faunas mingle with earlier and later ones.

Named from town of Dresbach in Winona County, Minn.

Dresden Amphibolite[1]

Precambrian: Northern New York.

Original reference: H. L. Alling, 1918, New York State Mus. Bull. 199.

Type locality: Dresden Township, Washington County.

Dresden Sandstone (in Pottsville Formation)[1]

Pennsylvanian: Southeastern Ohio.

Original reference: E. Orton, 1884, Ohio Geol. Survey, v. 5, p. 919, 920, 991.

Probably named for Dresden, Muskingum County.

Drews Lake Granite[1]

Carboniferous(?): Northeastern Maine.

Original reference: H. E. Gregory, 1900, U.S. Geol. Survey Bull. 165, p. 106–107, 148–149.

Named for exposures near Drews Lake, west of Houlton, Aroostook County.

Drinkard Sandy Member (of Yeso Formation)

Permian: Southeastern New Mexico (subsurface).

R. E. King, 1945, New Mexico Bur. Mines Mineral Resources Bull. 23, p. 13–15, fig. 1. Name applied to widespread clastic zone in middle or lower part of Yeso formation. In eastern Lea County, member is 90 to 110 feet thick, and consists of very fine grained calcareous and argillaceous gray and brown sandstone and sandy shale, in part pyritic, interbedded with brown sandy dolomite. In type well, occurs between depths of 6,100 and 6,210 feet.

Type section: Penetrated in Texas Co. Blinebry 1, 660 feet from south line and 1,980 feet from east line sec. 19, T. 22 S., R. 38 E., Drinkard area, Lea County.

Drinker Creek sandstone member (of Lanesboro formational suite)

Upper Devonian (Chautauquan): Northeastern Pennsylvania.

K. E. Caster, 1938, Jour. Paleontology, v. 12, no. 1, p. 45 (fig. 7), 46, 47–49. Name proposed for member at base of formational suite. Described as micaceous, quartzose, usually gray or olive-greenish sandstone; varies from fine sand to thin layers of flat vein-quartz pebbles up to 1 inch in diameter. Whole unit more or less lenticular and locally broken into flags and shales. Thickness 25 feet. Basal unit of upper sandstone sequence of White's (1881) New Milford group.

Type locality: Old quarry pits near forks of Drinker Creek about 1½ miles south of Susquehanna, Susquehanna County.

Dripping Spring Quartzite (in Apache Group)[1]

Precambrian: Southeastern Arizona.

Original reference: F. L. Ransome, 1903, U.S. Geol. Survey Prof. Paper 12.

M. N. Short and others, 1943, Arizona Bur. Mines Bull. 151, Geol. Ser. 16, p. 12, 21–22. Completely uninterrupted section crops out on east side of Potts Canyon just west of Prudential mine. Here thickness is 820 feet, which is average total thickness of formation in Superior area.

J. R. Cooper, 1950, Arizona Bur. Mines Bull. 156, Geol. Ser. 18, p. 31, 32 (fig. 13). Unconformably underlies Bolsa quartzite in Johnson Camp area, Little Dragoon Mountains, Cochise County.

H. C. Granger and R. B. Raup, 1959, U.S. Geol. Survey Bull. 1046–P, p. 422–424, pls. 46–48. An upper and a lower member recognizable throughout Gila County. Lower member typically feldspar-rich cross-stratified well-indurated sandstone; upper member mostly of thinly stratified arenaceous siltstone. Thickness ranges from 450 to 700 feet and averages about 600 feet in Sierra Ancha region and about 450 to 540 feet in Mescal Mountains. Overlies Barnes conglomerate; underlies Mescal limestone.

D. W. Peterson, 1960, U.S. Geol. Survey Geol. Quad. Map GQ–128. Three members recognized in Haunted Canyon quadrangle. Lower, 100 to 200 feet thick, medium- to coarse-grained quartzite, grayish yellow, light gray, white; middle, 10 to 15 feet, nearly pure white medium-grained quartzite; upper, 200 to 300 feet, fine-grained quartzite interbedded with layers of shale. Overlies Barnes conglomerate; underlies Mescal limestone.

U.S. Geological Survey currently classifies the Barnes Conglomerate as a member of the Dripping Spring Quartzite on the basis of a study now in progress.

Named for Dripping Spring Mountains, Globe quadrangle.

Dripping Springs Formation

Pleistocene: Southern California.

J. F. Mann, Jr., 1955, California Div. Mines Spec. Rept. 43, p. 3, 9, 14–15, pl. 1. Defined as the fanglomerates, in Temecula region, deposited with reference to a base level not greatly above present base level, as opposed to Pauba fanglomerates which were deposited at a much higher base level. Thickness about 30 feet. Unconformably underlies Recent terrace gravels; unconformably overlies Pauba formation (new).

Occurs in Elsinore fault zone in western Riverside and northern San Diego Counties. Well exposed in Dripping Springs alcove, Riverside County, especially in roadcuts along Highway 71.

Driscoll-Sevier Sand

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), 1632–1633, 1634. Name suggested for sand unit north and west of marine shale wedge [Old Ocean sand] and representing merged western representatives of both underlying [Van Vleck] and overlying [Pierce Estate or Flour Bluff] sand.

Typically developed in well No. 27 (Santa Clara, Driscoll-Sevier No. A–1), Nueces County.

Droop Sandstone (in Bluefield Formation[1] or Group)

Mississippian: Southeastern West Virginia and southwestern Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 300, 415.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey Greenbrier County, p. 225, 264. In Greenbrier County is grayish brown, massive, medium grained, and hard, commonly crossbedded, and ripple marked with carbonized plant remains. Thickness 50 to 100 feet. Underlies unnamed shale sections; overlies yellow, olive sandy shale above Reynolds limestone. Mauch Chunk series.

Type locality: On Droop Mountain, Pocahontas County, W. Va., in vicinity of Spice, Mt. Zion Church and West Droop School.

†Drum Group[1]

Pennsylvanian: Northeastern Oklahoma.

Original reference: C. N. Gould, 1925, Oklahoma Geol. Survey Bull. 35, p. 73–74.

Drum Limestone (in Kansas City Group)[1]

Drum Limestone (in Skiatook Group)

Drum Limestone Member (of Kansas City Formation)[1]

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

Original reference: G. I. Adams, 1903, U.S. Geol. Survey Bull. 211, p. 37, 63, 66.

R. C. Moore and others, 1937, Kansas Geol. Soc. Guidebook 11th Ann. Field Conf., p. 40 (table), 42. Included in Skiatook group. Overlies Cherryvale shale; underlies Chanute shale of Ochelata group. Near Kansas-Oklahoma State line, the Drum is absent owing to erosion. Reappears a few miles south of State line and in Oklahoma has been known as Dewey limestone.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2030–2032. Drum limestone, in type area, comprises two units classed as members. Upper unit, Corbin City, locally 40 feet or more in thickness, is not persistent. Corbin City disconformably overlies lower member which consists of fine-grained bluish limestone; this is identified unquestionably as Dewey limestone of northeastern Oklahoma. Northeastward tracing proves that Dewey member is same as limestone called Cement City in Kansas City area. Inasmuch as Dewey has priority over Cement City and has been widely used, it is recognized by Oklahoma Geological Survey as formational unit which is classed as uppermost division of Skiatook group. Kansas has used Cement City for lower member of Drum limestone, and Cement City was recognized by interstate conference. Kansas proposes to deviate from interstate classification by adopting Dewey, instead of Cement City.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 36–37. Formation comprises (ascending) Corbin City limestone (missing in Nebraska), Cement City limestone, Richfield Quarry shale (new), and P. W. A. Quarry limestone (new) members. Thicknesses: 12½ feet southwestern Iowa; 14 feet, Sarpy County, Nebr.; 3 to 18 feet, Kansas City, Mo.; 2 to 60 feet in Kansas. Underlies Chanute formation; overlies Quivera formation. Note on type locality.

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 2 feet in Madison and Adair Counties; no members differentiated. Overlies Cherryvale formation; underlies Chanute formation. Kansas City group.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. As shown on chart, Drum Limestone comprises (ascending) Cement City Limestone and Corbin City Limestone Members.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 26, fig. 5. Formation in Iowa is single conglomeratic, oolitic limestone bed characterized by tiny *Triticites*. Thickness 6 feet, Madison County; 14 feet, Pottawattamie County. Overlies Quivera shale; underlies Chanute shale. Kansas City group.

Type locality: Along highway east of Independence, Kans., and at cement plant in NW sec. 4, T. 33 S., R. 16 E. Named for Drum Creek, Montgomery County, Kans.

Drumheller Silts

Quaternary (post-Wisconsin): Central Washington.

[G. F. Beck], 1937, Central Washington Coll. Education Bull., v. 2, no. 7. Proposed for most recent valley fills occurring generally over Columbia Basin. Channel fills are 6 to 12 feet in depth. Bones showing relationship to modern buffalo are abundant in silts.

Well exposed in Drumheller section of Lower Crab Creek, Grant County.

Drumlummon Porphyry[1]

Tertiary, upper(?): Western central Montana.

Original reference: J. Barrell, 1907, U.S. Geol. Survey Prof. Paper 57.

Mapped on Drumlummon Hill, just south of Marysville, Lewis and Clark County.

Drummond[1] (clays)

Tertiary: Montana.

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

Derivation of name not stated.

Drury Shale Member (of Caseyville Formation)

Drury Shale Member (of Battery Rock Formation)

Drury Shale and Sandstone Member (of Pottsville Formation)[1]

Pennsylvanian: Southwestern Illinois.

Original reference: J. E. Lamar, 1925, Illinois Geol. Survey Bull. 48, p. 23, 91–95, map.

J. M. Weller, 1940, Illinois Geol. Survey Rept. Inv. 71, p. 37, 38. Reallocated to member status in Battery Rock formation. Principally sandy shale and shaly sandstone 50 to 100 feet thick. Upper part of formation; overlies Battery Rock sandstone in lower part of formation.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 29–30, 44 (table 1), 61, pl. 1. Reallocated to member status in Caseyville formation (redefined). Includes all strata between Battery Rock sandstone member below and Pounds sandstone member. Dominantly shale but includes some sandstone and two or more discontinuous coals. Thickness at type section of Caseyville, 98 feet. Name Drury not used in southeastern Illinois where Gentry coal and Sellers limestone are differentiated in this interval. Presentation of new rock-stratigraphic classification of Pennsylvanian strata of Illinois.

Type locality: Along Drury Creek, secs. 33 and 34, T. 10 S., R. 1 W., Jackson County. Named for exposures along Drury Creek, in bluffs south of Makanda, Jackson County.

Dry Shale Member (of Stotler Limestone)

Dry Shale (in Wabaunsee Group)[1]

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

Original reference: R. C. Moore, 1936, Kansas Geol. Survey Bull. 22, p. 22, 236.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 15. Consists of clay-shale, sandy shale, and fossiliferous limeseams. Thickness 14 feet in clay pits at Nebraska City. Areal extent noted.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2274 (fig. 1), 2275. Rank reduced to member status in Stotler limestone (new). Underlies Grandhaven limestone member; overlies Dover limestone member.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 12, fig. 5. Bluish-gray silty shale with thin interbedded gray limestone and siltstone; ferruginous concretions common in siltstone. Thickness about 20 feet. Underlies Grandhaven limestone; overlies Dover limestone. Wabaunsee group.

Type locality: Dry Creek, in sec. 5, T. 20 S., R. 11 E., southwest of Emporia, Lyon County, Kans.

Dry Camp Breccia

Tertiary: Northwestern Arizona.

U.S. Bureau of Reclamation, 1950, U.S. Bur. Reclamation, Boulder Canyon Proj. Final Repts., pt. 3, Preparatory Exams., Geol. Inv., Bull. 1, p. 99, fig. 34 (geol. map). An intervolcanic sedimentary breccia. Resembles Dam breccia (new) but more definitely bedded. Maximum thickness about 400 feet. Part of younger volcanic series of area. Underlain and overlain by basalt. Name credited to F. L. Ransome (unpub. rept.).

Occurs only on east side of Black Canyon, Hoover Dam area.

Dry Cimarron Flow (in Capulin Basalts)

Quaternary: Northeastern New Mexico.

R. F. Collins, 1949, Geol. Soc. America Bull., v. 60, no. 6, p. 1031. Black fine-grained vesicular olivine basalt with 4-mm olivine phenocrysts.

One long flow north and east 21 miles down Dry Cimarron Canyon, from Folsom, Union County.

Dry Creek Formation[1]

Eocene: Northern California.

Original reference: V. T. Allen, 1929, California Univ. Pub., Bull. Dept. Geol. Sci., v. 18, no. 14, p. 367–369, 400, 401, 403.

Ralph Stewart, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 34. Used in quotational sense as a sandstone member of Ione formation. Name Dry Creek is preoccupied by Dry Creek shale of Montana.

Exposed in steep-walled valley formed by a tributary of Dry Creek, Chico quadrangle.

Dry Creek Glaciation

Pleistocene: Central southern Alaska.

Clyde Wahrhaftig 1953, *in* T. L. Péwé and others, U.S. Geol. Survey Circ. 289, p. 7, 13 (table 1); Clyde Wahrhaftig, 1958, U.S. Geol. Survey Prof. Paper 293–A, p. 17, 28–30, pls. 2, 3, 5.

Lake deposit at Dry Creek, 5 miles west of Healy; and drift between McKinley Park Railroad Station, 10 miles south of Healy, and Windy 20 miles further to the south, Nenana River valley area.

Dry Creek Sandstone Member[1] (of Edwardsville Formation)

Lower Mississippian: Southern Indiana.

Original reference: P. B. Stockdale, 1931, Indiana Dept. Conserv., Geol. Pub. 98, p. 76, 238, 243, 246.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 74. Dry Creek sandstone and Brownstown Hills sandstone members included in Medora Knob facies of formation.

Named for prominence along Dry Creek, both east and west of Jackson-Lawrence County line.

Dry Creek Shale[1]

Dry Creek Shale Member (of Open Door Limestone)

Dry Creek Shale Member (of Red Lion Formation)

Dry Creek Shale Member (of Sage Limestone)

Dry Creek Shale Member (of Snowy Range Formation)

Upper Cambrian: Western Montana and northwestern Wyoming.

Original references: A. C. Peale, 1893, U.S. Geol. Survey Bull. 110; 1896, U.S. Geol. Survey Geol. Atlas, Folio 24; W. H. Weed, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 3, p. 286.

Charles Deiss, 1936, Geol. Soc. America Bull., v. 47, no. 8, p. 1284, 1335–1337, strat. sections. Weed's (1900) definition of Dry Creek shale emended. Dry Creek rests on Pilgrim limestone (emended) and is youngest Cambrian formation in any of measured sections. Underlies Devonian limestones; term Yogo limestone discarded. Characteristically bright-maroon and yellow-buff dolomitic sandy calcareous mudstones, interbedded with red and green shales and thin limestones. Average thickness 68 feet, exclusive of Checkerboard and Helena sections; from maximum thickness of 99 feet, on Belt Creek, formation thins eastward to 32 feet in Big Snowy Mountains, and westward to extinction in Beaver Creek area in Big Belt Mountains; thickness 50 feet at emended type section, herein designated Weed (1900) defined Dry Creek shale as lying "between the beds of the massive Pilgrim limestone and the dark chocolate-colored beds of the Jefferson formation." The statement gives exactly the actual conditions observable wherever these rocks are exposed and is concise in placing Cambrian-Devonian boundary at top of Dry Creek shale. Consequently, Yogo limestone or any other Cambrian rocks could not be present in Little Belt Mountains above Dry Creek. That Weed did not find Cambrian rocks in these mountains is implied in his statement. If Weed's statement had not been confused by the definition of the fictitious Yogo limestone, much confusion would have been avoided, and a more correct picture of Cambrian stratigraphy in central Montana would have resulted. Weed (1900) did not specify type section for Dry Creek shale, name of which he obviously took from Peale's (1893) Three Forks section, instead of from Little Belt Mountains. Type of Dry Creek shale (formation) must be in Little Belt Mountains province, or serious confusion will result. In section on north side of Dry Wolf Creek, Dry Creek shale is sharply defined at its top by *Spirifer* bed which marks base of Devonian. However, Dry Creek shale is better exposed in Yogo Gulch, and lower 13 feet contain only identifiable Dry Creek fossils in Montana known to writer. [See Flathead quartzite.]

Erling Dorf and Christina Lochman, 1940, Geol. Soc. America Bull., v. 5, no. 4, p. 551. Unit termed Dry Creek shale by Deiss (1936) apparently represents lower part of Snowy Range formation (new).

Christina Lochman and Donald Duncan, 1944, Geol. Soc. America Spec. Paper 54, p. 2–3, 4 (fig. 1), 6–12. Dry Creek shale is partly emended by restricting all limestone pebble conglomerates and gray-green shales to Pilgrim formation. This revision gives lithologic unity to both Dry Creek and Pilgrim in all sections and restricts fossil horizons to Pilgrim. As thus emended, contact between the two formations differs in most sections from that designated by Deiss (1936). Dry Creek-Jefferson boundary discussed.

L. L. Sloss and W. M. Laird, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 8, p. 1405–1406, 1407–1409, 1413, 1415. In central Montana, shales, mudstones, and argillaceous dolomites assigned to Devonian are apparently transitional with beds lithologically like Upper Cambrian Dry Creek shale. Weed (1900) and Deiss (1936) assigned all shales to Cambrian, although Deiss recognized difficulty of separating them from Devonian. It is believed that a variable proportion of the shale previously placed in Cambrian is Devonian in age. In Three Forks area, basal Devonian rocks are predominantly red shales, mudstones, and argillaceous dolomites. These beds are in apparent transition with underlying Cambrian strata and were formerly grouped with them in Dry Creek shale. For purposes of this report, the glauconitic, micaceous, and sandy shales associated with flat-pebble conglomerates, bearing trilobite fragments and phosphatic brachiopods, are assigned to the Cambrian Dry Creek shale; the nonmicaceous and less fissile shales and mudstones interbedded with rocks of Devonian type are placed in Devonian. At Logan, the Dry Creek is 45 feet thick; 34 feet, Yogo Creek section, Judith Basin County.

Christina Lochman, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 11, p. 2200–2222. Name Dry Creek shale was originally proposed by Peale for small nonfossiliferous unit in Gallatin formation in Upper Cambrian sequence in vicinity of Three Forks, Mont. Weed (1899, U.S. Geol. Survey Geol. Atlas, Folio 55) used same name for formation of brick-red shales and dolomites, a unit entirely different in age, lithology, and stratigraphic position from that of Peale. Subsequent usage of term, with or without definition, has been regarded by authors as implying that they were referring to beds which were wholly or in part the equivalent of original Dry Creek shale member of Peale. With exception of Knopf (1913, U.S. Geol. Survey Bull. 527), no author using Dry Creek shale as formational unit in Montana sections referred to beds which were lithologic or time equivalent of Peale's Dry Creek shales. Names should be used as originally defined by Peale, but strata involved do not constitute a mappable lithic unit by present mapping standards. Peale's Dry Creek shales constitute lower member of Snowy Range formation; name Sage pebble conglomerate is proposed for upper member of this formation. Weed's (1899) formation of brick-red shales and dolomites is mappable lithic unit of Devonian age; it is basal Devonian unit (unit C) of Sloss and Laird (1947) should be called Maywood formation, the name proposed by Emmons and Calkins (1913) for same lithologic unit in Philipsburg quadrangle.

L. L. Sloss and C. A. Moritz, 1951, Am. Assoc. Petroleum Geologists Bull. v. 35, no. 10, p. 2146. Term Red Lion is favored for beds formerly assigned to Dry Creek in southwestern Montana.

A. M. Hanson, 1952, Montana Bur. Mines and Geology Mem. 33, p. 12, 18, pl. 5. Lochman restricted term Dry Creek to Peale's original usage, and, as thus defined, the Dry Creek shale becomes lower shale member of Red Lion formation in southwestern Montana. Overlies Sage pebble conglomerate member. Thickness commonly 20 feet; locally absent.

A. B. Shaw and P. O. McGrew, 1954, Wyoming Geol. Assoc. Guidebook 9th Ann. Field Conf., chart 2. Lochman (1950) revised and redescribed 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 it is better called Sage limestone. Dry Creek shale is thin and rarely mappable and most commonly should be regarded as member of Sage limestone. Gallatin is herein raised to rank of group with Sage limestone as upper member.

A. B. Shaw and C. R. DeLand, 1955, Wyoming Geol. Assoc. Guidebook 10th Ann. Field Conf., p. 38, 39 (fig. 1), 40 (fig. 2), 41. Rank reduced to member status in Open Door limestone (new) in southwestern Wyoming. Forms basal part of formation; overlies Du Noir limestone.

P. W. Richards, 1957, U.S. Geol. Survey Bull. 1021–L, p. 400–401. Snowy Range formation is used in this report [area east and southeast of Livingston] because of inconsistencies in use of Dry Creek shale. Formation in this area apparently includes beds in stratigraphic position of Peale's Dry Creek shales and pebbly limestones and still younger beds.

Type locality (emended): North side of Yogo Gulch, on northeastern side of Little Belt Mountains, Judith Basin County, Mont. Section measured approximately one-eighth mile west of mouth of Bear Creek, in SE¼ sec. 1, T. 13 N., R. 10 E. Peale (1893) did not designate type locality but stated unit was best exposed on Dry Creek, northeast corner Three Forks quadrangle, Gallatin County.

Dry Creek Canyon Member (of Dakota Sandstone)

Lower Cretaceous: South-central Colorado.

K. M. Waagé, 1953, U.S. Geol. Survey Bull. 993, p. 12, 13–17, fig. 2, pls. 2, 4, 5. Consists of three lithologic zones (ascending): even-bedded white sandstone with some interbedded shale with average thickness in type area of about 6 feet; a middle zone composed commonly of upper bed of blue-gray to black plastic clay and lower bed of flint clay and sandy flint clay, thickness up to 18 feet; and roof-rock zone of fine-grained thin- to thick-bedded soft-white to hard-green sandstone, with intercalated sandy gray clay shale and blue-gray plastic clay, up to 27 feet thick. Member underlies upper sandstone unit of Dakota sandstone with local unconformity and overlies lower sandstone unit of Dakota.

Type area: Along Dry Creek Canyon in S½NW¼SE¼ sec. 26, T. 18 S., R. 67 W., Pueblo County.

Dryden Formation

Middle Ordovician (Mohawkian): Western Virginia and eastern Tennessee.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 58, chart 1 (facing p. 130). Name used for combined Benbolt and Wardell formations when these two are not separated by Gratton formation. Consists mostly of limestone, but may contain conspicuous amounts of shale as at Rye Cove and Lone Mountain. Usually easy to identify Benbolt or Wardell parts of sequence in upper and lower parts, respectively, but boundary between two more difficult to find. Thickness 300 to 500 feet. Underlies Witten formation; overlies Surgener formation (new) in Tennessee sections and undivided Peery-Ward Cove sequence in Virginia. Name attributed to B. N. Cooper and G. A. Cooper.

Type section: In fields on both sides of highway about 1 mile east of Dryden and less than 1,000 feet west of Stallard Ford Bridge across Powell River, Keokee (TVA 178–SW) quadrangle, Lee County, Va.

Dry Hill Granite 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. Name credited to Robert Balk. Pre-Triassic.

Robert Balk, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–93. Described in its type area as medium-grained well-foliated granitoid gneiss with uniform pinkish or light-gray color. Layers and lenses of quartz and feldspar are separated by thin black films of biotite; large ellipsoidal crystalloblasts of microcline common. Includes border facies consisting of closely related finer grained siliceous gneiss which lacks feldspar crystalloblasts, has more evenly distributed biotite flakes, and has chalky-appearing feldspars. Both facies occur as sheets 2,500 feet or more in thickness; numerous thinner sheets penetrate Poplar Mountain gneiss. Represents igneous facies of domelike gneissic complex which Emerson (1917) termed Pelham granite. Border facies is stratigraphic equivalent of Joshua schist of Greenfield quadrangle. Middle Paleozoic.

Named for exposures on Dry Hill, 3 miles southeast of Millers Falls, Millers Falls quadrangle.

Dry Hollow Formation

Dry Hollow Latite

Pliocene(?): Southwest-central Utah.

Eugene Callaghan, 1939, Am. Geophys. Union Trans. 20th Ann. Mtg., pt. 3, p. 439 (fig. 2), 440 (fig. 3), 449. Individual latite flows are more than 200 feet thick in many places and aggregate thickness probably about 1,000 feet. Rests on earlier volcanic rocks and upon Mount Belknap rhyolite; interbedded with Joe Lott tuff (new); overlain by younger rocks including Sevier River formation and basalt flows. Tertiary.

U.S. Geological Survey has approved the name Dry Hollow formation for this unit. Age considered to be Pliocene(?). This designation is made on the basis of a restudy of units in this area.

Occurs in Marysvale region. Derivation of name not stated.

Dry Hollow Member (of Frontier Formation)

Upper Cretaceous: Northeastern Utah.

L. A. Hale, 1960, Wyoming Geol. Assoc. Guidebook 15th Ann. Field Conf., p. 136 (chart 1), 139 (fig. 1), 140, 141, 143 (fig. 2), 145 (fig. 3). Consists of basal conglomerate, a lower shaly interval 880 feet thick, 90 feet of carbonaceous coal-bearing rocks, and prominent white cliff-forming sandstone 200 feet thick. Aggregate thickness 1,000 to 1,220 feet. Underlies Grass Creek member (new); unconformably overlies rocks of early Carlile age [Oyster Ridge sandstone member.] Name credited to D. W. Trexler (unpub. thesis).

Typically exposed in Dry Hollow, a strike valley, 1½ miles northeast of Coalville, Summit County.

Drywood Formation (in Cherokee Group)

Drywood 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 Dry Wood (Drywood) formation. Includes Dry Wood coal at top. Underlies Bluejacket sandstone; overlies Rowe formation (new). Included in Krebs group.

C. C. Branson, 1954, Oklahoma Geol. Survey Guide Book 2, p. 6. Referred to as Dry Wood coal cycle in Savannah formation, Krebs group.

W. V. Searight, 1955, Missouri Geol. Survey and Water Resources Rept. Inv. 20, p. 14 (fig. 5), 18 (fig. 7), 20 (fig. 9), 35. At type section, Drywood (Dry Wood) consists of basal black shale, underclay, lenticular sandy shale, and thin coal horizon. Thickness about 5 feet. Overlies Rowe formation; underlies Bluejacket formation. Krebs group.

W. B. Howe, 1956, Kansas Geol. Survey Bull. 123, p. 22 (fig. 5), 38–39. A formation in Krebs subgroup of Cherokee group. In southeastern Kansas, includes (ascending) basal dark shale containing lenticular limestone, thin irregular silty limestone and clay ironstone, underclay, and Dry Wood coal. Thickens from 6 to 8 feet in Crawford County to maximum of somewhat more than 15 feet in Cherokee County. Overlies Rowe formation; underlies Bluejacket formation.

Type locality: Below spillway of the artificial lake on a tributary of Dry Wood Creek in SE¼NE¼ sec. 4, T. 32 N., R. 33 W., 1½ miles west of Liberal, Barton, County, Mo.

Duarte Conglomerate

Pliocene(?): Southern California.

J. S. Shelton, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 63. Coarse unsorted sandy poorly consolidated conglomerate; conspicuously gray and light colored. Maximum exposed thickness at least 1,500 feet, due north of Duarte, where it either overlies or is faulted against sandstone of Topanga(?) formation, and is overlain by Quaternary deposits.

Exposed in steeply dipping, isolated outcrops, in foothills between Maddock and Sawpit Canyons, north and northwest of town of Duarte, east of Monrovia, Los Angeles County.

Dublin Blue Shale[1]

Middle Devonian: Central Ohio.

Original reference: E. Claypole, 1903, Am. Geologist, v. 32, p. 19, 20, 34, 35.

Named for exposures along Scioto River near Dublin, Franklin County.

Dubois Greenstone[1]

Precambrian (Gunnison River Series): Central western Colorado.

Original reference: J. F. Hunter, 1925, U.S. Geol. Survey Bull. 777.

Extends from Lake Fork of Gunnison River on west to beyond South Beaver Creek on east. Named for exposures at old mining camp of Dubois, on Goose Creek, Gunnison River region.

Du Bois Limestone[1] Member (of Topeka Limestone)

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; F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 18. Du Bois limestone member of Topeka formation; underlies Holt shale member; overlies Turner Creek shale 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. 21. Type locality stated.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 15–16, fig. 5. Commonly single bluish-gray bed; locally divided into two limestone beds separated by shale; fossiliferous. Thickness seldom more than 1 foot; lenses out in some localities. Underlies Holt shale member; overlies Turner Creek shale member.

Type locality: About 4 miles southeast of Du Bois, Pawnee County, Nebr. Not definitely identified south of Topeka, Kans.

Dubose Member (of Whitsett Formation)

Dubose Sands and Clays[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), 2632–2633. Here considered member of Whitsett; overlies Stones Switch member. Near Czestochowa, Karnes County, about 85 feet of Dubose is exposed; it is underlain by Stones Switch member and unconformably overlain by Catahoula tuff. Lower 100 feet of member exposed in Tordilla Hill in western Karnes County, hill is capped by sandstone locally called Tordilla sandstone bed; upper part of member is exposed in type section of Whitsett. In southeastern Atascosa County and southwest, Dubose is conformably overlain by Calliham sandstone member; northeast of Fashing, the Calliham is not traceable and Dubose, Calliham sandstone, and Fashing clay member become indistinguishable; northeast of Fashing, this part of section is truncated and overlapped by Catahoula; about 100 feet of Dubose is overlapped in vicinity of Fashing, and about 200 feet is overlapped in northern Karnes County.

Named for exposures in valley wall south of Sandies Creek near former Dubose Ranch, 2.5 miles by county road north-northeast of Sample in southern part of Gonzales County. Sample is on U.S. Highway 87, 7.8 miles south of Smiley.

Dubuque Formation[1]

Dubuque Shaly Member (of Galena Dolomite)

Dubuque Formation (in Galena Group)

Dubuque Member (of Maquoketa Formation)

Middle Ordovician: Eastern Iowa, northwestern Illinois, southeastern Minnesota, and southwestern Wisconsin.

Original reference: F. W. Sardeson, 1907, Geol. Soc. America Bull., v. 18, p. 193.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 90–92. Considered member of Maquoketa formation in Minnesota. Thickness about 30 feet. Underlies Wykoff member; overlies Stewartville member of Galena limestone.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., p. 6, fig. 3. In Dixon-Oregon area, Illinois, considered uppermost formation in Galena group. Thickness about 30 feet. Overlies Wise Lake formation (new).

A. F. Agnew and others, 1956, U.S. Geol. Survey Prof. Paper 274–K, p. 26, 297–299; A. V. Heyl, Jr., and others, 1959, U.S. Geol. Survey Prof. Paper 309, p. 17–18. Referred to as shaly member of Galena dolomite; overlies Stewartville massive member. In mining district member is light-gray to buff fine-grained sugary and silty dolomitic limestone that weathers to yellowish buff; medium to thin bedded and contains interbeds of platy dolomitic shale. Thickness 35 to 45 feet. Age of Galena, Middle Ordovician.

M. P. Weiss, 1957, Geol. Soc. America Bull., 68, no. 8, p. 1029 (fig. 1), 1040–1042, pl. 1. This report [Fillmore County, Minn.] follows Kay's (1935, Jour. Geology, v. 43, no. 5) concept of type section. At type section, interval of transition from Stewartville rock to Dubuque rock is thicker than it commonly is in Minnesota. The Dubuque is unit of interbedded limestone and shale and contains two feldspathized shale beds. Control on thickness of Dubuque in southeastern Minnesota and adjacent Iowa is meager, but it is about 34 feet thick at two outcrops; in Fillmore County, outcrops are close to eroded edge of formation. Overlies Stewartville member of Galena formation; underlies Maquoketa formation.

Named for Dubuque, Dubuque County, Iowa.

Dubuque terrane[1]

Quaternary: Iowa.

Original reference: C. R. Keyes, 1914, Iowa Acid. Sci. Proc., v. 21, p. 186.

Probably named for Dubuque or Dubuque County.

Duchesne Formation[1]

Oligocene: Northeastern Utah.

Original reference: O. A. Peterson, 1932, Carnegie Mus. Annals, v. 21, no. 2, p. 61–63, pl. 1.

Duchesne River, in Duchesne County, traverses these beds.

Duchesne limestone[1]

Upper Jurassic: Utah.

Original reference: C. R. Keyes, 1924, Pan-Am. Geologist, v. 41, p. 36, 300.

Derivation of name not stated.

Duchesnean 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 Duchesne River formation of northeastern Utah. Covers interval between Uintan (Eocene) and Chadronian (Oligocene) ages. Report defines 18 provincial time terms, based on mammal-bearing units, for North American continental Tertiary. [For sequence see under Puercan.]

Duchesne River Formation[1]

Eocene or Oligocene: Northeastern Utah and northwestern Colorado.

Original reference: J. L. Kay, 1934, Carnegie Mus. Annals, v. 23, p. 357–359, pls. 45, 46, map.

P. T. Walton, 1944, Geol. Soc. America Bull., v. 55, no. 1, p. 97 (table 1), 99 (table 2), 122–123. Consists of buff and gray sandstone, red and pink sandy shale, and conglomerate; fluviatile. Thickness western part Uinta basin 1,500 feet; eastern part of basin, 1,372 feet. Unconformably underlies Bishop conglomerate; unconformably overlies Uinta and Uinta(?) formation. Oligocene.

W. B. Cashion and J. H. Brown, Jr., 1956, U.S. Geol. Survey Oil and Gas Inv. Map OM–153. Mapped in oil shale area, Uintah County, Utah, and Rio Blanco County, Colo. Only basal 50 feet of formation exposed. Along Raven Ridge, unconformably overlies both Uinta formation and Green River formation; near axis of basin, unconformably overlies Uinta formation. Eocene or Oligocene.

First described along Duchesne River, Duchesne County, Utah.

Duck Creek Formation[1] or **Limestone** (in Washita Group)

Duck Creek Limestone Member (of Georgetown Limestone)

Lower Cretaceous (Comanche Series): Central and northwestern Texas and south-central Oklahoma.

Original reference: R. T. Hill, 1891, Geol. Soc. America Bull., v. 2, p. 504, 516.

D. L. Frizzell, 1954, Texas Univ. Bur. Econ. Geology Rept. Inv. 22, p. 25–26, table 4. Foraminifera of formation described.

W. J. Fox and O. N. Hopkins, Jr., 1960, Baylor Geol. Soc. Guidebook 5th Field Conf., p. 88, 90–91. In central Texas, considered member of Georgetown limestone. Overlies Kiamichi clay member; underlies Fort Worth limestone member. Thickness 120 feet at type section, thinning to 30 feet in McLennan County. Locally Kiamichi is missing, and Duck Creek rests on Edwards limestone.

B. F. Perkins, 1960, Geol. Soc. America Mem. 83, p. 9 (fig. 3), 12 (fig. 4), 24–27, pl. 2. Formation described in Tarrant and Parker Counties, Tex., where it consists of lower thickly bedded fucoidal limestone and an upper marl with interbedded thin marly limestone. Thickness 50 to 60 feet. Overlies Kiamichi formation with possible unconformity; conformably underlies Fort Worth limestone. Washita group.

Named for Duck Creek, north of Denison, Grayson County, Tex.

†Duck Creek limestone,[1] marl,[1] or limy marl[1]

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

Original reference: W. M. Winton and W. S. Adkins, 1919, Texas Univ. Bull. 1931.

Duck Lake Formation

Pleistocene: South-central Louisiana (subsurface).

J. A. Doering, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 4, p. 782–783. Name applied to interval between base of Lissie and top of Citronelle equivalent that occurs in type well between 880 feet and 1,470 feet.

Type well: Hunt Oil Co. State Lease 1392 No. 1, sec. 2, T. 15 S., R. 11 E., Duck Lake field, St. Martin Parish.

Duck Lake Stage

Miocene: Southeastern Louisiana (subsurface).

C. M. McLean, 1957, Gulf Coast Assoc. Geol. Soc. Trans., v. 7, p. 241, 242 (fig. 1), 243. Stage name, based on faunal assemblages occurring in sediments commonly referred to as "Middle" Miocene in subsurface of southeastern Louisiana. Clovelly and Napoleonville stages are proposed as replacements for "Lower" and "Upper" Miocene respectively. Names were selected arbitrarily only because denoted fields demonstrate representative sections for each; nothing in way of principal producing members is implied.

†Dudley Limestone[1] or Series[1]

Ordovician: New York.

Original reference: T. A. Conrad, 1839, New York Geol. Survey 3d Rept., p. 58–59.

Exposed at Dudley.

†Dudley Shale (in Pleasanton Group[1]

†Dudley Shale Member (of Pleasanton Formation)[1]

Pennsylvanian: Eastern Kansas, Missouri, and southeastern Nebraska.
Original reference: G. I. Adams, 1903, U.S. Geol. Survey Bull. 211, p. 34.

Named for Dudley, Neosho County, Kans.

Duff Formation or Tuff (in Buck Hills Volcanic Series)

Duff Tuff (in Green Valley Volcanic Series)

Oligocene and younger: Western Texas.

S. S. Goldich and M. A. Elms, 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1197. Name applied to upper 1,000 feet of Green Valley volcanic series (new). Overlies Cottonwood Spring basalts (new). Underlies Mitchell Mesa rhyolite (new).

S. S. Goldich and C. L. Seward, 1948, West Texas Geol. Soc. [Guidebook] Oct. 29–31, p. 14 (table 1), 17 (fig. 3), 20–21; S. S. Goldich and M. A. Elms, 1949, Geol. Soc. America Bull., v. 60, no. 7, p. 1138 (table 1), 1144 (fig. 3), 1159–1161, pl. 1. Formation included in Buck Hill volcanic series (new). [Authors make no reference to use of term Green Valley volcanic series.] Chiefly rhyolitic tuff with minor breccia and conglomerate. Thickness at type section 1,015 feet. Overlies Cottonwood Spring basalt. Oligocene(?). Derivation of name stated.

R. L. Erickson, 1953, Geol. Soc. America Bull., v. 64, no. 12, pt. 1, p. 1362–1364. Formation described in Tascatol Mesa quadrangle where it is about 764 feet thick. Underlies Mitchell Mesa tuff flow; overlies Pruett formation.

W. N. McAnulty, 1955, Geol. Soc. America Bull., v. 66, no. 5, p. 536 (table 1), 551–554. Includes Decie member (new) in Cathedral Mountain quadrangle. Northward across quadrangle, formation changes from dominantly rhyolite tuff to lava tuff, and conglomerate (Decie member). Thickness 1,400 to 1,500 feet. Overlies Cottonwood Spring basalt; underlies Mitchell Mesa welded tuff.

Named for Duff Spring in northwestern part of Buck Hill quadrangle, Brewster County.

Duffin Limestone[1]

Duffin limestone or dolomite facies (of Portwood Formation)

Middle Devonian: East-central Kentucky.

Original reference: A. F. Foerste, 1905, Kentucky Geol. Survey Bull. 6, p. 145.

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

Guy Campbell, 1946, Geol. Soc. America Bull., v. 57, no. 9, p. 860 (fig. 4), 861, 862–863. Portwood formation (new) contains three coeval facies: Duffin limestone or dolomite, Harg shale (new), and Ravenna shale (new). Duffin layer is mottled gray to brownish dolomite which commonly presents brecciated appearance. Typically represented in Boyle, Lincoln, and Casey Counties, where it ranges from 3 to 8 feet thick, and eastward to Berea, thins to 1 foot at Crab Orchard. Harg replaces Duffin dolomite in area where former appears and is transitional between Duffin and Ravenna.

A. C. McFarlan and W. H. White, 1952, Kentucky Geol. Survey, ser. 9, Bull. 10, p. 5–16. Discussion of Boyle-Duffin-Ohio shale relationships.

Named for Duffin cut three-fourths mile north of Junction City, Boyle County.

Duffin Sandstone and Shale (in Chinle Formation)

Upper Triassic: Southwestern Utah.

P. D. Proctor, 1953, Utah Geol. and Mineralog. Survey Bull. 44, p. 36–37, pl. 2. Medium- to coarse-grained brick-red sandstones with interbedded purple shales. Crossbedding locally prominent. Near California, Barbee and Walker, and Thompson mines, a clay pebble conglomerate as much as 1 foot thick lies just above upper contact of Tecumseh sandstone (new). West of McNally mine, unit includes thin white lenticular sandstone 50 feet above lower contact. Total thickness 427 feet. Under lies Quaternary alluvium; overlies Silver Reef sandstone with local unconformities.

Section measured 500 feet south of Duffin mine, Silver Reef (Harrisburg) Mining District, Washington County.

Dufrene Slate (in Amador Group)

Middle or Upper 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. Dufrene consists of sequence of dark-blue-gray slates and fine-grained gray sandstone; some green chloritic feldspathic schist near base. Approximate thickness 745 feet. In absence of fossil evidence, wider regional studies will be necessary to determine definitely whether Dufrene slate and Mountain Spring volcanics should be considered uppermost Amador or part of Mariposa slate. Measured section, along Mountain Spring Creek from Mariposa slate eastward, dips steeply to east; relation of beds to Mariposa slate suggests section is overturned and is on west limb of overturned anticline or its faulted equivalent.

Name derived from Dufrene Ranch west of Newton mine, Amador County.

Dugger Formation

Middle Pennsylvanian: Southeastern Indiana.

C. E. Wier, 1950, U.S. Geol. Survey Coal Inv. Map C–1. Consists of (ascending) 55 feet of sandstone and shale locally containing two thin coal beds and massive conglomeratic limestone in places; Coal VI, which may be absent or as much as 6 feet thick; 40 to 50 feet of sandstone and shale containing thin limestone in places; Coal VII, which is generally 2½ feet thick; and 20 feet of gray shale in places. Overlies Alum Cave member of St. Petersburg formation; unconformably underlies sandstone of Shelburn formation.

C. E. Wier, 1951, U.S. Geol. Survey Coal Inv. Map C–9. Includes Universal limestone member (new) between Coal VI and Coal VII.

Named for exposures in secs, 31 and 32, T. 8 N., R. 7 W., and secs. 5 and 6, T. 7 N., R. 7 W., 2 miles northeast of Dugger, Sullivan County.

Dugout Beds[1]

Pennsylvanian: Texas.

Original reference: C. L. Baker and W. F. Bowman, 1917, Texas Univ. Bull. 1753, p. 104–105.

Exposed in vicinity of Dugout Creek at Payne's Ranch, Marathon Basin.

Dugout Clay and Gravel[1]

Miocene and Pliocene: Western Texas.

Original reference: J. A. Udden, 1907, Texas Univ. Bull. 93, p. 17, 68.

Named for Dugout wells, near Boquillas, Brewster County.

Dukes Boulder Bed[1]

Pleistocene: Southeastern Massachusetts and southern Rhode Island.

Original reference: J. B. Woodworth and Edward Wigglesworth, 1934, Harvard Coll. Mus. Comp. Zool. Mem., v. 52, p. 163.

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 occurrence in Dukes County, Mass.

Duluth Gabbro[1]

Duluth Gabbro or Gabbro Complex (in Keweenawan Group)

Precambrian: Northeastern Minnesota, northern Michigan, and northern Wisconsin.

Original reference: R. D. Irving, 1883, U.S. Geol. Survey 3d Ann. Rept., p. 124, 134.

F. F. Grout and others, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 1021 (table 3), 1054–1057. Included in middle part of Keweenawan group, late Precambrian. Upper part of middle division of group is made up of acidic and basic intrusives: Logan intrusives, Beaver Bay complex, Duluth gabbro, and scattered granites. Detailed description of Duluth gabbro and its relation to other units.

F. F. Grout, R. P. Sharp, and G. M. Schwartz, 1959, Minnesota Geol. Survey Bull. 39, p. 13, 40–50. Described as Duluth gabbro complex in Cook County.

Named for development near Duluth, Minn.

†Duluth Group[1]

Precambrian (Keweenawan): Northeastern Minnesota.

Original reference: R. D. Irving, 1883, U.S. Geol. Survey 3d Ann. Rept., p. 134, 142–146, 185, pl. 14.

Exposed along north side of St. Louis River up to Duluth, St. Louis County.

Dun Limestone[1]

Pennsylvanian: Southeastern Kansas.

Original reference: Robert Hay, 1887, Kansas Acad. Sci. Trans., v. 10, p. 7.

Named for Dun, Wilson County.

Duncan Chert[1]

Mississippian: Northern California.

Original reference: W. Lindgren, 1900, U.S. Geol. Survey Geol. Atlas, Folio 66, p. 2.

Extends from Duncan Peak across North Fork of American River to vicinity of Monumental Hill, Colfax quadrangle.

Duncan Group

Miocene, upper: Southeastern Arizona.

A. A. Stoyanow, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 297 (table). Named on table. Lithology shown questionably as clay. Older than San Pedro group; younger than Sonoita group (new).

Duncan Sandstone[1] (in El Reno Group)

Permian: Central southern and southwestern Oklahoma.

Original reference: C. N. Gould, 1924, Am. Assoc. Petroleum Geologists Bull., v. 8, p. 324–341, map.

Henry Schweer *in* O. E. Brown, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 12, p. 1553 (fig. 9). Included in El Reno group. Overlies Hennessey formation; underlies Chickasha formation.

G. L. Scott, Jr., and W. E. Ham, 1957, Oklahoma Geol. Survey Circ. 42, p. 13–14, pl. 1. Described in Carter area where it is base of El Reno group. Underlies Flowerpot shale; overlies Hennessey shale. Thickness about 40 feet. Maximum thickness about 250 feet to southeast in Stephens County. Note on type locality.

Type locality: Duncan, county seat of Stephens County.

Dunchee Hill Basalt or Flow (in Clayton Basalt)

Late Cenozoic: Northeastern New Mexico.

Brewster Baldwin and W. R. Muehlberger, 1959, New Mexico Bur. Mines Mineral Resources Bull. 63, p. 124–126, 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 is known but stratigraphic position of Dunchee Hill, Purvine Mesa, Sierra Grande, and Gaylord Mountain is not known.

Dunchee Hill, a low hill, 1 mile north of Des Moines, Union County, is eroded remnant of volcano.

Dundee Limestone[1] or **Formation**

Middle Devonian: Southern Michigan and northern Ohio, and Ontario, Canada.

Original references: A. C. Lane, as reported by M. C. Wadsworth, 1893, Michigan Geol. Survey Rept. 1891 and 1892, p. 66; A. C. Lane, 1895, Michigan Geol. Survey, v. 5, pt. 2.

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. Dundee limestone restricted to lower unit, about 140 feet thick at Rogers City, which contains characteristic Dundee limestone fauna. Upper unit with distinct fauna is herein named Rogers City limestone.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1756, chart 4. Bassett (1935, Geol. Soc. America Bull., v. 46, no. 3) shows that type Dundee exposed in Sibley quarry, southeastern Michigan, contains *Spirifer lucasensis* and is underlain by Anderdon limestone. He correlates this section with "Upper Columbus" of the Silica and Whitehouse quarries in northwestern Ohio where the Dundee overlies Lucas dolomite and underlies "Blue bed" of Silica shale. Thus, the Dundee lies between Onondaga dolomite and Hamilton shale. In Presque Isle County, Mich., the Dundee overlies Mackinac breccia of lower Onondaga (Schoharie) age and underlies Rogers City limestone which carries *Stringocephalus* fauna.

K. K. Landes, G. M. Ehlers, and G. M. Stanley, 1945, Michigan Geol. Survey Div. Pub. 44, Geol. Ser. 37, p. 35 (table 1), 52, 101, 111, 115, 118. Dundee limestone in northwestern Ohio is erroneously designated Columbus limestone. Columbus limestone contains upper Onondaga fauna and is older than Dundee limestone. Dundee limestone of so-called Anderdon quarry near Amherstburg, Ont., owned by Bruner Mond Canada Limited, is incorrectly called Onondaga limestone. Examination of several reports of Devonian of southwestern Ontario leads to belief that Dundee limestone underlies large areas of southwestern Ontario where it is incorrectly designated Onondaga. In Mackinac Straits area, Detroit River group is underlain by Bois Blanc formation (new), most if not all of which is correlative of typical Onondaga limestone of southwestern Ontario. In Rogers City area and apparently elsewhere in northern part of Southern Peninsula, Detroit River group is overlain by Dundee limestone. Table of rocks of Straits of Mackinac region shows Dundee limestone overlies Mackinac breccia. In northwestern Ohio, the Dundee disconformably overlies Lucas dolomite of Detroit River group; in southeastern Michigan and at Amherstburg Ont., unconformably overlies Anderdon limestone of Detroit River group.

G. M. Ehlers, E. C. Stumm, R. V. Kesling, 1951, Devonian rocks of southeastern Michigan and northeastern Ohio: Ann Arbor, Mich., Edwards Brothers, Inc., p. 17–18. Dundee limestone ("Columbus limestone" of Ohio geologists) is 61½ feet thick at Silica, Lucas County, Ohio. Underlies Silica formation.

Named for exposures at Dundee, Monroe County, Mich.

Dundee sandstone member

Pennsylvanian (Pottsville series): Northeastern Ohio.

R. E. Lamborn, 1956, Ohio Geol. Survey Bull. 55, p. 26–29, geol. map. Gray to yellowish brown, medium to coarse, heavy bedded to massive, bedding planes rare. Thickness 5 to 75 feet. Base occurs either below drainage or is obscured by alluvial deposits. Top of sandstone in massive development occurs about 10 feet below Lower Mercer limestone on north side of Walnut Creek in sec. 13, Walnut Township; rises stratigraphically down valley to northeast; where Lower Mercer limestone is absent, top of Dundee is about 20 feet below Upper Mercer limestone; where both Upper and Lower Mercer are absent, the sandstone is about 15 feet below Tionesta coal. Only upper half of Pottsville series occurs above drainage in area of this report.

Named for exposure at Dundee, Tuscarawas County. Forms prominent cliffs along valleys of Walnut Creek and South Fork.

Dunderberg Shale[1] or Formation

Upper Cambrian: Eastern Nevada and western Utah.

Original reference: C. D. Walcott, 1908, Smithsonian Misc. Colln., v. 53, no. 1812, p. 184.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 18–19. Dunderberg shale was originally defined by Hague (1883) as Hamburg shale. In order to avoid use of name Hamburg for two formations in same district, Walcott (1908) proposed name Dunderberg for shale unit. Latter name is used in this report [vicinity of Eureka, Nev.]. It is not certain whether top of unit as mapped by Hague is exactly equal to one currently used. Hague writes of the shale as having, near the top, persistent layers of chert and sand. It is probable that these layers have been included within overlying Windfall formation (new), although all beds of flaky shale of any appreciable thickness have been included within Dunderberg of this report. Thickness 265 feet on ridge in Windfall Canyon. Overlies Hamburg formation. Underlies Catlin member (new) of Windfall formation. Late early Late Cambrian and early middle Late Cambrian, that is, late Dresbach and early Franconia age in standard Late Cambrian time scale.

R. H. Olson, 1956, Utah Geol. Soc. Guidebook 11, p. 47–48. Geographically extended into Promontory Range, Utah, where it is exposed along crest of Black Mountain and on both sides of North Fork of Little Valley. Thickness at least 378 feet. Overlies Marjum limestone; separated from Garden City formation by thick sequence of dolomites, limestones, and interbedded shales.

M. S. Johnson and D. E. Hibbard, 1957, U.S. Geol. Survey Bull. 1021–K, p. 340, 342–343. In Nye and Clark Counties, Nev., Dunderberg shale, about 195 feet thick; overlies Yucca Flat formation (new). Underlies unnamed limestone and dolomite interval provisionally referred to as Upper Cambrian.

J. K. Rigby, 1958, Utah Geol. Soc. Guidebook 13, p. 24–25, 28 (fig. 4), geol. map. Described in Stansbury Mountains where it is 30 to 200 feet thick; overlies Opex formation and underlies Ajax limestone.

C. B. Bentley, 1958, Brigham Young Univ. Research Studies, Geology Ser., v. 5, no. 6, p. 21–24, 39–40, 44, 48, 53, 58, 61, 62–63. Described in western Utah where it is 4 to 137 feet thick; overlies Orr formation (restricted) or Hicks formation (restricted); underlies Notch Peak formation. Dunderberg is basal Franconian and is equivalent to a sandstone, shale, and limestone unit about 600 feet above base of Mendha limestone at Pioche, Nev. Dunderberg shale is present in Snake Range, Nev., where Drewes and Palmer (1957) called it Corset Spring shale. Although they correlated it [Corset Spring] with Dunderberg shale at Eureka, Nev., and found basal Franconian fossils, they designated it as Trempealeauan (Drewes, 1958). Underlying Corset Spring shale is limestone which they designate Johns Wash limestone, supposedly of Upper Franconian and basal Trempealeauan age. Author [Bentley] does not agree with their dating nor with nomenclature employed and believes that their formation names, at least those for Upper Cambrian, should be suppressed and section renamed with either Eureka district or House Range terminology. Olson (1956) designated 378 feet of argillaceous siltstone and limestone in Promontory Range as Dunderberg. Formation as used by Olson is not equivalent to Dunderberg shale of Eureka and may not even by Upper Cambrian. Olson states that overlying his Dunderberg is 3,800 feet of Upper Cambrian (undifferentiated) dolomites and limestones, 1,160 feet below top of which is Worm Creek quartzite member [of St. Charles formation]. Haynie (1957, unpub. thesis) affirmed Olson's Worm Creek designation. Since Worm Creek is same age as Dunderberg shale of Eureka, Olson's Dunderberg shale is misnomer and should not be used.

A. R. Palmer, 1960, U.S. Geol. Survey Prof. Paper 334–C, p. 53–109, pls. Report describes trilobites of Dunderberg shale. Five local lithic units, designated by letters (ascending) A–E, are recognized. All but upper unit (E) contain thin fossiliferous limestones bearing generally distinctive trilobite assemblages. Fauna of units A–C belong to upper half of *Dunderbergia* zone of late Dresbach age. Fauna of unit D correlates with basal part of *Elvinia* zone of early Franconia age.

A. R. Palmer, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B289–B290. Previous to 1958, the Dunderberg shale or supposedly equivalent unit had been identified at many places in eastern half of Great Basin. Bentley (1958) described what he called "Dunderberg shale" as occurring at many localities in western Utah and has shown that it is shaly westward extension of Worm Creek quartzite member of St. Charles formation of northern Wasatch Range. Bentley has also shown that trilobite fauna of "Dunderberg shale" in western Utah is that of *Elvinia* zone. Recent studies of Dunderberg at its type locality reveal that trilobites of *Elvinia* zone are confined to upper 50 feet of formation. Bentley's "Dunderberg shale" is younger than almost all of Dunderberg shale at its type locality. In Eureka district, contact of Dunderberg with underlying Hamburg dolomite is zone of shearing. Until recently, only a few feet of beds were believed to be missing.

New evidence indicates that as much as 200 to 300 feet of lower part of Dunderberg may be faulted out at Eureka. Practically unfaulted exposure of Dunderberg, 600 feet thick, has now been recognized at Cherry Creek about 65 miles northeast of Eureka. In this section, upper 350 feet of beds contain trilobites of both *Elvinia* and *Dunderbergia* zones similar to those at Eureka. Lower 250 feet contains trilobites belonging to *Aphelaspis* zone. Below these beds, and above another shaly unit containing *Eldoradia*, there is about 1,000 feet of thick-bedded limestone which has not been named. As *Eldoradia* is found in upper beds of Secret Canyon shale, which underlies Hamburg dolomite at Eureka, unnamed limestone near Cherry Creek should probably be correlated with Hamburg dolomite. Hence, there is no indication of significant stratigraphic thinning of Dunderberg between Cherry Creek and Eureka. A 30-foot unit of interbedded limestone and shale at top of Hicks formation in Deep Creek Range, Utah, contains trilobites of *Elvinia* zone. This unit was identified by Bentley as "Dunderberg shale" and separated from underlying Hicks. Shaly unit in middle of Hicks formation, separated from Bentley's "Dunderberg shale" by 120 feet of dolomite, contains trilobites of *Dunderbergia* zone in its upper part and trilobites of the *Aphelaspis* zone in its lower part. This unit correlates with lower part of Dunderberg shale as exposed near Cherry Creek. Therefore, unit that has been called "Dunderberg shale" by Bentley and by those who have studied it at many localities in western Utah is not equivalent to whole of Dunderberg shale exposed near Eureka and Cherry Creek, Nev. Evidence indicates that name "Dunderberg shale" should no longer be used for thin unit of interbedded limestones and shales occurring in western Utah and containing *Elvinia* zone trilobites. This unit is better named Corset Spring shale.

J. C. Young, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field. Conf., p. 160. In Shell Creek Range, Nev., name Dunderberg formation is applied to sequence of shales and limestones which forms characteristic ledge above Raiff limestone (new) and below Windfall formation. Thickness about 600 feet.

F. L. Humphrey, 1960, Nevada Bur. Mines Bull. 57, p. 10 (fig. 3), 14–15, pl. 1. Described in White Pine district. Average thickness about 350 feet. Overlies Secret Canyon shale, and although they appear to form continuous depositional sequence, they are apparently separated by disconformity. Underlies Goodwin formation of Mount Hamilton group (new). [Editor's note states that reexamination of Humphrey's collections from Secret Canyon and re-collection of trilobites in 1959 show that all known trilobites of Secret Canyon in Hamilton district are Upper Cambrian. 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 opposite Dunderberg mine, Eureka district, Nevada.

Dunderbergian series[1]

Upper Cambrian: Nevada.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 53, 78.

Dun Glen 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]. Dark-gray to black massive dolomite, in part crossbedded, standing in bold relief; interbedded with limestone and shale in lower 100 feet. In Stillwater Range, principally nodular limestone with some quartzite near base. Thickness generally 500 to 600 feet but reaches 1,150 feet in northwestern part of Sonoma Range. Underlies Winnemucca formation with local unconformity; overlies Grass Valley formation.

Type locality: Dun Glen Peak, East Range, Winnemucca quadrangle.

Dunham Dolomite[1]

Lower Cambrian: Southern Quebec, Canada, and northwestern and west-central 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, 146–147. Dark gray, sometimes black, rock weathering brown. Crystalline throughout; stratification obscure. Thickness 30 to 120 feet. Underlies Oak Hill slate; overlies Gilman quartzite conformably. Type locality cited.

W. M. Cady, 1945, Geol. Soc. America Bull., v. 56, no. 5, p. 525, 528–530. Extended into Vermont where it includes Mallett member in upper part. Thickness 1,700 to 2,000 feet. Overlies Cheshire quartzite; underlies Monkton quartzite.

A. B. Shaw, 1958, Geol. Soc. America Bull., v. 69, no. 5, p. 523 (table 1), 525–528, 532 (fig. 5), pl. 1. Described in St. Albans area, where it consists of sandy facies (Mallett member of Cady) and carbonate facies. Thickness 2,800 feet east of Highgate Springs; about 1,500 feet at southern boundary of area; 25 feet at international boundary. Overlies Gilman quartzite; underlies Parker slate. Lower Cambrian (Georgian series).

Type locality: At Oak Hill, Sutton quadrangle, Quebec. Named for nearby town of Dunham.

Dunkard Group[1]

Dunkard Series or Division

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

Original reference: I. C. White, 1891, U.S. Geol. Survey Bull. 65, p. 22.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 88. Permian strata in Ohio are grouped under term Dunkard which has been given rank of group by U.S. Geological Survey, and of series in earlier publications of Ohio Geological Survey. Washington and Greene subdivisions of Dunkard have been classified as formations. Latter are herein raised to series rank, thus making main subdivisions of strata in Permian the same stratigraphic rank as those in Pennsylvanian. Dunkard becomes a sort of superseries and is superfluous. Term in Ohio is synonymous with term Permian. In this report, term Dunkard division is used in order to keep term under consideration until decision is made as to its validity in current stratigraphic usage.

H. L. Berryhill *in* C. O. Dunbar and others, 1960, Geol. Soc. America Bull., v. 71, no. 12, pt. 1, p. 1789–1790. West Virginia, Pennsylvania, and Ohio Geological Surveys and U.S. Geological Survey agreed (November, 1959) to designate age of Washington formation as Pennsylvanian-Permian and age of Greene formation as Early Permian. [Thus age of Dunkard group is Pennsylvanian and Permian.]

First described on Dunkard Creek, Greene County, Pa.

†Dunkard Creek Series[1]

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

Original reference: I. C. White, 1891, U.S. Geol. Survey Bull. 65, p. 22.

On Dunkard Creek, Greene County, Pa.

Dunkirk Shale Member (of Perrysburg Formation)

Dunkirk Formation (in Canadaway Group)

Dunkirk Shale Member (of Canadaway Formation)

Dunkirk Shale or Sandstone[1]

Upper Devonian: Western and west-central New York.

Original reference: J. M. Clarke, 1903, New York State Mus. Handb. 19, p. 24, chart.

W. H. Bradley and J. F. Pepper, 1938, U.S. Geol. Survey Bull. 899–A, p. 17. In area of this report, Dunkirk sandstone is used in preference to Canaseraga sandstone.

R. G. Sutton, 1951, Rochester Acad. Sci. Proc., v. 9, nos. 5–6, p. 397. In Batavia quadrangle, considered a formation in Canadaway group. Youngest formation present in area of this report.

J. F. Pepper and Wallace de Witt, Jr., 1951, U.S. Geol. Survey Oil and Gas Inv. Chart OC–45. Rank reduced to member status in Perrysburg formation (new). Dunkirk shale member of this report is restricted to 19 feet of black and 20 feet of olive-black and brownish-black shale resting on Hanover shale in exposures on Walnut Creek south of town of Silver Creek, Chautauqua County. In some areas, overlies Wiscoy sandstone. Grades upward into South Wales member (new) through transition zone between very dark-gray and brown shales and gray shales containing some platy siltstones. Thickens eastward from 40 feet on Walnut Creek to maximum of about 120 feet in area between Big Indian Creek and Irish Gulf; thins to featheredge in Woodhull quadrangle and has not been identified to south in Pennsylvania. Name Canaseraga sandstone is reapplied to unit termed Dunkirk sandstone by Bradley and Pepper (1938).

I. H. Tesmer, 1955, New York State Mus. Sci. Service Circ. 42, p. 10 (fig. 1), 14. Basal member of Canadaway formation. Underlies South Wales member; overlies Hanover or Wiscoy member of Chemung formation.

Named for Dunkirk, Chautauqua County.

Dunlap Formation[1]

Lower and Middle 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. Muller, and S. H. Cathcart, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–45. Described in Mina quadrangle where five units are mapped. Formation deposited during folding and thrusting; consequently lithology varies from range to range. Usual sequence not everywhere complete. Upper part: conglomerate, with interbedded sandstone, pebbles derived from Luning formation; includes "thrust conglomerate" derived from upper plates of surface thrusts and overridden by same thrusts; greenstone and greenstone breccia with variable amounts of conglomerate and sandstone. Lower part: basal conglomerate overlain by interbedded sandstone and conglomerate in variable proportions; sandstones commonly reddish and crossbedded, locally interbedded shale; pebbles in conglomerates almost exclusively derived from Excelsior formation. In eastern Excelsior Mountains, basal unit is coarse breccia (fossil talus) of felsite fragments. Locally thin beds of moraine limestone and dolomite. Variable thickness, maximum about 5,000 feet in Pilot Mountains. Though locally conformable on Sunrise over most of area, it is unconformable on Luning and Excelsior formations.

N. J. Silberling, 1959, U.S. Geol. Survey Prof. Paper 322, p. 24 (fig. 3), 29–31, pls. 10, 11. Described in Union district, Shoshone Mountains, where it conformably overlies undifferentiated Gabbs and Sunrise formations. Consists mainly of noncalcareous, possibly nonmarine, sandstone including two relatively thin dolomitic carbonate units near top. Structure is for most part a syncline, which is partly overturned to west and divided into three dislocated segments of unequal size by two westerly trending high-angle faults; east limb of this syncline in middle one of its three faulted segments approaches anticlinal axis adjacent to Third Canyon thrust. On east, formation is bounded by thrust [Third Canyon] which has carried undifferentiated Gabbs and Sunrise formations to west over Dunlap. Southern limit of formation is intrusive contact with Tertiary volcanic rocks. Thickness about 800 feet. Unfossiliferous; might be assigned, at least in lower part, to lower Middle Jurassic.

Type locality: In ridge west of upper part of Dunlap Canyon, Pilot Mountains, Mina quadrangle.

†Dunlap Limestone[1]

Pennsylvanian: Eastern Kansas.

Original reference: M. Z. Kirk, 1896, Kansas Univ. Geol. Survey, v. 1, p. 81, 82.

Named for Dunlap, Morris County.

Dunlap Sandstone (in Greene Group)

Permian (Dunkard Series): Southwestern Pennsylvania.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 152–153. Thin-bedded brown micaceous sandstone, with little crossbedding. Mica especially conspicuous along bedding planes. Individual beds ½ to 1 inch thick. Total thickness 10 to 35 feet, average about 20 feet. Overlying strata commonly obscured. Base of sandstone lies 5 to 15 feet (average 10 feet) above top of Upper Washington limestone of Washington group. Was noted by Stevenson (1876) in his Greene group section for Washington County but not named.

Named from Dunlap Creek just north of which it is well exposed on hill, 2 miles east of Republic, Fayette County.

Dunlap Sandstone Member (of Catahoula Formation)

See Dunlap Quarry Sandstone Member (of Catahoula Formation)

Dunlap Quarry Sandstone Member[1] (of Catahoula Formation)

Miocene, lower(?): Southeastern Texas.

Original reference: B. C. Renick, 1936, Texas Univ. Bull. 3619, p. 64, table facing p. 17.

W. L. Russell, 1957, Gulf Coast Assoc., Geol. Soc. Trans., v. 7, p. 68. Formation, in Grimes, Brazos, and Burleson Counties, includes Chita, Dunlap, and Corough (new) members.

Well exposed in large quarry on G. W. Dunlap 165-acre tract, in southeastern part of E. M. Millican survey, 2.4 miles S. 17° E. of Millican, Brazos County.

Dunleith 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, 23–24, figs. 3, 9. Dolomite, pure and argillaceous in alternating units, cherty, medium crystalline, medium- to thick-bedded; green shale partings. Thickness up to 125 feet. Differentiated into 10 members (ascending) Buckhorn, St. James, Beecher, Eagle Point, Fairplay, Mortimer, Rivoli, Sherwood, Wall, and Wyota. Underlies Wise Lake formation (new); overlies Guttenberg formation.

In copy of guidebook used by compiler, in figures 3 and 9, name Buckhorn had been crossed out and name Red Oak written in.

Type area is extreme northwestern Illinois.

Dunn Creek Slate (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), 37–38. Basal formation of group. Consists of sequence of siltstones and slates; in type area contains one or more layers of slaty sideritic iron-formation; in uppermost part includes newly defined Wauseca pyritic member. Probable maximum thickness about 800 feet; probable minimum thickness about 400 feet. Underlies Riverton formation (new); overlies Badwater greenstone (new).

Type area: Eastern Iron County. Name derived from Dunn Creek, south of Crystal Falls.

†Dunnellon Formation[1]

Pliocene, lower: Northern Florida.

Original reference: E. H. Sellards, 1910, Florida Geol. Survey 3d Ann. Rept., p. 22–35.

Named for exposures at Dunnellon, Marion County.

Dunns Peak Sandstone

Eocene: Northern California.

Boris Laiming, 1940, 6th Pacific Sci. Cong. Proc., v. 2, p. 562 (fig. 8). Shown on stratigraphic column as sandstone 350 feet thick. Underlies Markley sandstone; overlies Capay formation ("Vacaville shales"). Occurs in Vaca Valley north of San Francisco.

Du Noir Limestone (in Gallatin Group)

Du Noir Member (of Gallatin Formation)[1]

Upper Cambrian: Western Wyoming.

Original reference: B. M. Miller, 1936, Jour. Geology, v. 44, no. 2, p. 124–127.

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1104. Original nomenclature and definitions of formations in Wind River Canyon section is herein revised. Name Gallatin formation is replaced by Boysen formation (new). Because Upper-Middle Cambrian boundary is nearly 100 feet below base of Miller's Du Noir, member would have to be redefined to include many beds which Miller assigned to Middle Cambrian; hence, Du Noir member is not recognizable in Wind River Canyon, and lower member of Boysen is called Maurice member.

A. B. Shaw and P. O. McGrew, 1954, Wyoming Geol. Assoc. Guidebook 9th Ann. Field Conf., chart 2. Rank raised to formation in Gallatin group. Underlies Dry Creek shale; overlies Park shale. In Wind River basin, overlies Buck Spring formation (new).

Type section: Along Warm Springs Creek, 2 miles west of Du Noir, in nothwestern part of Wind River Mountains.

Du Page 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.

Duperow Formation (in Jefferson Group)

Upper Devonian: Subsurface in North Dakota, northeastern Montana, and northwestern South Dakota, and Manitoba and Saskatchewan, Canada.

C. A. Sandberg and C. R. Hammond, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 10, p. 2299 (fig. 2), 2302–2304 (fig. 4), 2309 (fig. 5), 2315–2318, 2319 (fig. 6). Named by Powley (1951, unpub. thesis). He designated type subsurface section as interval between depths of 3,310 and 4,150 feet in Tidewater Oil Co.'s Duperow Crown Well 1 in southwestern Saskatchewan and considered the Duperow to be equivalent to all but basal section of Beaverhill Lake formation of Late Devonian age in Alberta. Through misunderstanding of Powley's definition, the Duperow came to be considered as an equivalent of Woodbend formation of Late Devonian age which overlies Beaverhill Lake formation in Alberta. In February 1953, Williston Basin Nomenclature Committee of American Association of Petroleum Geologists abandoned use of Duperow formation in sense in which Powley had originally intended and applied name to overlying lithologic unit. The Duperow as defined by the committee has been used widely in geologic literature and by geologists working in Williston basin. Standard subsurface section herein designated. Consists of medium- to brownish-gray dense to microcrystalline limestone, yellowish- to light-brownish-gray fine-grained argillaceous limestone and dolomitic limestone, brownish-gray finely crystalline dolomite, and white to brownish-gray anhydrite, interbedded with thinner beds of greenish-gray dolomitic shale, very fine-grained siltstone, and sandy argillaceous dolomite. Formation ranges in thickness from fraction of a foot to approximately 600 feet in north-central and northeastern Montana along international boundary. Overlies Souris River formation; underlies Birdbear formation (new). In Jefferson group.

Standard section: Interval between depths of 10,400 to 10,743 feet in Mobil Producing Co.'s Birdbear Well 1, center sec. 22, T. 149 N., R. 91 W., Dunn County, N. Dak.

Duplin Marl[1]

Miocene, upper: Eastern North Carolina, Florida, eastern Georgia, and eastern South Carolina.

Original reference: W. H. Dall, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 2, p. 388; published in 1897, as 55th Cong., 2d sess. H. Doc. 5.

C. W. Cooke, 1945, Florida Geol. Survey Bull. 29, p. 180–195. Geographically extended into Florida where it includes *Ecphora* and *Cancellaria* zones formerly included in Choctawhatchee marl (abandoned). *Ecphora* zone, which lies near base of Duplin, is believed to be equivalent to deposit in South Carolina named Raysor marl (Cooke, 1936); recommended that use of Raysor marl be discontinued. Thickness at Alum Bluff 46 feet; in Georgia 5 to 16 feet; maximum thickness South Carolina 41 feet; North Carolina 100 feet. From North Carolina to Florida, unconformably overlies older beds—in Carolinas, underlying formations range in age from Upper Cretaceous Black Creek to middle Miocene Hawthorn; in Georgia and Florida east of the Apalachicola, underlying formation is Hawthorn; west of the Apalachicola, Chipola and Shoal River formations. Everywhere unconformably underlies Pliocene or Pleistocene deposits.

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. In this report, the Duplin and Yorktown are considered one formation, the Yorktown.

H. E. Malde, 1959, U.S. Geol. Survey Bull. 1079, p. 28–34. Term Duplin marl, defined as the rocks deposited in this region [Carolinas and Georgia] during late Miocene time, denotes a stage, in time-stratigraphic sense. The Duplin has distinctive marine fauna but little lithologic uniformity; Duplin outcrops would be difficult to identify if adequate fossils were lacking. Many other time-stratigraphic units in Atlantic and Gulf Coastal Plain are similarly named, but with progress in detailed mapping, formations will be defined as rock units, not on basis of age. Term Duplin marl might then be abandoned. Base of Duplin is an unconformity. Along Pee Dee River, the Duplin rests on Cretaceous rocks (Peedee formation). Farther south, rests on Eocene rocks (probably Black Mingo formation), and in Charleston area [this report] on Oligocene rocks (Cooper marl). Along Savannah River, rests on middle Eocene (Hawthorn formation). Fossils indicate that the Duplin near present coast is younger than Duplin marl farther inland. Upper Miocene.

Named for exposures in Duplin County, N.C., especially in Natural Well, southwest of Magnolia.

Duquesne cyclothem

Pennsylvanian (Conemaugh Series): Southeastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 94 (table 11), 141 (map 17), 143–147. Embraces interval between Gaysport cyclothem (new) below and Elk Lick cyclothem above. Includes (ascending) Lower Grafton shale and sandstone, Duquesne redbed, Duquesne limestone, Duquesne underclay, Duquesne coal, Skelley shale and sandstone, and Skelley limestone members. Except for Skelley marine limestone, members of cyclothem are inconspicuous and not well known in eastern Ohio; in Athens County it is rather thick with all members at least present but with several not well developed. Average thickness between 35 and 40 feet.

Most outcrops are in Alexander, Ames, Athens, Canaan, and Dover Townships, Athens County. Named for Duquesne coal. Name is taken from Duquesne, a locality in metropolitan district of Pittsburgh, Pa.

Duquesne Limestone (in Conemaugh Formation)[1]

Pennsylvanian: Western Pennsylvania.

Original reference: M. E. Johnson, 1929, Pennsylvania Topog. and Geol. Survey Atlas 27, p. 31, 60, 61.

Well exposed in bluff on north side of Allegheny River which faces Herrs Island. Probably named for Duquesne, Allegheny County.

Durango Glaciation or Till

Durango Glacial Stage[1] or Till[1]

Pleistocene (pre-Wisconsin): Southwestern Colorado and northwestern New Mexico.

Original references: W. W. Atwood and K. F. Mather, 1915, U.S. Geol. Survey Prof. Paper 95, p. 14, map; 1924, Geol. Soc. America Bull., v. 35, p. 122; 1932, U.S. Geol. Survey Prof. Paper 166.

V. C. Kelley, 1949, New Mexico Univ. Pubs. in Geology 2, fig. 2, facing p. 2. Durango gravels shown on correlation chart of New Mexico formations as present in San Juan County.

Named for Durango, southwestern Colorado.

Durango Sand Member (of Taylor Marl)[1]

Upper Cretaceous (Gulf Series): Eastern Texas.

Original reference: C. H. Dane and L. W. Stephenson, 1928, Am. Assoc. Petroleum Geologists Bull., v. 12, p. 51.

Occurs 1.2 miles south of Chilton, Falls County, and extends southwest through Durango to Theo, on Bell-Falls County line.

Durbin Formation[1]

Durbin Group

Middle Silurian: Southwestern Ohio.

Original reference: A. F. Foerste, 1917, Ohio Jour. Sci., v. 17, p. 187.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Shown no correlation chart as group including (ascending) Euphemia dolomite, Springfield dolomite, and Cedarville dolomite. Underlies Peebles dolomite; overlies Lilley formation.

Named for exposures at Mills quarries, about 1 mile east of Durbin and 1 mile southwest of Springfield, Clark County.

Durgin Brook Member (of Littleton Formation)

Lower Devonian: Northern New Hampshire.

M. T. Heald, 1955, The geology of the Gilmanton quadrangle, New Hampshire: New Hampshire State Plan. Devel. Comm., p. 8, 9, 10 (table 1), geol. map. Uppermost part of Littleton formation in Gilmanton quadrangle. Composed of well-bedded schists, chiefly sillimanite schist, pseudosillimanite schist and mica schist. Overlies Jenness Pond member (new).

Good exposures near village of Belmont.

Durham Quartz Diorite[1]

Devonian(?): Southeastern New Hampshire.

Original reference: A. Wandke, 1922, Am. Jour. Sci., 5th, v. 4, p. 149.

Extends from 2 miles southwest of Exeter to within one-quarter mile of Rollingsford. Named for exposures through Durham Township, Strafford County.

Durkee Hill Greenstones

Upper Devonian or post-Devonian: East-central Vermont.

C. G. Doll, 1945, Vermont State Geologist 24th Rept., p. 16, 20. A complex of gray to green to black basic and ultrabasic intrusives and volcanics. Massive and schistose, fine grained to coarse grained. Chlorite schist prominent. Light-gray feldspathic gneiss occurs irregularly among the greenstones. Some volcanics may be of Middle Ordovician age.

Exposed in area between Monroe and Ammonoosuc faults, Strafford quadrangle. Named for good exposures on Durkee Hill.

Durst Group

Pennsylvanian-Permian: Northeastern Utah.

Walter Sadlick, 1957, Intermountain Assoc. Petroleum Geologists Guidebook 8th Ann. Field Conf., p. 62 (fig. 1), 70–76 Name proposed to include type Morgan and type Weber formations; group should also include Hells Canyon formation of eastern Uinta Mountains because this formation is facies of Morgan. Unconformable above Round Valley formation. Term probably can be applied within at least the following localities: North Rich County, where names Wells formation and Weber sandstone have been used; southward to just north of Charleston thrust; and eastward along flanks of Uinta Mountains to Juniper Mountain in eastern Moffatt County, Colo.

Walter Sadlick, 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 83 (table 1), 84–85, 86–87. Includes Permian (mainly Wolfcamp) fusulinids in upper 150 to 180 feet.

Named after Durst Mountain, a prominent peak about 7 miles north of Morgan, Morgan County.

Durst Silts

Pleistocene (Wisconsin?): West-central Texas.

M. M. Leighton, 1936, Medallion Papers 24, p. 16, 39 (fig. 5). Compact pebbly silts unconformably underlying Elm Creek silts (new). Show evidence of human occupation.

Well exposed on the P. Durst Survey near Abilene, Taylor County.

Dushkin Basalt

Quaternary: Southwestern Alaska.

G. C. Kennedy and H. H. Waldron, 1947, U.S. Geol. Survey Alaska Volcano Inv. Rept. 2, pt. 2, p. 13–14, pl. 2; 1955, U.S. Geol. Survey Bull. 1028–A, p. 9–10, pl. 3. Youngest of three extensive lava-flow units filling old canyons and gullies carved in Belkofski tuff (new) and intrusive diorite stocks. Overlies Arch Point basalt (new). Locally, a single flow more than 200 feet thick makes up unit; elsewhere unit comprises many superimposed flows, each a few tens of feet thick, which in places aggregate several thousand feet, as in the cliffs south of "Emmons" Lake.

Well displayed on north margin of Dushkin Lagoon, vicinity of Pavlof Volcano, Alaska Peninsula.

Duskin Creek Formation[1] (in Lee Group)

Pennsylvanian: Eastern Tennessee and southern Kentucky.

Original reference: W. A. Nelson, 1925, Tennessee Dept. Ed., Div. Geol. Bull. 33A.

H. R. Wanless, 1946, Geol. Soc. America Mem. 13, p. 37, 44 (table 3), 139. Extended to include strata between Rockcastle and Corbin sandstones in northern Tennessee and southern Kentucky. Includes Crossville sandstone member (new).

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [Folio], p. 4–5. Duskin Creek formation was used for beds presumably overlying Rockcastle, and including Dorton shale (new) of this report. Type section of Duskin Creek, which is along this tributary of Piney River, however, consists of beds of Vandever formation that actually underlie the Rockcastle. This error is believed to have been due to failure to identify the Rockcastle because of its local shaly character. For this reason, the name Duskin Creek is no longer used.

Well exposed on Duskin Creek, a tributary of Piney Creek, which flows by Spring City, Rhea County, Tenn.

Dutch Creek Sandstone[1]

Middle Devonian: Southwestern Illinois and eastern Missouri.

Original reference: T. E. Savage, 1920, Am. Jour. Sci., 4th, v. 49, p. 170–171, 175.

J. M. Weller and G. E. Ekblaw, 1940, Illinois Geol. Survey Rept. Inv. 70, p. 15–16; J. M. Weller, 1940, Illinois Geol. Survey Rept. Inv. 71, p. 24–25, 26. Further described in southwestern Illinois where it is included in Ulsterian group. Comparatively thin and highly characteristic formation. It is only restricted zone in Devonian succession that can be invariably recognized, but actual outcrops in places are not abundant. Massive sandstone 10 to 30 feet thick, composed almost exclusively of rounded grains of St. Peter type. Probably overlies Clear Creek chert with slight unconformity; grades upward into Grand Tower limestone through a few inches or feet of calcareous sandstone and sandy limestone. Strata intervening between Grand Tower limestone (or the Dutch Creek sandstone where Grand Tower is absent) and Mountain Glen shale (or Springville shale where Mountain Glen is absent) have been referred by Savage (1920) to Misenheimer shale and Lingle and Alto limestones. Restudy of the area suggests that recognition of these three formations may be neither stratigraphically logical nor practically feasible.

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

Named for exposures along Dutch Creek, southwestern part Union County, Ill.

Dutchmans Conglomerate Lens[1] (in Amity Shale)

Devonian or Carboniferous: Northwestern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am.'Paleontology, v. 21, no. 71, table opposite p. 61, 84.

I. H. Tesmer, 1958, (abs.) Geol. Soc. America Bull., v. 69, no. 12, pt. 2, p. 1651. Mentioned in proposed stratigraphic sequence of Cattaraugus formation.

Named for exposures along Dutchman's Run, a tributary of Allegany River in Mead Township, Warren County.

Dutch Peak Tillite (in Sheeprock Series)

Precambrian: Western Utah.

R. E. Cohenour, 1959, Utah Geol. and Mineralog. Survey Bull. 63, p. 19–25, 28, 131–133, 135, pl. 1. Proposed for tillite in Sheeprock series(new). Typically dark-green conglomeratic rock having a slate of quartzite matrix. Thickness 4,044 feet on Dutch Peak; 2,555 feet in Pole Canyon. Occurs in middle part of series.

R. E. Cohenour, 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 37. Gradational character of upper and lower contacts and interfingering of tillite with quartzites and phyllites of Sheeprock series indicates that Dutch Peak is conformably included between strata represented by hiatuses above and below Mineral Fork tillite of Wasatch Range.

Type section: Dutch Peak, Tooele County. Crops out from head of South Oak Brush Canyon along crest of Sheeprock Mountains to Dutch Peak where it leaves divide and forms dip slope along north-facing slopes to Little Valley Creek. Present north of principal mining area in West Tintic mining district.

Dutchtown Formation

Middle Ordovician: Southeastern Missouri and northern Arkansas.

H. S. McQueen, 1937, Missouri Geol. Survey and Water Resources 59th Bienn. Rept., app. 1, p. 12–25. Name applied to rocks which intervene between St. Peter and Everton sandstones below and Joachim dolomite above. Lower member is light to dark, smoky-gray, dense to fine-grained, argillaceous limestone and dark-gray shale; middle member, referred to as Geiser Quarry member, consists of dark-brown to black, argillaceous limestone, calcareous, hard, platy and fissile shale, and calcareous siltstone; upper member contains dark-brown to black, dense, and occasionally very finely crystalline limestone, and calcareous shales and siltstones of same color. Thickness 5 to 170 feet (determined from wells). Lower Ordovician.

J. S. Cullison, 1938, Jour. Paleontology, v. 12, no. 3, p. 219–228. Formation belongs in Buffalo River group. Fauna described.

E. B. Branson and M. G. Mehl, 1943, Jour Paleontology, v. 17, no. 4, p. 375. Whether Dutchtown is Lower or Middle Ordovician depends on where line between two series is drawn. In this report boundary is placed below St. Peter sandstone; hence, Dutchtown is lower Middle Ordovician in age.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2 (columns 52, 53). Correlation chart shows Dutchtown limestone as Chazyan. In Missouri and Arkansas.

Name derived from village of Dutchtown, SE¼ sec. 24, T. 30 N., R. 12 E., Cape Girardeau County, Mo.

Duzel Formation

Upper Ordovician(?): Northern California.

F. G. Wells, G. W. Walker, and C. W. Merriam, 1959, Geol. Soc. America Bull., v. 70, no. 5, p. 645–646, 647 (fig. 1), pl. 1. Proposed for sequence of pale-gray-green phyllitic graywackes. Crumpled structure is most distinctive feature. The graywacke is thinly layered and fissile; in general, it is layered at 1- to 2-mm intervals, although occasional beds up to 3 inches occur, and some a foot to 18 inches thick crop out at stratigraphic intervals of 1 to several hundred feet. Such beds are hard in contrast to the fragile thin layers. Limestone and associated chert beds occur within the phyllite. Many are less than 2 feet thick, but others as much as 200 feet in outcrop width are conspicuous in Horseshoe Gulch and to northeast along the ridge. The largest is more than a mile long and several hundred feet thick. Attitudes of beds indicate that the Duzel is involved in northward-plunging synclinorium, the east limb of which has been thrust over beds of younger Gazelle formation (new). In southern part of area, the syncline has been cut off by steeply dipping northward-trending fault which has dropped beds of the Duzel against peridotite and quartz-mica schist. Because top of Duzel is not exposed and base is uncertain, total thickness cannot be determined; below Duzel Rock, 1,250 feet of crinkled phyllite and phyllitic graywacke is exposed, but structure of the formation indicates its total thickness must be many times this figure. Contains coral and brachiopod fauna and is oldest fossil-bearing formation in Klamath Mountains.

Occurs in two valleys south of Yreka, Siskiyou County. Crops out in drainage basin of Moffett Creek. Name is derived from Duzel Creek, a tributary of Moffett Creek, which is just east of Duzel Rock, conspicuous mass of white marble that caps highest peak in area.

Dwale Shale[1]

Pennsylvanian: Eastern Kentucky.

Original reference: W. C. Morse, 1931, Kentucky Geol. Survey, ser. 6, v. 36, p. 296.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 42, 43, 82. In lower part of Breathitt formation, forming roof of Prestonburg coal.

Exposed at Dwale, Floyd County.

Dyberry Glomerate[1] (in Cherry Ridge Red Beds)

Dyeberry Conglomerate

Upper Devonian: Northeastern Pennsylvania.

Original reference: Bradford Willard, 1936, Geol. Soc. America Bull., v. 47, no. 4, p. 571, 578.

Bradford Willard, 1939, *in* Bradford Willard, F. M. Swartz, and A. B. Cleaves, Pennsylvania Geol. Survey, ser. 4, Bull. G–19, p. 279 (table 30), 284–285. Upper Devonian.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Listed as Dyeberry conglomerate.

Named from Dyberry Creek and Township, Wayne County.

Dyer Dolomite Member (of Chaffee Formation)[1]

Upper Devonian: Central Colorado.

Original reference: C. H. Behre, Jr., 1932, Colorado Sci. Soc. Proc., v. 13, no. 3, p. 60.

Ogden Tweto, 1949, Colorado Sci. Soc. Proc., v. 15, no. 4, p. 152 (table 1), 174–177. Described in Pando area where it is 73 to 80 feet thick; overlies Parting quartzite member and uncomformably underlies Gilman sandstone member (new) of Leadville dolomite.

Typically exposed on West Dyer and Dyer Mountains, 5 miles east of Leadville.

Dyer Bay Dolomite Lentille (of Cabot Head Shale Member[1] of Cataract Formation)

Dyer Formation

Middle Silurian: Ontario, Canada, and Michigan.

Original reference: M. Y. Williams, 1919, Canada Geol. Survey Mem. 111, no. 191, geol. ser., p. 35, chart opposite p. 18.

T. E. Bolton, 1953, Canada Geol. Survey Paper 53–23, p. 3, 11. Rank raised to formation and geographically extended into northern Michigan. Formation is considered northern facies of Lower Clinton, rather than local phase of Cabot Head as postulated by Williams (1919). Overlies Cabot Head shales.

Type locality: Dyer Bay, Ontario, Canada.

Dyer Hill member (of Madrid Formation)

Age not stated: West-central Maine.

A. R. Cariani, 1959, Dissert. Abs., v. 19, no. 10, p. 2577. Composed of chloritoid-bearing black slates. Grades downward into quartzites of formation.

In Anson quadrangle.

†Dyestone Group[1]

Silurian: Tennessee.

Original reference: J. M. Safford, 1856, Geol. Reconn. Tenn., 1st Rept., p. 149, 156–158, map.

Dynneson Sand

Lower Cretaceous: Eastern Montana and western North Dakota.

G. R. Wulf, 1959, Dissert. Abs., v. 20, no. 5, p. 1747. Blanket-type sand much of which came from land areas to the east. Upper part deposited as series of northeasterly trending features resembling offshore bars. Underlies highly siliceous clays. Previously called Newcastle sand.

Type locality and derivation of name not given.

Dyson Hollow Limestone Member or zone (of Stoner Member of Stanton Formation)

Pennsylvanian (Missouri Series) : Eastern Nebraska.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 32. Zone or member within Stoner limestone. Thickness 1½ to 2 feet. Underlies Kiewitz shale zone; overlies Eudora shale.

Type locality: Below upper water fall in Dyson Hollow, located about 1⅜ miles west of La Platte, Sarpy County.

Eager Formation

Upper Cretaceous-Paleocene: Northeastern Arizona.

G. K. Sirrine, 1959, Dissert. Abs., v. 19, no. 8, p. 2064. Incidental mention.

Springerville-St. Johns area, Apache County.

Eagle Bed[1]

Upper Cretaceous (Gulf Series) : Western Texas.

Original reference: J. A. Taff, 1891, Texas Geol. Survey 2d Ann. Rept., p. 733, 735.

Probably named for Eagle Spring, at northeast end of Eagle Mountain, El Paso County.

Eagle Dolomite Member (of Bluebell Formation)

Upper Ordovician: Central Utah.

Paul Billingsley *in* J. M. Boutwell, 1933, Internat. Geol. Cong., 16th, [United States] Guidebook 17, Excursion C–1, p. 110 (fig. 14). Name appears on stratigraphic column of Tintic district. Basal member of formation. Underlies Beecher member (new) ; overlies Opohonga formation.

T. S. Lovering and others, 1949, Econ. Geology Mon. 1, p. 7 (table 1). Light-gray fine-grained dolomite with dark-gray cherty bed at top, and 15-foot bed of dark-blue-gray fine-grained thin-bedded flaky dolomite at base. Thickness 180 feet.

T. S. Lovering and others, 1951, (abs.) Geol. Soc. America Bull., v. 62, no. 12, pt. 2, p. 1506. Entire lower part of Bluebell, known locally as Eagle dolomite, is Upper Ordovician. Thickness about 200 feet on Pinyon Peak.

H. J. Bissell, 1959, Utah Geol. Soc. Guidebook 14, p. 137, 139. What has been termed Eagle dolomite in Tintic district should be called Fish Haven dolomite.

Type locality and derivation of name not stated.

Eagle Greenschist (in Easton Group)

Paleocene or older: Northwestern Washington.

R. S. Yeats, 1958, Dissert. Abs., v. 19, no. 4, p. 775. Contains blue-amphibole schist intercalations.

Between central and eastern part of Skykomish area in northwestern Cascade Mountains, 45 miles east of Seattle.

Eagle Limestone (in Kanawha Formation[1] or Group)

Pennsylvanian: Southwestern West Virginia.

Original reference: I. C. White, 1891, U.S. Geol. Survey Bull. 65, p. 140, 141, 177.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 82. Marine limestone in lower part of Kanawha group about 100 feet below Eagle coal, between Cedar above and Little Cedar coals, in Eagle shale.

Named for exposures in cuts of Chesapeake and Ohio Railroad at mining village of Eagle, Fayette County.

Eagle Sandstone (in Kanawha Formation)[1]

Pennsylvanian: Southern West Virginia.

Original reference: R. V. Hennen and D. B. Reger, 1914, West Virginia Geol. Survey Rept. Logan and Mingo Counties, p. 202.

Named for association with underlying Eagle coal.

Eagle Sandstone (in Montana Group)[1]

Upper Cretaceous: Montana and central northern Wyoming.

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

R. M. Lindvall, 1953, U.S. Geol. Survey Geol. Quad. Map GQ-29. Exposed along Missouri River and along several faults in Eagleton quadrangle. Includes Virgelle sandstone member in lower 80 to 100 feet. Middle and upper members consist of 125 to 150 feet of alternating beds of gray to buff medium-grained sandstone, containing sandy limonitic concretions. Conformably underlies Claggett shale; overlies Colorado shale with contact transitional through series of alternating beds of sandstone and shale.

W. A. Cobban, 1955, Billings Geol. Soc. Guidebook 6th Ann. Field Conf., p. 108 (fig. 1), 114–115. On east side of Sweetgrass arch, the Eagle sandstone includes all strata between Telegraph Creek formation and Claggett shale. Divided into lower Virgelle sandstone member and upper unnamed member of mudstone, shale, siltstone, and sandstone.

M. M. Knechtel and S. H. Patterson, 1956, U.S. Geol. Survey Bull. 1023, p. 15, 16. Discussion of marine Cretaceous formations of Hardin district, Montana and Wyoming. Local nomenclature revised. Names Frontier and Eagle which appear on maps published by Thom and others (1935, U.S. Geol. Survey Bull. 856), Richards and Rogers (1951, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 111), and Knechtel and Patterson (1952, U.S. Geol. Survey Circ. 150) have been dropped from nomenclature adopted for this report. Rocks formerly called Eagle sandstone are assigned to unnamed sandy shale member in upper part of the Cody; they represent a shaly facies of strata that elsewhere in central Montana includes thick massive sandstone beds that are typical of Eagle sandstone.

Type exposures: Along Missouri River about mouth of Eagle Creek, 40 miles below Fort Benton, Chouteau County, Mont.

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

Pennsylvanian: Southern West Virginia.

Original reference: R. V. Hennen and D. B. Reger, 1914, West Virginia Geol. Survey Rept. Logan and Mingo Counties, p. 211–215.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 82. Widespread dark-gray to black marine shale including Eagle limestone; in lower part of Kanawha group.

Derivation of name not given but may be same as Eagle limestone.

Eagle Bridge Quartzite[1]

Lower Cambrian: Eastern New York.

Original reference: L. M. Prindle and E. B. Knopf, 1932, Am. Jour. Sci., 5th, v. 24, p. 277–278.

Rudolf Ruedemann, J. H. Cook, and D. H. Newland, 1942, New York State Mus. Bull. 331, p. 65 [1946]. Mentioned in discussion of correlation of Schodack formation in geology of Catskill quadrangle.

D. W. Fisher, 1956, Internat. Geol. Cong., 20th, Mexico, Cambrian Symposium, pt. 2, p. 330–331. Named and originally described by Prindle and Knopf, the Eagle Bridge was assigned to Lower Cambrian. Basis for this age assignment appears unsound. Nomenclators state that its stratigraphic position below slate that carries Beekmantown graptolites and above Lower Cambrian limestone indicates that it is probably Lower Cambrian. It is equally as logical to assume Lower Ordovician age by virtue of such reasoning. Type locality restudied for present report. Here, bluish-gray slightly feldspathic calcitic and dolomitic orthoquartzite grades upward through alternating thin beds of argillaceous sandstone and sandy and silty shale into graptolite-bearing shales carrying *Dicellograptus*, *Dicranograptus*, and *Nemagraptus*. Thus, Eagle Bridge is transitionally overlain by Middle Ordovician Normanskill formation. At the base, Eagle Bridge is set off sharply but conformably from platy black pyritiferous, somewhat siliceous, shales with no fossils. They may be Lower Cambrian Schodack shales or Lower Ordovician Deepkill shales. Whatever the age of underlying unit, Eagle Bridge is intimately associated with the overlying unit, which is proved Middle Ordovician. Eagle Bridge is removed from Lower Cambrian and assigned to Ordovician.

Well exposed in vicinity of Eagle Bridge, on Hoosick River, Washington County.

Eagle City Beds[1] or Limestone

Eagle City Member (of Hampton Formation)

Mississippian (Kinderhook): Central northern Iowa.

Original reference: F. M. Van Tuyl, 1925, Iowa Geol. Survey, v. 30, p. 52, 92–94.

L. A. Thomas, 1960, Tri-State Geol. Soc. Guidebook 24th Ann. Field Conf., p. [3, 17–19]. Stratigraphic reconstruction of Lower Mississippian rocks across Iowa Falls area, when adjusted to orthodox system of classification, presents anomalous situation that is irreconcilable with stratigraphic relationships observed elsewhere in the State. Believed that this stems from miscorrelations resulting from misunderstanding of relationships of Gilmore City to Iowa Falls dolomite. Van Tuyl (1925) considered Eagle City limestone to be nearly 80 feet thick and to consist of two limestones separated by a thick dolomite and to be unconformable beneath Iowa Falls dolomite. Present evidence suggests that formation is essentially limestone, about 20 feet thick, and conformable with Iowa Falls and Maynes Creek dolomites. May be facies of Gilmore City.

Named for exposures in banks of Iowa River at Eagle City, Hardin County.

Eagle Cliff Porphyrite[1]

Permian and Cretaceous: Northwestern Washington.

Original reference: R. D. McLellan, 1927, Washington Univ. Pub. in Geology, v. 2, p. 142, 146–148.

W. R. Danner, 1960, (abs.) Geol. Soc. America Bull., v. 71, no. 12, pt. 2, p. 2056. Volcanic rocks originally described as intrusive dikes of Eagle Cliff porphyrite appear to be composed largely of submarine pillow lavas of Permian and Cretaceous age.

Named for Eagle Cliff on north end of Cypress Island, San Juan Islands.

†Eagle Creek Formation[1]

Upper Triassic: Northeastern Oregon.

Original reference: W. D. Smith and E. L. Packard, 1919, Oregon Univ. Bull., v. 16, no. 7, p. 88, 105, 108.

Wallowa Mountains region.

Eagle Creek Formation[1]

Miocene: Central northern Oregon and southwestern Washington.

Original reference: I. A. Williams, 1916, Oregon Bur. Mines and Geol. Res. Oregon, v. 2, no. 3, p. 95–96.

W. M. Felts, 1939, Ohio Jour. Sci., v. 39, no. 6, p. 300–301, 304, 315 (fig. 4). Described in Skamania County, Wash., where it underlies Skamania andesites (new) and is intruded by Silver Star granodiorite (new).

T. P. Thayer, 1939, Oregon Dept. Geology and Mineral Industries Bull. 15, p. 7. Mehama volcanics are comparable in age to Warrendale or Eagle Creek formation in Columbia River Gorge. Oligocene.

W. D. Lowry and E. M. Baldwin, 1952, Geol. Soc. America Bull., v. 63, no. 1, p. 5. In Columbia River Gorge, Columbia River basalt lies on erosional surface cut in sediments of Eagle Creek formation. Chaney (1944, Carnegie Inst. Washington Pub. 553) assigned fossil flora of Eagle Creek formation to lower Miocene.

Exposed along Columbia River Gorge from Warrendale to Viento, on Oregon side, with corresponding distribution on north side of river.

Eagle Flats Formation

Quaternary or later: Western Texas.

R. T. Hill, 1890, (abs.) Am. Assoc. Adv. Sci. Proc., p. 242. Largest part of area west of Pecos River consists of extensive flats which are shown to be almost recent lakes, drained of their waters, except in rare instances where salt lakes still occupy limited parts of basin. Quaternary or later sediments of these former lakes are described as Eagle Flats formation.

Eagle Ford Shale,[1] Clay,[1] or Formation

Eagle Ford Formation (in Woodbine Group)

Eagle Ford Group

Upper Cretaceous (Gulf Series): Texas, western Louisiana, and southeastern Oklahoma.

Original reference: R. T. Hill, 1887, Am. Jour. Sci., 3d, v. 33, p. 298.

W. S. Adkins, 1932, Texas Univ. Bur. Econ. Geology Pub. 3232, p. 425–426. Group divided into (ascending) Tarrant, Britton, and Arcadia Park formations. Names credited to W. L. Moreman.

C. C. Albritton, Jr., and others, 1941, Field and Lab., v. 10, no. 1, p. 17–42, pls. 1, 3. Referred to as formation. Moreman's subdivisions not recognized in area of this report [Dallas County]. Underlies Austin formation. Chiefly clay-shale. Average thickness 475 feet.

L. W. Stephenson and others, 1942, Geol. Soc. America Bull., v. 53, no. 3, chart 9. Shown on correlation chart as Eagle Ford shale. Overlies Woodbine sand; underlies Austin chalk.

R. T. Hazzard, B. W. Blanpied, and W. C. Spooner, [1947], Shreveport Geol. Soc. 1945 Ref. Rept., v. 2, p. 472, 473, 474, 475, 477, 480 (correlation chart). Formation in Woodbine group (surface and subsurface). Includes Tarrant member. Overlies Lewisville formation with unconformity; underlies Ector chalk of Austin group with unconformity.

L. W. Stephenson, 1953, U.S. Geol. Survey Prof. Paper 243–E, p. 58. Eagle Ford shale unconformably overlies Pepper shale member of Woodbine formation at type section of Pepper shale.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped as Eagle Ford shale.

Named for exposures at Eagle Ford, Dallas County, Tex.

Eagle Gulch Latite[1]

Tertiary: Southwestern Colorado.

Original reference: H. B. Patton, 1916, Colorado Geol. Survey Bull. 9, p. 21–63.

Forms county rock on both sides of Eagle Gulch, Bonanza district, Saguache County.

Eagle Hill Rhyolite[1]

Eocene(?): Central northern Utah.

Original refernece: J. E. Spurr, 1895, U.S. Geol. Survey 16th Ann. Rept., p. 377.

P. D. Procter, 1959, Utah Geol. Soc. Guidebook 14, p. 183–187. Discussed in report on igneous rocks of Mercur-Ophir area. Table lists Eagle Hill under heading probable late Eocene or early Oligocene(?).

Named for exposures in vicinity of Eagle Hill, just south of Mercur, Mercur district.

Eagle Mills Formation

Permian(?): Subsurface in Arkansas, Louisiana, Mississippi, and Texas.

H. K. Shearer, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 6, p. 724. Consists chiefly of red shale and sand that overlies Pennsylvanian and Mississippian beds and underlies Smackover limestone and also underlies, and evidently in part contemporaneous with, mass of rock salt. Age of salt and associated red beds unknown, but best estimate is early Mesozoic, probably Triassic or Jurassic, because Eagle Mills beds seem to be more nearly conformable and related to overlying Cretaceous than to underlying Paleozoic. Name approved by Shreveport Geological Society.

W. B. Weeks, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 8, p. 958–959 (fig. 2), 960 (fig. 3), 962–964. Thickness 1,190 feet in type well, herein designated. Underlies Smackover limestone; overlies Pennsylvanian and possibly Mississippian. Permian(?).

R. W. Imlay, 1940, Arkansas Geol. Survey Inf. Circ. 12, p. 8–15, pl. 12. Southward from type locality, red beds pass abruptly into thick rock salt that contains minor amounts of anhydrite. Salt is bounded at top and bottom, in most sections in Arkansas, by red beds and associated anhydrite which constitute southward spreading tongues from main mass of red beds. Upper red beds are herein defined as Norphlet tongue and lower red beds, Louann tongue. Overlies Morehouse formation (new), apparently conformable and gradational; underlies Smackover, apparently conformable. Formation has been tentatively assigned by various authors to periods as removed as Permian, Upper Jurassic, and Lower Cretaceous. Herein considered Jurassic.

R. W. Imlay, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 11, p. 1422–1440. Described in Gulf Coast region. Upper Jurassic.

R. T. Hazzard, W. C. Spooner, and B. W. Blanpied, [1947], Shreveport Geol. Soc. 1945 Ref. Rept., v. 2, p. 483, 484–486, cross sections. As used in this report, Eagle Mills is older than Morehouse formation. Term Louann tongue is synonymous with Werner formation (new); term Louann salt is proposed for formation overlying the Werner; term Norphlet tongue, as formerly used, is replaced by Norphlet formation. Thickness 500 to 4,500 feet; maximum thickness unknown. Permian.

F. M. Swain, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 7, p. 1207–1212. Formation, as used in this report [Upper Jurassic of northeastern Texas], 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 formation. Upper Jurassic.

E. D. McKee and others, 1956, U.S. Geol. Survey Misc. Geol. Inv. Map I–175. If Louann and Werner formations are of Jurassic age, then Eagle Mills of this report is youngest pre-Jurassic formation in middle part of Gulf Coast region. Late Paleozoic age assigned to unfossiliferous Eagle Mills (restricted) is questionable. Validity of paleogeologic map in Gulf Coast region, as well as summary isopach and Interval B maps herein presented, depends on solution of these stratigraphic problems. Neither relation of Morehouse to overlying and underlying formations nor its position relative to Eagle Mills formation is clear. Three interpretations suggested: Eagle Mills older than Morehouse; Morehouse older than Eagle Mills; or unit separated by fault of unknown dip and displacement. Second interpretation followed in this report. Permian.

Type well: Amerada Petroleum Co. et al. No. 1 Eagle Mills Lumber Co. well in sec. 11, T. 12 S., R. 16 W., Ouachita County, Ark.

Eagle Mountain Quartzite[1]

Paleozoic: Northeastern Washington.

Original reference: C. E. Weaver, 1920, Washington Geol. Survey Bull. 20, p. 56, map.

Named for occurrence on Eagle Mountain, 5 miles northeast of Chewelah, Stevens County.

Eagle Mountains Sandstone Member (of Grayson Formation)

Eagle Mountains Sandstone

Upper Cretaceous: Southwestern Texas.

Elliot Gillerman, 1953, U.S. Geol. Survey Bull. 987, p. 11 (table 1), 27, 28, 31, pls. 1, 8, 16. Uppermost member of Grayson. About 70 feet of interbedded brown sandstones (some of which are quartzitic), brown shales, siltstones, and sandy limestones; dominantly brown; contrasts strongly with dominant blue gray of other formations of late Comanche age. Overlies 60-foot middle member informally referred to as reef-limestone. Conformably underlies Buda limestone.

P. C. Twiss, 1959, Texas Univ. Bur. Econ. Geology Quad. Map 23. Rank raised to formation. In Van Horn Mountains, overlies Loma Plata limestone, upper member of which is approximately correlative with San Martine member of Boracho limestone (Brand and De Ford, 1958); underlies Buda limestone.

Type locality: Carpenter Canyon at point about 1 mile above Carpenter Wells, Hudspeth County. Named for exposures on east side of Eagle Mountains.

Eagle Nest Formation

Pliocene(?): Central northern New Mexico.

L. L. Ray and J. F. Smith, Jr., 1941, Geol. Soc. America Bull., v. 52, no. 2, p. 190–191, pl. 1. Reddish clay and white tuffs interbedded with coarse white to buff sand and gravel. Cobbles up to 8 inches in diameter not uncommon. In general, cobbles are smooth but subangular. A few small channel deposits of sand in thicker beds of clay. Thickness unknown since neither top nor base has been seen, but total thickness must have been over 1,000 feet. Probably represents great coalescing stream fans. Tentatively assigned to Pliocene and perhaps early Pleistocene.

Along U.S. Highway 64, north of Eagle Nest Lake, in Moreno Valley, Colfax County.

Eagle Pass Formation[1]

Upper Cretaceous (Gulf Series): Southwestern Texas.

Original reference: C. A. White, 1891, U.S. Geol. Survey Bull. 82, p. 116, 117, 124, 126, 127, 130, 138, 139.

Named for Eagle Pass, Maverick County.

Eagle Peak Syenite

Tertiary: Southwestern Texas.

Elliot Gillerman, 1953, U.S. Geol. Survey Bull. 987, p. 38, pl. 1. Proposed for brownish-gray medium-grained rock with large phenocrysts of feldspar, chiefly orthoclase, which occurs in central and highest part of Eagle Mountains and is exposed on Eagle Peak. Much of rock has been altered to "soda syenite". Crops out as roughly elliptical-shaped body, with, in the main, almost vertical contacts with surrounding rhyolite.

Altered syenite is well exposed on summit of Eagle Peak; unaltered syenite is well exposed on flanks of Eagle Peak and in Wind Canyon 1½ miles southeast of Eagle Peak, Hudspeth County.

Eagle Point Member (of Dunleith Formation)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., p. 33, fig. 3. Shown on columnar section as underlying Fairplay member (new) and overlying Beecher member (new).

Occurs in Dixon-Oregon area.

Eagle River Group[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: A. C. Lane and A. E. Seaman, 1907, Jour. Geology, v. 15, p. 680, 690.

W. S. White, H. R. Cornwall, and R. W. Swanson, 1953, U.S. Geol. Survey Geol. Quad. Map GQ–27. Name Portage Lake lava series (new) proposed to include Eagle River, Ashbed, Central Mine, and Bohemian Range groups of old reports; these subdivisions are quite arbitrary and depend on continuity of individual flows or conglomerate beds for validity. They are not useful for purpose of this report.

Named for exposures on Eagle River, Keweenaw County.

Eagle River Porphyry[1]

Tertiary, lower: Central Colorado.

Original reference: S. F. Emmons and W. Cross, 1886, U.S. Geol. Survey Mon. 12, p. 80, 188, 193, 330, 591.

Ogden Tweto, 1951, Geol. Soc. America Bull., v. 62, no. 5, p. 510, 511, 512. Term Eagle River porphyry is used here for a quartz monzonite porphyry that is younger than Lincoln porphyry. Originally (Emmons and Cross, 1886) term included both this and later porphyry and Lincoln porphyry. Emmons and Cross used term only in Leadville monograph and made no mention of it in their later work on Tenmile district (U.S. Geol. Survey Geol. Atlas, Folio 48). Eagle River porphyry is similar to Johnson Gulch porphyry of Gray porphyry group at Leadville, and mapping now in progress may prove it to be equivalent. In this area [near Pando], four varieties of early Tertiary quartz monzonite and quartz latite porphyries: Elk Mountain, Lincoln, Eagle River, and Pando (new) form numerous sills in Pennsylvanian and Permian(?) clastic rocks of southern part of Gore Range.

Odgen Tweto, 1953, U.S. Geol. Survey Mineral Inv. Field Studies Map MF-12. Mapped in Pando area, Summit and Eagle Counties, where early Tertiary sequence of porphyries includes (ascending) Pando, Elk Mountain, Quail, Lincoln, and Eagle River.

Named for occurrence at headwaters of Eagle River, Tenmile region, Eagle County.

Eagle Rock Flow or Basalt

Pliocene, lower(?): Southeastern Idaho.

H. T. Stearns and Andrei Isotoff, 1956, Geol. Soc. America Bull., v. 67, no. 1, p. 24, 30, 33–34, pl. 1. Basalt has red vesicular base and dense olive-black middle phase which grades into red scoriaceous basalt at top. Locally lenses of pyroclastic material intercalated between flow units. Basal part carries inclusions of basaltic cinders and quartz grains. Lower Pliocene(?).

Exposed on crest of Eagle Rock, a prominent hill on northwest bank of Snake River, 7½ miles downstream from American Falls, and on both sides of river in secs. 28 and 29, T. 8 S., R. 30 E., Power County.

Eagle Rock Tuff[1]

(?)Pliocene, lower: Southern Idaho.

Original references: H. T. Stearns, 1932, Correlation chart of Idaho compiled by M. G. Wilmarth, dated Sept. 1, 1932; 1936, Jour. Geology, v. 44, no. 4, p. 434–439.

H. T. Stearns, Lynn Crandall, and W. G. Steward, 1938, U.S. Geol. Survey Water-Supply Paper 774, p. 32 (table), 44–46, pls. 4–6. Thickness about 35 feet. Shown on stratigraphic column above Neeley lake beds and below Massacre volcanics. Type locality designated.

H. T. Stearns and Andrei Isotoff, 1956, Geol. Soc. America Bull., v. 67, no. 1, p. 23. Renamed Walcott welded tuff to avoid confusion with basaltic tuff that originated at locality of Eagle Rock.

Type locality: North bank of Snake River at America Falls, Power County.

†Eangua Limestone[1]

Upper Cambrian and Lower Ordovician(?): Central Missouri.

Original reference: H. King, 1844, Am. Jour. Sci., 1st, v. 47, p. 129.

In vicinity of Eangua River.

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

Pennsylvanian: Western Iowa, eastern Kansas, and Missouri.

Original reference: H. F. Bain, 1897, Iowa Geol. Survey, v. 7, p. 511–517.

Well exposed at Earlham, in sec. 22, Lincoln Township, Madison County, Iowa.

†Earlton Limestone[1]

Pennsylvanian: Eastern Kansas.

Original reference: E. Haworth, 1898, Kansas Univ. Geol. Survey, v. 3, p. 51, 103.

Well developed to west and northwest of Earlton, Neosho County.

Earp Formation (in Naco Group)

Upper Pennsylvanian and 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. 18–23. Base of formation arbitrarily taken where thin shaly limestones and reddish shales become dominant over more massive limestones characteristic of Horquilla formation (new). Much shale, a little sandstone, and a few beds of limestone and shale conglomerate occur somewhat higher in section and in turn give way upward to more massive limestone with a few conspicuous beds of dolomite, 1 to 5 or 6 feet thick, that weather to brilliant orange or red. Dolomites commonly crossbedded and somewhat cherty, and associated with a few thin sandstones. Topmost dolomite bed taken as top of formation. Underlies Colina limestone (new). Broken sequences exposed west of Dragoon Camp (Pearce quadrangle) suggest thickness of 600 feet. Formation may thicken abruptly toward north. Late Pennsylvanian and possibly Permian.

Elliot Gillerman, 1958, New Mexico Bur. Mines Mineral Resources Bull. 57, p. 35–38, tables 1 and 2, pl. 1. In Peloncillo Mountains, southwestern New Mexico, formation comprises lower dominantly clastic unit and upper dominantly carbonate section. As exposed near Silver Hill mine, lower unit of alternating beds of sandstone, siltstone, or shale and medium-grained gray limestone—399 feet thick; upper unit wholly of medium- to thick-bedded medium-grained gray limestone—432 feet thick. In Peloncillo Mountains, formation includes beds of Permian [Wolfcamp] age only.

Type section: Extends from saddle south of Earp Hill up to conspicuous mottled, pink and gray limestone, and then (to avoid faulting at this locality) is completed by exposed section above this mottled bed about one-half mile to east on the same slope. Named from Earp Hill in sec. 5, T. 21 S., R. 23 E., on whose slope lower part of formation is well exposed, central Cochise County. There is no continuous, unfaulted section of entire formation in area of northern Mule Mountains, Tombstone Hills, or Dragoon Mountains, included in Pearce and Benson quadrangles, Arizona.

Easley Group

Mississippian (Kinderhookian): Missouri, Illinois, Indiana, Iowa, and Kentucky.

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. Proposed for Upper Kinderhook strata which are generally conceded to be of Mississippian age. In type area, in Mississippi Valley, group consists of Hannibal shale and Chouteau limestone and related formations or members. At least locally, these are separated by unconformities from underlying Fabius group (new) and overlying Osage series.

M. G. Mehl, 1960, Denison Univ. Jour. Lab., v. 45, art. 5, p. 94. Weller and others (1948) proposed that the Kinderhook be considered a series and divided into two groups, the Easley and Fabius. The Easley was to include all Kinderhookian strata which are almost universally recognized to be of Mississippian age, and the Fabius to include all those Kinderhookian strata which are believed by some to be Mississippian and by others to be Devonian. Position of the committee in establishing two Kinderhook groups based on above distinction does not appear tenable. Recommended that terms Easley and Fabius groups be dropped from list of stratigraphic designations in Missouri.

Name derived from Easley, Boone County, Mo., where Chouteau limestone and Sylamore sandstone are well exposed.

Easly Creek 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. 229–237.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 46. Consists of red, green, and gray shale, partly calcareous and containing local limestone beds; upper part is light colored and calcareous; lower part largely red shale; locally contains gypsum bed near base. Thickness approximately 15 to 20 feet. Underlies Crouse limestone; overlies Bader limestone.

M. R. Mudge and R. H. Burton, 1959, U.S. Geol. Survey Bull. 1068, p. 13 (table 2), 81–82. Easly Creek shale was named by Condra (1927) who described it as member of Garrison shale and defined it as beds from top of Eiss limestone to base of Crouse limestone. Condra and Upp (1931, Nebraska Geol. Survey Bull 6, 2d ser.) redefined Easly Creek to include beds between Middleburg limestone [member of Bader limestone] and Crouse limestone. This is classification followed in present report [Wabaunsee County, Kans.]. Thickness 10 to 18 feet.

Type locality: On Easly Creek, in NE¼ sec. 35, T. 1 N., R. 13 E., about 10 miles south and 1¼ miles east of Humboldt, Richardson County, Nebr.

East Berlin 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), 14–24, pl. 1. Proposed for sedimentary rocks that conformably overlie Holyoke basalt and conformably underlie Hampden basalt. This unit was designated as upper sedimentary division of Meriden formation by Krynine (1950). Principally fine-grained clastics—shale and mudstone—predominantly grayish red. On basis of calculations along three cross sections in three different fault blocks, thickness found to vary between 550 and 600 feet.

Type section: On Connecticut Highway 72, just northeast of town of Berlin and west of village of East Berlin, in northwest corner of Middletown quadrangle.

East Bluff Member (of Windrow Formation)

Cretaceous: Southwestern Wisconsin, northwestern Iowa, and southwestern Minnesota.

G. W. Andrews, 1958, Jour. Geology, v. 66, no. 6, p. 599, 606 (fig. 2), 607–610. Proposed to include coarser clastic deposits of formation which commonly rest conformably on older ferruginous deposits here named Iron Hill member. Term Ostrander member of Dakota formation has been applied to these deposits in southeastern Minnesota by Stauffer and Thiel (1941). Thwaites and Twenhofel (1921) refer these deposits to Windrow. Section in Fillmore County, Minn., consists of 20 feet of lensing units of gray clay, sand, and sandy clay, with beds of iron oxide near base; channel fillings of small well-sorted quartz and chert pebbles, granules, grit, and sand common; channel deposits occasionally show cross-lamination. Underlies Kansan drift.

Named for exposures on the East Bluff in Devil's Lake State Park, Sauk County, Wis.

East Branch Arkose (in Dickinson Group)

Precambrian: Northern Michigan.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 30 (table 1), 31–32. Basal formation of group. Strata comprise arkose, arkosic conglomerate, and interbedded metamorphosed basalt flows and basic tuffs; beds are steeply dipping or vertical. Thickness in type area about 1,000 feet. Underlies Solberg schist (new); actual contact with older granitic gneiss not observed, though in some places the two rock units are exposed but a few feet apart. Strata have been referred to Sturgeon quartzite by earlier workers who assumed it to underlie Randville dolomite that is exposed a short distance to the north.

Well exposed in broad glacially polished outcrops in secs. 17 and 18, T. 42 N., R. 28 W., along East Branch of Sturgeon River, Dickinson County.

East Buffalo Creek Limestone Member (of Tyler Formation)

Carboniferous: Central Montana.

G. H. Norton, 1956, Billings Geol. Soc. Guidebook 7th Ann. Field Conf., p. 62, 63 (fig. 7). Limestone unit very much like Amsden in lithology; overlain by basal Amsden conglomerate.

Named from exposures on East Buffalo Creek, secs. 11 and 12, T. 12 N., R. 16 E.

East Cape Volcanics

Quaternary: Southwestern Alaska.

R. R. Coats, 1953, U.S. Geol. Survey Bull. 989-A, p. 8-9, 14-16, fig. 2. Rocks of East Cape Volcano include hypersthene-bearing hornblende basalts and basaltic andesites. All are dense medium-gray rocks, with 80 to 90 percent of plagioclase. Dome on flank of volcano also of pale-gray hypersthene-bearing hornblende basalt.

Associated with East Cape Volcano consisting of older and higher cone to the north and smaller volcanic dome on southeastern flank, which contributed largely to construction of northeastern part of Buldir Island, in western Aleutian Islands.

East Caroline Beds or Formation

Miocene. East Caroline Islands.

Risaburo Tayama, 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 69-70, table 5 [English translation in library of U.S. Geol. Survey, p. 84; S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 29. Consist of agglomerate, tuff, conglomerate, and breccia; intruded by basalt dikes. Rest unconformably on base rocks of islands. Getsuyoto [Getuyoto] beds of Truk, Matalanim [Mataranium] formation of Ponape, and Maremu [Marem (Malam)] formation of Kusaie are included in this formation.

Type locality: East Caroline Islands.

Eastern Basalts[1]

Cenozoic: Northern California.

Original reference: Howel Williams, 1932, California Univ. Pub., Dept. Geol. Sci. Bull., v. 21, no. 8, p. 230-235, geol. map.

O. P. Jenkins, 1943, California Div. Mines Bull. 118, p. 676. Cenozoic. Overlie Juniper lavas.

J. A. S. Adams, 1955, Geochim. et Cosmochim. Acta, v. 8, p. 78 (table 3). Listed on table accompanying report on uranium geochemistry of Lassen volcanic rocks.

Occurs in Lassen Volcanic National Park, near Butte Lake.

Easterwood Shales (in Yegua Group)

Eocene (Claiborne): East-central Texas.

A. A. L. Mathews, 1950, Texas Eng. Expt. Sta. Research Rept. 14, p. 3-4, geol. map. Name applied to dominantly shaly section of group; underlies Cockfield formation and overlies Byram sandstone.

Name derived from Easterwood Airport located on campus of A & M College of Texas, Brazos County.

Eastford Granite Gneiss[1]

Pre-Triassic: Northeastern Connecticut.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 115, 127, and map.

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

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Described as a granitic gneiss.

Good exposure in southeastern corner of Eastford [Township], Windham County.

East Fork Formation[1]

Precambrian(?): Central Idaho.

Original reference: L. G. Westgate and C. P. Ross, 1930, U.S. Geol. Survey Bull. 814, p. 10–17.

C. P. Ross and J. D. Forrester, 1947, Geologic map of the State of Idaho (1:500,000): U.S. Geol. Survey. Mapped as Precambrian(?).

C. P. Ross and J. D. Forrester, 1958, Idaho Bur. Mines and Geology Bull. 15, p. 3. Precambrian(?) rocks in Pioneer Mountains include Hyndman formation, about 6,600 feet, and East Fork formation, at least 1,560 feet. East Fork consists largely of metamorphosed limestone but includes conspicuous interbedded quartzite masses. The two formations crop out over an area of about 20 square miles along southwestern border of a granite body. They are cut by many faults and separated from all other sedimentary rocks in vicinity by faults. Assumption that the Hyndman and East Fork are Precambrian is far from proved.

Forms a belt on west side of area of metamorphosed rocks as far south as divide between Hyndman Creek and East Fork of Big Wood River. Best exposed on east side of headwaters area of Hyndman Creek, Hailey quadrangle.

†East Gallatin Group[1]

Precambrian: Central southern Montana.

Original reference: F. V. Hayden, 1885, U.S. Geol. Survey 6th Ann, Rept., p. 50.

Exposed near mouth of East Gallatin River, Threeforks quadrangle.

East Greenwich Group[1]

Mississippian(?): Central Rhode Island.

Original reference: B. K. Emerson and J. K. Perry, 1907, U.S. Geol. Survey Bull. 311, p. 58–65, map.

A. W. Quinn, 1952, Bedrock geology of the East Greenwich quadrangle, Rhode Island: U.S. Geol. Survey Geol. Quad. May [GQ–17]. Revived as a group because intrusive and extrusive rocks in vicinity of East Greenwich form a natural group closely related in composition and age. Subdivided to include (ascending) Spencer Hill volcanics (new), unnamed metadiorite, Maskerchugg granite (new), unnamed granite porphyry, Cowesett granite (new), and unnamed dark fine-grained granite. Younger than Blackstone series and Esmond granite; older than Pennsylvanian rocks of the Narragansett Basin. Mississippian(?). Derivation of name.

Occurs in and west of village of East Greenwich, East Greenwich quadrangle.

East Haven Granite[1]

Precambrian: Central Connecticut.

Original reference: E. Hitchcock, 1823, Am. Jour. Sci., 1st, v. 6, p. 3–86.

In East Haven and Branford, New Haven County.

†East Iowan Formation[1]

Pleistocene: Iowa.

Original reference: T. C. Chamberlin, 1894, Great ice age, by James Geikie, 3d ed., p. 724–775.

†East Iowan stage of glaciation[1]

Pleistocene: Iowa.

Original references: James Geikie, 1894, Great ice age, 3d ed., p. 724–775; 1895, Jour. Geology, v. 3, p. 270–277.

East Kane shale member[1] (of Knapp formational suite)

Devonian or Carboniferous: Northwestern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 61, 112, table opposite p. 61.

Well exposed in brick shale quarries at East Kane, McKean County.

Eastland Formation

Eastland Member (of Lee Formation)

†Eastland Shale Lentil (of Bon Air Sandstone)[1]

Lower Pennsylvanian: Central Tennessee.

Original reference: Charles Butts and W. A. Nelson, 1925, Tennessee Div. Geology Bull. 33–D, p. 4–12, 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.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 17). Correlation chart shows Eastland formation underlying Newton sandstone and overlying Herbert 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. Conglomeratic phase of Newton sandstone in southern Cumberland and northern Bledsoe Counties was type "Herbert conglomerate" erroneously considered by Nelson (1925) to be older than Newton. The shale thought to be between the sandstones and named "Eastland shale" by Nelson is actually Whitwell shale. Names "Herbert" and "Eastland" are here discarded.

Named for occurrence at mining town of Eastland, 1 mile west of Clifty, White County.

†Eastland Formation (in Canyon Group)[1]

Pennsylvanian: Central northern Texas.

Original reference: F. B. Plummer, 1919, Am. Assoc. Petroleum Geologist Bull., v. 3, p. 133–145.

Named for Eastland, Eastland County.

†Eastland Limestone Member (of Caddo Creek Formation)[1]

Pennsylvanian: Central northern Texas.

Original reference: F. B. Plummer, 1919, Am. Assoc. Petroleum Geologists Bull., v. 3, p. 133–145.

Well exposed in creek bed one-half mile east of Caddo and in Caddo oil field. Named for Eastland, Eastland County.

Eastland Sandstone (in Graham Formation)[1]

Pennsylvanian: Central Texas.

Original reference: F. B. Plummer and J. Hornberger, Jr., 1936, Texas Univ. Bull. 3534, p. 62.

Well exposed in railroad cut 1 mile northwest of Eastland, Eastland County.

Eastland Lake Formation (in Smithwick Group)

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

M. G. Cheney, 1940, Am. Asoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 84 (fig. 5), 86. Basal formation of group. Consists of sandstones in lower part and gray limestones in upper part. Occurs between depths of 3,960 and 4,225 feet in type well. Underlies Caddo Pool formation (new); overlies Sipe Springs formation (new).

Some reports place Eastland Lake in Kickapoo Group, Strawn Series.

Type well: Anzac Oil Corp. et al. E. S. Graham No. 1, in Allen Hines Survey, Abstract 135, central Young County. Named from Eastland Lake district of northwest Eastland County.

†East Lee Gneiss[1]

Precambrian: Western Massachusetts.

Original reference: B. K. Emerson, 1892, U.S. Geol. Survey Hawley sheet, that is, proof sheets of geologic maps and text intended for a geologic folio, but never completed and published in that form, although cited in U.S. Geol. Survey Bull. 191, 1902.

Named for exposures in hill overlooking East Lee on northeast.

†East Lee Limestone[1]

Precambrian: Massachusetts.

Original reference: B. K. Emerson, 1899, U.S. Geol. Survey Bull. 159, p. 50–51.

Exposed at East Lee, Berkshire County.

East Liberty Bone Bed (in Columbus Formation)

Middle Devonian: West-central Ohio.

J. W. Wells, 1944, Geol. Soc. America Bull., v. 55, no. 3, p. 280–282. Name applied to bone bed near top of formation. Consists of dolomitic sandstone containing phosphatic nodules, many of which are internal molds of small mollusks and other fossils; some fish remains also present. Thickness of bone bed commonly less than 1 foot but arenaceous character of bed extends downward for 10 feet or more, and lower boundary of bone is gradational in places. Disconformably overlain by Ohio black shale.

Well exposed in quarry of East Liberty Stone Co., 1 mile west of East Liberty, Logan County. Area is known as Bellefontaine Devonian outlier.

East Lynn Sandstone

East Lynn Sandstones (in Allegheny Formation)[1]

Pennsylvanian (Allegheny Series): Southern West Virginia and Eastern Kentucky.

Original reference: C. E. Krebs and D. D. Teets, Jr., 1913, West Virginia Geol. Survey Rept. Cabell, Wayne, and Lincoln Counties, p. 183.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 45, 48, 82. In lower Allegheny between Middle Kittanning above and No. 5 Block (Lower Kittanning) coals.

Named for occurrences at East Lynn, Wayne County, W. Va., where it forms massive cliffs 40 to 60 feet high.

East Molokai Volcanic Series

Pliocene(?): Molokai Island, Hawaii.

H. T. Stearns 1946, Hawaii Div. Hydrography Bull. 8, p. 69 (table), 71–72; H. T. Stearns and G. A. Macdonald, 1947, Hawaii Div. Hydrography Bull. 11, p. 16–23; G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 81–82. Consists of caldera complex member, lower (basalt) member, and upper (andesite) member. Exposed thickness 4,900 feet; probably extends 12,000 feet or more to ocean floor. Separated from underlying West Molokai volcanic series (new) by erosional unconformity; separated from overlying Kalaupapa basalt (new) by erosional unconformity.

Type locality: Cliff south of Kalaupapa Peninsula. Covers area 26 miles long and 8 miles wide, comprising almost all of East Molokai.

East Mountain Schist[1]

Precambrian(?): Southwestern Vermont.

Original reference: E. J. Foyles, 1931, Vermont State Geologist 17th Rept., p. 249.

East Mountain, Mendon Township, Rutland County.

East Mountain Shale Member (of Mineral Wells Formation)[1]

East Mountain Formation (in Lone Camp Group)

Middle Pennsylvanian: Central northern Texas.

Original references: F. B. Plummer and R. C. Moore, 1922, Jour. Geology, v. 30, p. 25, 31; Texas Univ. Bull. 2132, p. 77, charts.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 87, 88, 92. Rank raised to formation in Lone Camp group (new). Includes (ascending) Hog Mountain sandstone, Capps limestone (upper part), and Village Bend limestone members. Overlies Garner formation; underlies Salesville formation of Whitt group (new). Name Mineral Wells dropped in this report.

R. J. Cordell and others, 1954, Abilene Geol. Soc. Guidebook Nov. 19–20, fig. 2 (strat. chart). Formation revised to include (ascending) Brazos River sandstone (in part) and conglomerate, Hog Mountain sandstone, conglomerate sandstone in East Mountain shale, Capps limestone, and Village Bend limestone. Revision based on faunal break in Brazos River sandstone.

Leo Hendricks, 1957, Texas Univ. Bur. Econ. Geology Pub. 5724, p. 22–23, fig. 3, pl. 1. Formation in Parker County consists of shale, one sandstone body (Hog Mountain sandstone bed), and one conglomeratic sandstone. Thickness 330 feet in traverse located east of Lake Mineral Wells. Upper 35 to 40 feet exposed in scarp that crosses Wolters Military Base; beds are poorly laminated clay-shale; interval includes stratigraphic position of Village Bend limestone mapped in Palo Pinto County (Plummer and Hornberger, 1935 [1936]), but limestone cannot be traced into Parker County. Underlies Salesville formation; overlies Garner formation. Group terminology not used in this report.

Type locality: Extensive exposures on south end of East Mountain in Mineral Wells, Palo Pinto County.

Easton Schist[1]

Easton Group

Pre-Ordovician(?) or Carboniferous(?): Central Washington.

Original reference: G. O. Smith, 1903, U.S. Geol. Survey Prof. Paper 19.

R. S. Yeats, 1958, Dissert. Abs., v. 19, no. 4 p. 775. Easton group, in Skykomish area, subdivided into Eagle greenschist and Tonga formation (both new).

R. J. Foster, 1960, Geol. Soc. America Bull., v. 71, no. 2, p. 102, pl. 1. Easton schist forms pre-Tertiary basement west of Cle Elum Valley. In area of this report [northern parts of Mount Stuart and Snoqualmie folios], consists of blue amphibole schists and apparently interbedded greenschist and phyllite. Is apparently southern end of extensive but discontinuous unit that has been traced from near Canadian border to just north of Snoqualmie quadrangle. Schist is pre-Swauk and therefore pre-Tertiary. W. S. Smith (1915, Columbia Univ. School of Mines Quart., v. 36; 1916, Jour. Geology, v. 26, no. 6) reported Ordovician fossils north of Snoqualmie quadrangle in less metamorphosed rocks and used these to date Easton as pre-Ordovician. Recent workers have not found Ordovician fossils and original Ordovician collection has been lost.

Named for occurrence near Easton, Kittitas County. Exposed in cores of two anticlines between Kachess and Cle Elum Lakes.

East Point Formation

Quaternary: Southwestern Alaska.

G. L. Snyder, 1959, U.S. Geol. Survey Bull. 1028–H, p. 177, pl. 23. Uninterrupted sequence of andesitic lava flows, over 500 feet thick. Two dozen separate flow units distinguished in 700-foot sea cliff on southeast side of East Point. Lavas are light- to dark-gray andesite and basalt locally containing plagioclase, pyroxene, and olivine phenocrysts. Probably younger than Sitkin Point formation (new).: conformably underlies Double Point dacite (new).

Named for exposures, at sea level, on either side of East Point, Little Sitkin Island, in Rat Islands group of Aleutian Islands.

Eastport Formation[1]

Upper 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. Shown on correlation chart above Pembroke formation. Underlies Devonian. Cayugan series.

Named for exposures at Eastport on Moose Island, Washington County.

East Ridge Group

Age unknown: Southern California.

K. J. Hsu, 1955, California Univ. Dept. Geol. Sci. Bull., v. 30, no. 4, p. 278–283, geol. map. Dominantly ultramylonites with some layered plutonics interlayered. Occurs in an apparently homoclinal sequence. Separated from Aurela Ridge and West Ridge rocks (both new) by Marjo Canyon thrust. Contact relations with Sarac Ridge mylonite (new) not certain.

Exposed on East Ridge, San Bernardino County.

East Tioga 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. 8, 22, map. A 10-foot bed of clean, buff-colored clay. White Earth, South Ross, and Lakeside clays occur in same general area.

On Great Northern mainline in center sec. 33, T. 157 N., R. 94 W., Mountrail County.

East Verde limestone

[Upper Devonian] (Jeromian): Arizona.

[C. R.] Keyes, 1942, Pan-Am. Geologist, v. 77, no. 3, p. 228. Upper part of Jeromian series (new). Thickness 350 feet. Older than Island Mesa limestone. Overlies Sycamore sandstone. Upper part of Jerome formation (of Stoyanow).

[In Jerome region.]

East Waterford Red Sandstone Member (of Juniata Formation)

Upper Ordovician: Central Pennsylvania.

F. M. Swartz, 1957, Pennsylvania State Univ., Dept. Geol. Contr. 3, 58p. Consists of red graywacke-type sandstones with interbeds of shale and siltstone. Basal member of Juniata from Tyrone Gap to Susquehanna Gap. Underlies Plummer Hollow red mudstone and sandstone member (new) of Juniata from Tyrone Gap eastward to about vicinity of Lost Creek Gap. Overlies Spring Mount sandstone member (new) of Bald Eagle sandstone; eastward overlies Lost Run conglomerate. [Swartz refers to his 1955 report *in* Pennsylvania Geologists Guidebook 21st Ann. Field Conf. Compiler was unable to locate a copy of this report.]

Type locality: East Waterford Narrows in Tucsarora Mountain, Juniata County.

East Waynesboro 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 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 Blue Ridge in Albemarle and adjacent counties. Main Blue Ridge mountain is overturned anticline, with axial plane dipping 28° SE., and thrust fault bordering it on its western edge.

†East Wisconsin Formation[1]

Pleistocene: Wisconsin.

Original reference: T. C. Chamberlin, 1895, Jour. Geology, v. 3, p. 270–277.

Named for thick development of drift in eastern Wisconsin.

†East Wisconsin stage of glaciation[1]

Pleistocene: Wisconsin.

Original reference: T. C. Chamberlain, 1894, Great ice age, by James Geikie, 3d ed., p. 724–775.

Named for thick development of drift in eastern Wisconsin.

Eaton Beds[1]

Middle Silurian: Ohio.

Original reference: A. F. Foerste, 1888, Denison Univ. Sci. Lab. Bull., v. 3, p. 8.

Eaton Greensand Lentil (in Claiborne Group)[1]

Eocene, middle: Eastern central Texas.

Original reference: B. C. Renick and H. G. Stenzel, 1931, Texas Univ. Bull. 3101, p. 78, 90–91.

Occurs south of Eaton, in vicinity of Shiloh School, in southern Robertson County.

Eaton Sandstone Member (of Saginaw Formation)

Eaton Sandstone (in Grand River Group or Formation)

Pennsylvanian: Southern Michigan.

W. A. Kelly, 1936, Michigan Dept. Conserv., Geol. Div. Pub. 40, Geol. Ser. 34, p. 207, 211–214. Eaton sandstone (in newly defined Grand River group) proposed for uppermost sandstones forming bluffs or ledges along valley of Grand River and its tributaries in vicinity of Grand Ledge in northern part of Eaton County. Beds are post-Saginaw in age, but true stratigraphic relations to Woodville sandstone, Ionia sandstone, or other strata of Grand River group cannot be determined. Overlies Saginaw at type locality of that group. Thickness 50 feet in vicinity of Grand Ledge.

Michigan Geol. Soc., 1954, *in* Geologic cross section of Paleozoic rocks central Mississippi to northern Michigan; Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 28–29. Herein considered member of Grand River formation. Occupies channels cut into shale and sandstone of Saginaw formation. It is probable that future study will show that the Eaton is brown-weathering facies of the Ionia as exact stratigraphic position of Eaton and Ionia members in the Grand River is not known.

Name derived from Eaton County.

Eau Claire Grit[1]

Upper Cambrian: Southwestern Wisconsin.

Original reference: L. C. Wooster, 1878, Wisconsin Geol. Survey Ann. Rept. 1877, p. 37.

Exposed at mouth of Eau Claire River, Eau Claire County.

Eau Claire Sandstone[1] (in Dresbach Group)

Eau Claire Member (of Dresbach Formation)

Upper Cambrian: Western Wisconsin and southeastern Minnesota.

Original reference: C. D. Walcott, 1914, Smithsonian Misc. Colln., v. 57, p. 354.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 30, 32, 33, measured sections. Middle member of Dresbach formation. Commonly medium- to fine-grained gray to buff sandstone with beds and partings of gray shale; may include conglomerates, and over large areas its shales may be red. Thickness about 128 feet at type section of Dresbach. Overlies Mount Simon member; underlies Galesville member.

A. F. Agnew and others, 1956, U.S. Geol. Survey Prof. Paper 274–K, p. 255 (fig. 32), 371. Referred to as Eau Claire sandstone. Overlies Mount Simon sandstone; underlies Dresbach sandstone. Thickness 70 to 330 feet.

U.S. Geological Survey currently includes the Eau Claire Sandstone in the Dresbach Group.

Named for exposures at mouth of Eau Claire River, Eau Claire County, Wis.

Ebbetts Pass Granodiorite

Pre-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.

Ebbetts Pass is in Alpine County.

†Ebensburg Sandstone Member (of Conemaugh Formation)[1]

Pennsylvanian: Western Pennsylvania.

Original reference: C. Butts, 1905, U.S. Geol. Survey Geol. Atlas, Folio 133.

Crops out in river bluff to east of Summerhill, and also on top of knoll just northwest of Summerhill. Probably named for town of Ebensburg, Cambria County.

Echo Granite[1]

Precambrian(?): Southern California.

Original reference: W. J. Miller, 1930, Geol. Soc. America Bull., v. 41, p. 149–150.

Comprises several square miles, extending from Millard Canyon to Eaton Canyon, including part of Echo Mountain, San Gabriel Mountains.

Echo limestone or formation (in Kwaguntan series)

Precambrian: Northern Arizona.

Charles Keyes, 1938, Pan-Am. Geologist, v. 70, no. 2, p. 107 (chart), 113. Consists of three chief ledges of limestone separated by shales. Principal limestone formation of entire Protozoic section. Thickness 150 feet. Underlies Walhalla formation (new); overlies Carbon Butte shales (new).

Name derived from Echo Cliffs, at edge of Kaibab Plateau, on latitude of mouth of Little Colorado River; Grand Canyon region.

Echo Canyon Conglomerate

Upper Cretaceous: Northeastern Utah.

N. C. Williams and J. H. Madsen, Jr., 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10, p. 123, 125. Proposed for sequence of red conglomerates, sandstones, and shaly sandstones exposed in Echo Canyon and adjacent areas. Thickness 3,100 feet. Overlies Wanship formation; unconformably underlies Knight formation. Fossils near base are considered to be late(?) Niobrara; upper part of unit may be Montanan in age. Relationship of Echo Canyon conglomerate to Hilliard formation, which contains Coloradoan-Montanan boundary in southwestern Wyoming not presently known.

Eardley (1944, Geol. Soc. America Bull., v. 55, no. 7) mentioned, but did not define, an Echo Canyon conglomerate which he stated (p. 844) occurred below Fowkes(?) formation. Table 1, p. 824, shows his newly defined middle Paleocene(?) Saw Mill conglomerate underlying upper Paleocene(?) Fowkes formation.

L. A. Hale, 1960, Wyoming Geol. Assoc' Guidebook 15th Ann. Field Conf., p. 142. Refers to Echo Canyon (formerly Pulpit) conglomerate.

Exposed in Echo Canyon and vicinity of Echo Junction, Coalville area, Summit County.

Echo Falls Shale

Eocene, upper: Southern California.

T. L. Bailey, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 11, p. 1920 (fig. 3). Shown on structure section as underlying Matilija sandstone and overlying Topatopa sandstone.

Section is 2 miles east of Santa Paula, Ventura County.

Echooka River Glaciation

Pleistocene: Central northern Alaska.

R. L. Detterman, 1953, *in* T. L. Péwé and others, U.S. Geol. Survey Circ. 289, p. 12, 13 (table 1). Four Quaternary glacial advances recognized in Sagavanirktok-Anaktuvuk district. Echooka, the last recognizable advance, succeeded Itkillik glaciation (new). Relatively minor, covering less than 50 square miles. At its maximum extent, ice did not reach front of range and formed independent valley glaciers. Well-developed end moraines and kame terraces along valley wall. Knob and kettle topography of moraine relatively fresh. Till sheet 30 to 50 feet thick.

Named after Echooka River, major eastern tributary of Sagavanirktok River. Confined to major valleys of Sagavanirktok River drainage area.

Echo Pond Granitic Complex

Age not stated: Northeastern Vermont.

B. K. Goodwin, 1959, Dissert, Abs., v. 20, no. 5, p. 1740. Granitic rocks occupy about two-thirds of map area. Three major granitic bodies are present: Averill granite, Nulhegan quartz monzonite (new), and Echo Pond granitic complex. Rocks of Echo Pond range from granite to gabbro.

Report discusses geology of Island Pond area, located between Green Mountain anticlinorium and Connecticut River.

Eckman Sandstone (in Pottsville Group)[1]

Eckman Sandstone (in Pocahontas Group)

Pennsylvanian (Pottsville Series): Southern West Virginia.

Original reference: R. V. Hennen and R. M. Gawthrop, 1915, West Virginia Geol. Survey Rept. Wyoming and McDowell Counties, p. 221.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey [Rept.] Greenbrier County, p. 217, 245. Included in Pocahontas group, Pottsville series. In Greenbrier County is lenticular brown to gray sandstone. Thickness 20 to 40 feet. Underlies No. 6 Pocahontas coal and overlies No. 5 Pocahontas coal.

Named for exposures at Eckman, McDowell County.

Economy Formation or Shale (in Eden Group)

Economy Member (of Eden Formation)

Economy 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 basal formation in Eden group in Indiana. Underlies Southgate formation; overlies Cynthiana formation in Trenton group. Consists of shale 50 to 80 feet thick.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 66, no. 3, chart 2 (column 45). Shown on correlation chart as Economy shale in Eden group. Underlies Southgate shale; overlies Fulton shale.

W. C. Sweet and others, 1959, Jour. Paleontology, v. 33, no. 6, p. 1030–1031. Basal member of Eden formation. Economy member (designated "Fulton-Economy" in this rept.) is 20 to 80 feet thick. Gradationally underlies Southgate member.

Economy was old name of village now known as West Covington, Kenton County, Ky.

Ector Tongue (of Austin Chalk)[1]

Upper Cretaceous (Gulf Series): Northeastern Texas.

Original reference: L. W. Stephenson, 1918, U.S. Geol. Survey Prof. Paper 120–H, p. 149.

L. W. Stephenson and others, 1942, Geol. Soc. America Bull., v. 53, no. 3, chart 9. Shown on correlation chart as underlying Bonham marl and overlying Eagle Ford shale.

Exposed near Ector, Fannin County.

Eddy sandstone[1]

Permian: Southern New Mexico.

Original reference: C. R. Keyes, 1906, Jour. Geology, v. 14, p. 147–154.

Derivation of name not stated, but probably named for Eddy, Lincoln County [now Eddy County].

Eddy Hill Grit[1]

Eddy Hill Grit Member (of Schodack Formation)

Eddy Hill lithofacies

Lower Cambrian: Southwestern Vermont and eastern New York.

Original reference: Rudolf Ruedemann, 1914, New York State Mus. Bull. 169, p. 67–70.

Winifred Goldring, 1943, New York State Mus. Bull. 332, p. 64. Rank reduced to member of revised Schodack formation.

Christina Lochman, 1956, Geol. Soc. America Bull., v. 67, no. 10, p. 1335, 1336, 1339, pl. 9. Referred to as a lithofacies of third phase of Lower Cambrian sedimentation in Cambridge and Hoosick quadrangles, New York. Not considered time-stratigraphic unit. Contemporaneous with Mettawee and Schodack lithofacies.

D. W. Fisher, 1956, Internat. Geol. Cong., 20th, Mexico, Cambrian Symposium, pt. 2, p. 332. Dale's "Black patch grit" (1898, U.S. Geol. Survey Ann. Rept., v. 19, pt. 3B) was named the Eddy Hill grit by Ruedemann (1914) from type exposure at Eddy Hill, Vt., where unit is 40 feet thick. The Eddy Hill is dark-gray calcareous quartz grit with black shaly patches and calcareous sandstone nodules. Another variant is feldspathic sandstone or subgraywacke with calcareous and sericitic cement. Formation may be mistaken for Middle Ordovician Normanskill graywacke but lacks kaolinized inclusions and more pronounced bedding. Southward extension of Eddy Hill into Rensselaer County is unproved, and its correlation with Diamond Rock quartzite is speculative.

Named for exposures at Eddy Hill near Fairhaven, Vt.

Eden Beds[1]

Pliocene, lower: Southern California.

Original reference: C. Frick, 1921, California Univ. Pub., Dept. Geol. Bull., v. 12, p. 283–288.

Occur in Eden region, San Jacinto quadrangle, Riverside County.

Eden Group[1] **or Formation**

Eden Formation (in Covington Group)

Eden (Edenian) Stage

Upper Ordovician: Southwestern Ohio, southern Indiana, central northern Kentucky, central Tennessee, and West Virginia.

Original reference: J. S. Newberry, 1873, Ohio Geol. Survey, v. 1, table facing p. 89.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 2 (fig. 1), 175–179. Eden group geographically extended into central Tennessee. An intercalation of beds carrying an Eden fauna and lithologically different from Leipers and Catheys occurs low on southeastern flank of Nashville dome. This zone is here named Inman formation.

J. B. Patton, T. G. Perry, and W. J. Wayne, 1953, Indiana Geol. Survey Field Conf. Guidebook 6, pl. 1. Generalized stratigraphic column of Ordovician rocks exposed in Jefferson and Switzerland Counties, Ind., shows Eden group comprising (ascending) Economy formation, 50 to 80 feet, Southgate formation, 70 to 120 feet, and McMicken, 60 to 80 feet. Underlies Maysville group; overlies Trenton group.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, 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.

W. C. Sweet and others, 1959, Jour. Palentology, v. 33, no. 6, p. 1029–1030. Basal formation in Covington group. Underlies Fairview formation; above Point Pleasant (Cynthiana) beds. Formation divided into three members (ascending); Economy (including basal Fulton beds), Southgate, and McMicken. Eden formation may be considered reference standard for early Cincinnatian Eden stage.

Named for Eden Park, Cincinnati, Ohio.

Edgecliff Member (of Onondaga Limestone)

Middle Devonian: New York.

W. A. Oliver, Jr., 1954, Geol. Soc. America Bull., v. 65, no. 7, p. 626–627, 631 (fig. 2), 635–636, 641–642, pl. 1. Lowest member of Onondaga. Massive light-gray (in some places pink) very coarsely crystalline limestone characterized, in type area of Onondaga, by profusion of tabulates, large rugose corals, and crinoidal columnals. This is true coral biostrome and is Hall's (1879, New York Geol. Survey, Palentology, v. 5, pt. 2) "great coral bearing limestone" and the "Onondaga limestone" of early reports. Biostrome ranges in thickness from 8 feet at Split Rock to 25 feet at Chittenango Falls. Base of this unit is very sandy in most places; sandy zone (Springvale horizon) ranges in thickness from fraction of an inch with only widely scattered sand grains to 4 feet with high enough sand concentration at its lower limit to make it a sandstone; carries Onondaga fauna and is easily distinguished from true Oriskany sandstone. Whitish-gray chert nodules are characteristic of upper half of limestone but may occur in lower part also. Recognizable as far west as Buffalo; main changes are in thickness and amount of chert; near Buffalo contains large biohermal "reef" structure 35 feet thick and several hundred feet in diameter. Thickens eastward; 20 feet thick at Springfield Four Corners, where biostrome extends to top of member; 39 feet in Berne and Albany quadrangles, where biostrome occupies only lower 16 feet. Underlies Nedrow member (new). Onondaga in New York is generally considered lower Middle Devonian (Onesquethaw stage).

Named from exposures at Edgecliff Park, southwest of Syracuse and 1 mile northeast of Howlet Hill, Camillus quadrangle, Onondaga County. Member is most accessible at Split Rock, but this name is preoccupied.

†Edgehill Quartzite[1]

Lower Cambrian: Southeastern Pennsylvania.

Original reference: C. E. Hall, 1881, Pennsylvania 2d Geol. Survey Rept. C_6, p. 14–47, map.

Probably named for Edge Hill, Montgomery County.

Edgewood Limestone[1] or Dolomite

Lower Silurian: Northeastern Missouri, western Illinois, and northeastern Iowa.

Original reference: T. E. Savage, 1909, Am. Jour. Sci., 4th, v. 28, p. 517–518.

T. J. Laswell, 1957, Missouri Geol. Survey and Water Resources Rept. Inv. 22, p. 9 (fig. 2), 16–22, pl. 1. Formation described in Bowling Green quadrangle where it is 0 to 40 feet thick and includes Cyrene limestone member below and Bowling Green dolomite member above. Unconformably overlies Maquoketa formation of upper Ordovician age; unconformably underlies Grassy Creek formation of Mississippian or Devonian age. Reference section designated. Albion series.

C. E. Brown and J. W. Whitlow, 1960, U.S. Geol. Survey Bull. 1123–A, p. 34–40, pls. 1, 3. Geographically extended into Dubuque South quadrangle, Iowa-Illinois, where it consists chiefly of dolomite. Thickness 9 to 116 feet. Separable into (ascending) Mosalem and Tete des Morts members (both new). Unconformably overlies Neda member of Maquoketa shale; underlies Kankakee formation.

Reference section: On Higginbotham Farm in NW¼NE¼ sec. 28, T. 53 N., R. 1 W., Bowling Green quadrangle, about 1 mile north of Calumet, Pike County, Mo. Named for exposures 3 miles north of Edgewood, Pike County, Mo.

Edie School Rhyolites

Pliocene: East-central Idaho and southwestern Montana.

Robert Scholten, K. A. Keenmon, and W. O. Kupsch, 1955, Geol. Soc. America Bull., v. 66, no. 4. p. 376–377, pl. 1. Named for slightly porous pale-lavender rhyolitic rocks that weather in shades of brown. Attain greatest thickness, estimated at 200 to 250 feet, in southeast corner of area and wedge out where they overlap on flanks of adjoining ranges. Overlie mid-Tertiary sediments of South Medicine Lodge Basin and are overlapped by Snake River basalts in southeast corner of region.

Described in Lima region, Clark County, Idaho, and Beaverhead County, Mont.

Edinburg Formation

Middle Ordovician: Western Virginia.

B. N. Cooper and G. A. Cooper, 1946, Geol. Soc. America Bull., v. 57, no. 1, p. 78–86. Proposed for stratigraphic interval above Lincolnshire limestone and below *Reuschella "edsoni"* zone which characterizes Oranda formation (new). In Shenandoah Valley, underlies Collierstown limestone (new). Embraces two equivalent facies: one of cobbly to nodular buff-weathering limestone, Lantz Mills (new), and other of black limestone and shale, Liberty Hall facies (new). Thickness as much as 1,348 feet; at type locality 455 feet. Includes Botetourt limestone member (new) at base and St. Luke member (new) near top. Corresponds to substantial part of Chambersburg formation of Pennsylvania.

Type section: One and one-half miles N. 61° E., of Edinburg, Shenandoah County.

Edison 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.

D. R. Baker, 1957, Dissert. Abs., v. 17, no. 3, p. 597–598. Edison gneiss, a major lithologic unit in Edison area, is divided into four unnamed subunits. Detailed petrographic description given.

Edison area is in New Jersey highlands 3 miles south of Franklin, Sussex County.

Edisto Marl[1]

Miocene, lower: 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 in South Carolina, p. 12, 18, 19.

Extends from mouth of Wando River by Charleston, Church Flats, Port Royal, Parachucla, Givhams Ferry, Bacon's Bridge and thence back to head of Wando River, Colleton County.

Edmunds 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 Niagaran and Cayugan series [Middle and Upper Silurian].

Named for exposures near Edmunds, Washington County.

Edmunds Hill Andesite[1]

Devonian(?): Northeastern Maine.

Original reference: H. E. Gregory, 1899, Am. Jour. Sci., 4th, v. 8, p. 359-360.

Forms entire top of Edmund's Hill, Chapman Township, Aroostook County.

Edna Dolomite (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 the second of five formations in group. Younger than Togo formation; older than McHale slate.

Report of discusses magnesite belt of Stevens County.

Edna Mountain Formation

Upper Permian: North-central Nevada.

R. J. Roberts, 1951, Geology of the Antler Peak quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ-10]. Gray to buff calcareous sandstone and shale with interbedded chert-pebble conglomerate and thin limestone beds. Thickness about 100 feet. Unconformably overlies Antler Peak limestone.

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]. Thickness about 250 feet in Edna Mountain, about 100 feet in Battle Mountain.

Type locality: West slope of Edna Mountain, Golconda quadrangle.

Edray Sandstone (in Bluefield Formation)[1]

Edray Sandstone (in Lillydale Shale)

Mississippian: Southeastern West Virginia and southwestern Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 301, 443.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey [Rept.] Greenbrier County, p. 265. Lenticular sandstone that may correspond to Edray sandstone of Reger (1926) is present in Lillydale shale. It is a thin poorly defined stratum.

Type locality: In Pocahontas County, W. Va., on mountain road 1.2 miles north of Edray.

Edson Beds (in Ash Hollow Formation)

Edson Beds (in Ogallala Formation)[1]

Pliocene, lower: Western Kansas.

Original reference: M. K. Elias, 1931, Kansas Univ. Bull., v. 32, no. 7, p. 161-162.

M. K. Elias, 1942, Geol. Soc. America Spec. Paper 41, p. 144. Included in Ash Hollow formation (Ogallala group). Consist of unconsolidated sands topographically a few tens of feet below Rhinoceros Hill beds. Contain vertebrate fauna.

Form an isolated outcrop near Edson, Sherman County.

Edwards Limestone (in Fredericksburg Group)[1]

Lower Cretaceous (Comanche Series) : Southern Texas.

Original references: R. T. Hill and T. W. Vaughan, 1898, U.S. Geol. Survey Geol. Atlas, Folio 42, p. 2; U.S. Geol. Survey 18th Ann. Rept., pt. 2, p. 227-235.

W. S. Adkins, 1932, Texas Univ. Bur. Econ. Geology Pub. 3232, p. 338-348.

Name Edwards replaced terms Caprina limestone (paleontological term) and Barton Creek limestone of Hill. From Fort Worth to south of Waco, Edwards gradually thickens, and is overlain, apparently unconformably by Kiamichi clay. South of Waco, Kiamichi is absent, and Edwards is overlain by Duck Creek limestone. Type locality stated.

F. E. Lozo and others, 1959, Texas Univ. Bur. Econ. Geology Pub. 5905, 235 p. Symposium on Edwards limestone. Based on outcrop sections, a southern complex of Edwards, Comanche Peak, and Walnut formations is indicated to pass northward into a complex composed of Goodland, Walnut, and Paluxy formations.

A. P. Noyes, Jr., and Keith Young, 1960, Texas Jour. Sci., v. 12, nos. 1, 2, p. 78–85, 99–104. Described in Purgatory Creek area where it is about 250 feet thick, overlies Walnut clay and underlies Georgetown limestone of Washita group.

Type locality (Adkins): Barton Creek, near Austin. Named for Edwards Plateau, Nueces and Uvalde quadrangles, southwestern Texas, of which it is chief component of scarps and mesas.

Edwardsville Formation (in Borden Group)[1]

Lower Mississippian: Southeastern Indiana.

Original reference: P. B. Stockdale, 1929, Ohio Jour. Sci., v. 29, no. 4, p. 170.

P. B. Stockdale, 1931, Indiana Div. Geology Pub. 98, p. 76, 220–300. Includes following facies: Stewarts Landing, Springler Knob, Medora Knob, Allens Creek, Bear Wallow, and Riverside sandstone. Named members (not in sequence): Dry Creek sandstone, Brownstown Hills, Cutright sandstone, Weed Patch, and Mount Ebel sandstone.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 74, 78. Indiana units, Locust Point, Carwood, Floyds Knob, and Edwardsville were proposed by writer [Stockdale] in 1931. In present report, the Floyds Knob is carried into the Kentucky classification; the Edwardsville and "Lower Harrodsburg" are combined in Muldraugh formation (new); the Locust Point and Carwood together make Brodhead formation (new) in Kentucky.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 799. Includes Floyds Knob member (rank reduced).

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (column 76). Shown on correlation chart in Borden group. Osage series; underlies Harrodsburg limestone; overlies Floyds Knob formation.

Named for village of Edwardsville, near center NE¼ sec. 1, T. 3 S., R. 5 E., 4½ miles west of New Albany, Floyd County.

Eel River Formation (in Wildcat Group)

Pliocene, lower: Northwestern California.

B. A. Ogle, 1953, California Div. Mines Bull. 164, p. 13 (fig. 3), 28–31, 105–107, pls. 1, 2. Massive dark gray-black siltstone and glauconitic sandstone 600 to 2,000 feet thick. Unconformably underlies Rio Dell formation (new); unconformably overlies Pullen formation (new).

Type section: West bank of Eel River near Scotia, Humboldt County. In southern part of area, unit forms northward-dipping belt of varying thickness which extends from coast southeastward to Eel River and beyond.

Effingham cyclothem

Pennsylvanian: Southeastern Illinois.

C. L. Cooper, 1946, Illinois Geol. Survey Bull. 70, p. 13. Studies by Ekblaw led to tentative recognition of six cyclothems of which Effingham is third in sequence (ascending). Succeeds Divide cyclothem and is followed by Omega cyclothem. If Greenup and Omega limestones are not equivalent, a single standard reference section would include 14 cyclothems of which the Effingham would be eighth in sequence (ascending).

Type locality and derivation of name not given. However, type locality of Effingham beds is in sec. 33, T. 8 N., R. 6 E., on tributary to Salt Creek one-half mile south of Effingham, Effingham County.

Effingham Limestone Member (of Mattoon Formation)

Effingham Beds (in McLeansboro Group)

Pennsylvanian: Southeastern Illinois.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 12. Referred to as Effingham beds in McLeansboro group. Type locality given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 41, 51 (table 1), pl. 1. Effingham limestone member of Mattoon formation (new) proposed. Occurs above Shumway limestone member and below Bogota limestone member. Thickness about 11 feet at type outcrop. Name Effingham beds discontinued.

Type locality: In sec. 33, T. 8 N., R. 6 E. on Tributary to Salt Creek one-half mile south of Effingham, Effingham County.

Effingham terrane[1]

Pennsylvanian: Illinois.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 39, no. 4, p. 320.

Probably named for Effingham, Effingham County.

Effna Limestone (in Cliffield Group)

Middle Ordovician (Mohawkian): Southwestern Virginia.

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 59–64, pl. 8. Proposed for beds overlying Lincolnshire limestone and underlying Whitesburg limestone along northwest base of Walker Mountain. Consists mainly of white to light-gray coarse-grained shell limestone, some beds of which are pinkish; pyrite occurs as nests and stringers in 15-foot zone about 70 feet above base of formation. Thickness at type section 221 feet; decreases to about 60 feet south of Ceres.

C. E. Prouty, 1946,, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 5, p. 1152. Effna limestone is below Whitesburg, Athens, and Peery limestones in sequence southeast of Saltville thrust and is thought to be partly equivalent to Thompson Valley limestone (new), but relationships of succeeding Whitesburg to the Thompson Valley and Ward Cove are uncertain; because of this indefinite relationship, use of both Effna and Thompson Valley appears advisable.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 60–61, chart 1 (facing p. 130). Underlies Rich Valley formation (new). At Porterfield quarry, rests on thin tongue [Fetzer (new)] of Arline formation (new). Older than Red Knobs formation (new).

Type section: In and near McNutt quarry, about 1½ miles southeast of Sharon Springs, Bland County, Va. Name derived from settlement on State Highway 42, about 2 miles east of Sharon Springs.

Egan limestone[1]

Lower Ordovician: Eastern Nevada.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 53, 78.

Named for Egan Range, Ely region.

Eggleston Limestone[1] or Formation

Middle Ordovician: Southwestern Virginia and eastern Tennessee.

Original reference: A. A. L. Mathews, 1934, Virginia Geol. Survey Bull. 40, p. 7, 11, 30.

R. R. Rosenkrans, 1936, Virginia Geol. Survey Bull. 46–I, p. 100. Not a valid formation name. Considered a facies of Black River age transitional between red Moccasin facies and overlying Trenton facies of the Martinsburg. Generally overlies red Moccasin facies but also replaces uppermost part of red Moccasin in more westerly belts.

R. L. Miller and J. O. Fuller, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 76 (two sheets); 1954, Virginia Geol. Survey Bull. 71, p. 108 (table 6), 109–116. Overlies Hardy Creek member (new) of Moccasin limestone in Rose Hill Oil Field, Lee County. Underlies Trenton limestone. Consists of buff-weathering earthy calcareous siltstone at base and near top; rest of formation is thin-bedded fine-grained moderately fossiliferous limestone; two thick and several thin bentonite beds in upper part. Thickness 135 to 165 feet.

R. L. Miller and W. P. Brosgé, 1954, U.S. Geol. Survey Bull. 990, p. 61–66, 110–111, pl. 1. Mathews (1934) did not give type section, but sections at Narrows in Giles County that include beds assigned to Eggleston limestone have been published by Rosenkrans (1936) and Butts (1940, Virginia Geol. Survey Bull. 52, pt. 1). Section along highway at Narrows has slumped and is less well exposed than when studied by Rosenkrans and Butts, but several bentonite beds listed in their sections are still visible. Base of Eggleston, as defined by Mathews, was clearly intended to begin with drab-green mudstones that overlie red mudstones typical of the Moccasin. Butts draws base of his Eggleston at this horizon. Top of Eggleston is less readily seen in this section, because the critical zone in which the contact was placed by Butts is now largely covered. Now lowest exposed beds of typical Trenton lithology and containing *Dalmanella* and *Sowerbyella* are 25 feet above place where Butts draws top of Eggleston. Drawing contact close below the lowest exposed *Dalmanella-Sowerbyella* beds would keep the two thick bentonites that should occur in this 25-foot covered interval within the the Eggleston, where they seem to belong according to evidence from other parts of southwest Virginia. However, it must be assumed that Butts' placing of the contact is correct unless the covered beds in the critical zone are reexcavated. Throughout Lee County and in adjacent Tennessee, the Eggleston is divisible into three unnamed members. Thickness 126 to 181 feet. Conformably overlies Hardy Creek limestone; underlies Trenton limestone; in both contacts, lithologic and faunal changes are abrupt and without evidence of erosion.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 61. Formation appears in western belts of southwestern Virginia and eastern Tennessee on northwest slope of Wallen Ridge from Tennessee nearly to Big Stone Gap, and throughout Russell and Giles Counties, Va.

Type locality: Along State Highway 8, 1 mile north of Narrows, Giles County, Va. Also well exposed 1.1 miles south of Eggleston.

Eggners Ferry Chert

Mississippian: Western Kentucky.

E. M. Luttrell and Ann Livesay, 1952, Kentucky Geol. Survey, ser. 9, Bull. 11, p. 5, 11–12. Dark-blue to black chert that weathers white and gray. Contains *Productus* and *Spiriferina*. Occurs above New Albany shale and below Warsaw chert and, therefore, of Fort Payne age. Near Eggners Ferry, beds are from a few inches to 1 foot thick. Chert has been mapped as undifferentiated Meramec, St. Louis member of Meramec, Fort Payne, Camden chert, or Clear Creek chert by various workers [see bibliography this report].

Exposed along and near Kentucky Lake in vicinity of Eggner's Ferry, near Aurora, Marshall County.

Egremont Limestone[1]

Cambrian and Ordovician: Southwestern Massachusetts and northwestern Connecticut.

Original reference: W. H. Hobbs, 1893, Jour. Geology, v. 1, p. 717–736, 780–802.

Named for its wide extent in Egremont Valley, Berkshire County, Mass.

Egypt sand[1]

Upper Cretaceous: Missouri.

Original reference: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 252. Derivation of name not stated.

Eidson Member (of Lincolnshire Formation)

Middle Ordovician (Mohawkian): Northeastern Tennessee.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 61–62, chart 1 (facing p. 130). Name proposed for thinned part of Lincolnshire formation underlying Hogskin shale (new) in belts where that member is present. Consists of dark limestone containing black chert. Name credited to B. N. Cooper and G. A. Cooper.

Type section: Just north of Eidson, Kyles Ford (TVA 170–SE) quadrangle, Hawkins County. Present in Clinch, Hogskin, and Beaver Valleys.

Eighteenmile Creek Member (of Ludlowville Formation)

Middle Devonian: Western New York.

R. G. Sutton, 1951, Rochester Acad. Sci. Proc., v. 9, no. 5–6, p. 366. Described as shale. Overlies Spring Brook shale member in Lake Erie sections. Name used by G. A. Cooper (unpub. thesis, 1929) who has since modified the stratigraphy by combining this unit and Spring Brook member to form Wanakah shale member.

Eight Mile Dacite

Pleistocene(?): Southwestern Utah.

E. F. Cook, 1957, Utah Geol. and Mineralog. Survey Bull. 58, p. 16 (fig. 2a), 69. Consists of lower massive hard cliff-forming pale-brown dacite 50 to 100 feet thick, principally composed of glass tabulae; and upper denser, heavier porphyritic lithoidal dacite at least 200 feet thick. Of probable Pleistocene age according to text; shown as Pliocene(?) age on figure 2a. Generalized section shows dacite stratigraphically above Pine Valley latite (new).

Filled a valley which descended to south from Eight Mile Spring, northeast of present village of Central, Washington County.

Eileen Sandstone (in Oronto Group)[1]

Precambrian: Northwestern Wisconsin.

Original reference: F. W. Thwaites, 1912, Wisconsin Geol. Nat. History Survey Bull. 25, p. 50, 54.

S. A. Tyler and others, 1940, Geol. Soc. America Bull., v. 51, no. 10, p. 1474–1479. Thwaites assumed that Eileen sandstone lay below Amnicon sandstone on basis of distribution of outcrops and strikes and dips. Eileen at type locality is not in contact with any other formation of Oronto series but is separated by unexposed interval of almost 1½ miles from Amnicon formation. Therefore, relation of the Eileen to the Amnicon is not definitely known at type locality, and sequence postulated by Thwaites is only one of several possible explanations of relation of these two sandstones. Lithological and heavy mineral evidence suggests that the Eileen belongs above the Amnicon and includes beds on Middle River and Fish Creek sections which Thwaites classes as lower Orienta (in Bayfield group). Eileen sandstone is probably basal Orienta, and Amnicon arkose is upper Freda. Thickness of the Amnicon as given by Thwaites—5,000 feet—is included in his estimate of thickness of Freda, and the 2,000 feet assigned to the Eileen is the Orienta. Hence, Oronto group is revised to exclude Eileen and Amnicon.

Type locality: South fork of Fish Creek in sec. 20 and 21, T. 47 N., R. 5 W., in town of Eileen, Bayfield County.

Einstine (Einstein) Sandstone[1]

Pennsylvanian: Eastern Kansas.

Original reference: G. C. Swallow and F. Hawn, 1865, Kansas Geol. Survey Rept. on Miami County, p. 7.

At McFaddin's and Ward's mill, Miami County. Derivation of name not stated.

Eiss Limestone Member (of Bader Limestone)

Eiss Limestone (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. 229, 233, 234, 235, 237.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 39, p. 61, 62. Rank reduced to member status in Bader limestone. Underlies Hooser shale member; overlies Stearns shale.

M. R. Mudge and R. H. Burton, 1959, U.S. Geol. Survey Bull. 1068, p. 78–79, pls. Thickness about 10.9 feet in Wabaunsee County, Kans. Generally, consists of two beds of limestone and thin bed of shale. Underlies Hooser shale member; overlies Stearns shale.

Type exposure: In SE¼ sec. 3, T. 1 N., R. 13 E., on Eiss Farm, 8 miles south of Humboldt, Richardson County, Nebr.

Ekker Formation (in Sheeprock Group)

Precambrian: West-central Utah.

DeVerle Harris, 1958, Brigham Young Univ. Research Studies, Geology Ser., v. 5, no. 1, p. 6, 16–23, pl. 1. Includes phyllitic quartzites, quartzites, graywackes, feldspathic quartzites, and tillites which comprise autochthon of Sheeprock thrust. Total measured thickness 4,159 feet. Underlies Quaternary alluvium; overlies Auts Canyon formation (new).

The only location where complete succession of beds can be seen fairly well exposed and in their proper relation is on ridges east and west of Hard-To-Beat Canyon. In vicinity of Dutch Peak and Rick Ekker Ranch, Sheeprock Range, Tooele County.

Eklutna Glaciation

Pleistocene: Alaska.

T. N. V. Karlstrom, 1957, Science, v. 125, no. 3237, p. 74 (fig. 1). Named on correlation chart of glacial events. Recognized in Cook inlet area. Older than Knik glaciation.

R. D. Miller and Ernest Dobrovolny, 1959, U.S. Geol. Survey Bull. 1093, p. 11–12, 13 (fig. 2), pl. 3. Represented by till, outwash, and silt. Locally truncated surface of till is overlain by till and outwash of Knik glacier. Oldest pre-Wisconsin deposits in Anchorage area.

Exposed north of Eagle River Flats along bluff of Knik Arm, Anchorage area.

Elbert Formation[1]

Upper Devonian: Southwestern Colorado.

Original reference: W. Cross, 1904, Am. Jour. Sci., 4th, v. 18, p. 245–252.

Harley Barnes, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 8, p. 1780–1791. Heretofore, Ignacio quartzite has been thought to be Late Cambrian in age, disconformably overlain by Elbert formation of Late Devonian. Recent fieldwork suggests that Ignacio quartzite is Devonian in age and that it forms essentially continuous depositional sequence with overlying Elbert formation and Ouray limestone.

R. L. Knight and J. C. Cooper, 1955, Four Corners Geol. Soc. Guidebook [1], p. 56, 57. In subsurface in Four Corners area, overlies Aneth formation (new) and subdivided to include McCracken sandstone member at base.

F. H. T. Rhodes and J. H. Fisher, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 11, p. 2508–2518. Major unconformity exists between Ignacio quartzite and Elbert formation. This is contrary to conclusions of Barnes (1954). No explanation is offered for parallelism of bedding of Ignacio and Elbert, nor for seeming transition is lithology between the two units.

Named for exposures on Elbert Creek, a western tributary of Animas River, entering it just above Rockwood.

Elberton Granite

[Cambrian-Ordovician]: Western Georgia.

Felix Chayes, 1952, Am. Jour. Sci., v. 250, no. 4, p. 284–286. Fine-grained massive granite. Extensively quarried.

G. W. Crickmay, 1952, Georgia Geol. Survey Bull. 58, p. 31. Intrudes Little River series in Wilkes County.

Marc Grunenfelder and L. T. Silver, 1958, (abs.) Geol. Soc. America Bull., v. 69, no. 12, pt. 2, p. 1574. Age determinations by isotope-dilution methods on zircon concentrates from Elberton granite yielded ages of 375 to 490 million years. These data are in contrast with K/A and Rb/Sr ages of 250 to 290 million years reported from same rocks by previous workers. Older ages indicate a late Cambrian(?) plutonic episode which has not been recognized in region previously.

Occurs in vicinity of Elberton and crops out over wide area in Elbert and Oglethorpe Counties.

Elbow Ridge Sandstone Member (of Coeymans Limestone)

Devonian: Southern Pennsylvania.

F. M. Swartz, 1939, Pennsylvania Geol. Survey Bull. G-19, p. 86. Thick-bedded quartzitic sandstone, some crinoid stems. Thickness about 11 feet.

Section is on south side of Licking Creek where it bends southward across Maryland line, and across northeastern end of Elbow Ridge. It is several hundred feet west of bridge crossing creek about 1 mile east of Warren Point and 1½ miles southwest of Yeakle Mill, Franklin County.

Elbrook Limestone,[1] Dolomite, or Formation (in Conasauga Group)

Middle and Upper Cambrian: Central southern Pennsylvania, western Maryland, northwestern Virginia, and northeastern West Virginia.

Original reference: G. W. Stose, 1906, Jour. Geology, v. 14, p. 209.

H. P. Woodward, 1949, West Virginia Geol. Survey, v. 20, p. 155–169. Geographically extended into Jefferson and Berkeley Counties, W. Va., where it occurs in two separated belts of outcrop. Estimated thickness in Jefferson County 2,200 to 2,400 feet; in Berkeley County, 2,000 to 2,200 feet. Overlies Waynesboro formation, but contact poorly exposed, may be unconformable; conformably underlies Conococheague dolomite with sharp contact.

P. B. King, 1950, U.S. Geol. Survey Prof. Paper 230, p. 32–33, pl. 1. Described in Elkton, Va., area where it consists mostly of thin-bedded light-gray fine-grained dolomite that contains laminae and partings a few inches apart; some blue-gray limestone is interbedded with the dolomite, especially in upper part; some dolomitic buff or pink shale forms partings between dolomite or limestone beds. In most outcrops, dips are varied and formation is crossed by many small faults. In Crooked River Valley, belt of outcrop is about 3,500 feet wide and beds stand nearly vertical, except for local folds near top. Estimated thickness about 3,000 feet. Overlies Waynesboro formation; underlies Conococheague.

P. B. King and H. W. Ferguson, 1960, U.S. Geol. Survey Prof. Paper 311, p. 54, pl. 1. Conasauga group is interfingering complex of shale, limestone, and dolomite, of which Elbrook dolomite, Honaker dolomite and Nolichucky shale are representatives in northeasternmost Tennessee [this report]. Within this region, group is exposed in two areas—one to north, along southeast edge of Appalachian Valley, and other to southwest near Elizabethton, in trough of Stony Creek syncline. In northern occurrence, interval is all Elbrook dolomite, but to southwest, Nolichucky shale is at top and underlying dolomite is Honaker. Thickness of Elbrook about 2,000 feet in Denton Valley area, upper contact uncertain.

Named for outcrops near Elbrook, Franklin County, Pa.

El Capitan Granite[1]

Cretaceous: West-central California.

Original reference: F. C. Calkins, 1930, U.S. Geol. Survey Prof. Paper 160, p. 121–122, map.

J. F. Evernden, G. H. Curtis, and J. Lipson, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 9, p. 2122, 2123 (fig. 1). Discussed in paper dealing with potassium-argon dating of igneous rocks. Age given as 92.2 millions of years. Younger than Gateway granodiorite and older than Sentinel granodiorite.

E. S. Larsen, Jr., and others, 1958, U.S. Geol. Survey Bull. 1070–B, p. 52 (table 9). Lead-alpha age 94 millions of years.

Named for fact that it forms greater part of El Capitan, Yosemite National Park.

Elco Gravel[1]

Mississippian: Southwestern Illinois.

Original reference: L. C. Glenn, 1906, U.S. Geol. Survey Water-Supply Paper 164, p. 22, 150–152.

Quarried near Elco, Alexander County.

Elden limestones[1]

Carbonic: Northern central Arizona.

Original reference: C. [R.] Keyes, 1922, Pan-Am. Geologist, v. 38, p. 243, 251, 336.

Charles Keyes, 1936, Pan-Am. Geologist, v. 66, no. 3, p. 215 (chart). In Mississippian series. Overlies Truxton limestones; unconformably underlies Pierce shales. Of Carbonic age.

Name derived from Elden Mountain near Flagstaff.

Eldena Member (of Nachusa Formation)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., figs. 3, 15 C. Shown on columnar section as underlying Elm member (new) of Nachusa formation and overlying Forreston member (new) of Grand Detour formation. Thickness varies from 2 to 6 feet.

Occurs in Dixon-Oregon area.

Elder Sandstone

Age not stated: Northeastern Nevada.

James Gilluly, 1955, *in* Pacific Petroleum Geologist, v. 9, no. 8, p. 1. Thickness 3,000 to 5,000 feet. Arkosic sandstone dominant with beds of tan, pale, or buff chert. Overlies Ordovician Valmy formation; underlies Middle Devonian Slaven chert (new).

Occurs in Roberts Mountains area, Eureka district.

Elder Creek Group

Upper Jurassic (Knoxville): Northern California.

F. M. Anderson, 1943, California Div. Mines Bull. 118, pt. 2, p. 184 (fig. 68) [preprint 1941]. Shown as lowermost group of Knoxville series. Underlies Grindstone group (new).

F. M. Anderson, 1945, Geol. Soc. America Bull., v. 56, no. 10, p. 924, 925–926. Basal beds, as exposed near Redbank Creek, consist of dark-reddish-brown greatly indurated shale or thin-bedded cherty strata standing at a high angle and in part slightly overturned. In Bennett Creek area, a thick succession of alternating thin-bedded shales and calcareous sandstone layers constitute major part of group. Maximum thickness 6,600 feet. To the north, group is overlapped by early Shasta (Paskenta) beds; farther south, it is overlapped by conglomerates of Grindstone group. Lowest exposed beds rest upon or against pre-Knoxville metaandesite of Klamath complex.

Traceable northwest from Redbank Creek for a short distance and toward the south for more than 40 miles to latitude of Elder Creek village, Tehama County.

Eldora Sandstone[1]

Pennsylvanian: Central northern Iowa.

Original reference: S. W. Beyer, 1900, Iowa Geol. Survey, v. 10, p. 254.

Named for Eldora, Hardin County.

Eldoradan series[1]

Middle Cambrian: Nevada.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 51, 53, 78.

Eldorado Dolomite

Eldorado Limestone[1]

Middle Cambrian: Eastern Nevada.

Original reference: C. D. Walcott, 1908, Smithsonian Misc. Colln., v. 53, no. 1812, p. 184, footnote.

H. E. Wheeler and D. M. Lemmon, 1939, Nevada Univ. Bull., Geology and Mining Ser., no. 31, p. 18–20, fig. 3. Referred to as dolomite. Consists of thick-bedded dolomite, dolomitic limestone, and limestone. Thickness 2,000 feet south of Prospect Peak. Overlies Prospect Mountain quartzite; underlies Geddes limestone (new). In absence of fossils, dolomite is questionably assigned to Lower and Middle(?) Cambrian.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 9–11, pl. 2. Detailed description of Eldorado dolomite. Wheeler and Lemmon's (1939) definition accepted in this report. Restricted in outcrop area—confined to Prospect Ridge and southerly extension of the Ridge in Secret Canyon. North of Secret Canyon divide, exposures are discontinuous as result of two minor thrust zones, the Eldorado occurring in each of the three thrust blocks. Lowest of blocks includes type locality. In middle plate, Eldorado lies concordantly above and to east of main mass of Prospect Mountain quartzite and in several places overrides belts of Secret Canyon shale. In third and highest block, dolomite commonly overlies Prospect Mountain with thrust contact, but in a few places it appears to dip westward and rest in relative conformity on Pioche shale. Cannot be dated by enclosed fossils, but time range is limited by upper Lower Cambrian Pioche shale below and medial Middle Cambrian Geddes limestone above. Wheeler and Lemmon assign unit to Lower and Middle(?) Cambrian; in view of occurrence of Middle Cambrian fauna in Pioche shale at Pioche, assignment to early Middle Cambrian is probably more suitable.

J. C. Young, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 159, 160. Eldorado limestone is as much as 3,171 feet thick in north-central Schell Creek Range. Overlies Pioche formation; underlies Monte Neva formation (new).

Type locality: Eldorado Tunnel, which is near north end of Prospect Ridge and about 2,000 feet north of east from portal of Prospect Mountain Tunnel. Beds exposed here are near top of formation as it is now defined. Named for Eldorado mine, Eureka district.

El Dorado Ridge Gneissose Quartz Diorite

Age unknown: Southern California.

K. J. Hsu, 1955, California Univ. Dept. Geol. Sci. Bull., v. 30, no. 4, p. 298–300, geol. map. Medium-grained gneissose biotite-hornblende quartz diorite. Occurs in east-northeast-trending El Dorado Ridge—Stoddard Canyon pluton and south of Rainbow Flat metamorphics (new).

Named from exposures on El Dorado Ridge in San Bernardino County. Also present in Los Angeles County.

Eldoran Epoch[1] or Series[1]

Quaternary (Wisconsin and Recent): Iowa and Illinois.

Original reference: G. F. Kay, 1931, Geol. Soc. America Bull., v. 42, pt. 1, p. 449–452.

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 38. In Iowa and Illinois, Pleistocene is classed as a Period (System) and four Epochs (Series) are used to include a glacial-interglacial pair each. These are Grandian (Nebraskan and Aftonian), Ottumwan (Kansas and Yarmouthian), Centralian (Illinoian and Sangamonian), and Eldoran (Wisconsinan and Recent). Of these units, each of first three essentially coincides with a glacial cycle; present data indicate that the youngest (Eldoran) includes two distinct cycles, each of which is complex within itself. These terms have not been adopted for official use in Kansas partly because of this inconsistency and partly because the retention of Quaternary as the System-Period with Pleistocene as its contained Series-Epoch would necessitate erection of new category of names to include these terms and thus produce further complication of classification system.

Named for Eldora, Hardin County, Iowa.

Eleana Formation

Mississippian to Lower Pennsylvanian: Southern Nevada.

M. S. Johnson and D. E. Hibbard, 1957, U.S. Geol. Survey Bull. 1021–K, p. 357–360, pls. 32, 33. Lithologically most diverse unit in area. Generally consists of a conglomerate, quartzite, and shale facies in northern part of area. Southward, these grade into finer grained sediments. On Quartzite Ridge, where incomplete measured section is 2,810 feet thick, the Eleana is subdivided into three units. Lower unit consists of 1,000 feet or more of dark-brown to buff hard poorly bedded slope-forming argillite and shale. Middle is composed of about 1,050 feet of interbedded quartzite, conglomerate. Upper consists of about 760 feet of varicolored argillite. These three units traceable southward into Eleana Range where they grade laterally into finer grained sediments. Most noticeable facies change is in middle unit which is split by shale tongue which thickens southward where it also contains interbedded limestone beds and occupies about a third of middle unit. Remainder is conglomerate and quartzite. Similar changes occur in upper unit. In southern part of Eleana, upper unit consists of interbedded sequence of argillite and limestone. South of Eleana Range and in Mine Mountains, middle and upper units not recognizable as such owing to abrupt lithologic changes. In these areas, formation consists of interbedded conglomerate, quartzite, shale, and some limestone. Lower contact of formation not exposed in area. Underlies Tippipah limestone (new). Upper contact on margins of Syncline Ridge, placed at lithic break between interbedded quartzite, argillite, and overlying limestone and appears to be conformable.

Named for exposures in Eleana Range, Atomic Energy Commission Nevada proving grounds area, Nye County.

†Electric Intrusives[1]

Miocene: Yellowstone National Park.

Original reference: A. Hague and others, 1899, U.S. Geol. Survey Mon. 32, pt. 2, pl. 10.

Probably named for Electric Peak.

Electric Peak Intrusives[1]

Miocene: Yellowstone National Park.

Original reference: A. Hague and others, 1904, U.S. Geol. Survey Mon. 32, Atlas, Gallatin sheet.

Intrude sedimentary rocks of Electric Peak in Gallatin quadrangle, Yellowstone National Park.

Elephant Limestone[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, chart 6 (column 53a). Mainly Pennsylvanian but may be Permian in part.

Named for Elephant Canyon, southeast of Frisco district.

Elephant Butte Formation (in Armendaris Group)

Pennsylvanian (Des Moines Series): Central New Mexico.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 27 (table 2), 44 (fig. 3), 47–49. Term proposed for all rocks between top of Derry series (new) and base of Whiskey Canyon limestone (new). Formation is essentially limestone, with one thin bed of conglomeratic sandstone about 22 feet above base and several beds of calcareous gray silty and micaceous shale near middle. Includes Warmington limestone member (new) at base. Thickness at type locality about 82 feet. Overlies Cuchillo Negro formation (new).

Type locality: Western end of Whiskey Canyon, in norther part of Mud Springs Mountains in southwest part of sec. 1, T. 13 S., R. 5 W., Sierra County. Name derived from Elephant Butte in Rio Grande Valley at Elephant Butte Dam.

Elephant Hill Breccia (in Glendora Volcanics)

Miocene, middle or older: Southern California.

J. S. Shelton, 1955, Geol. Soc. America Bull., v. 66, no. 1, p. 56, pl 1. Breccia member of Glendora volcanics. Composed of angular fragments of laminated gray spherulitic glass in tuffaceous matrix. Most of the blocks are 1 inch or less across, but the largest are at least 2 feet long.

Occurs in steep-walled semicircular valley head 500 feet in diameter that penetrates east flank of Elephant Hill, in Spadra area near Pomona, Los Angeles County.

Elephant Mountain Flow

Miocene and Pliocene: South-central Washington.

A. C. Waters, 1955, Geol. Soc. America Bull., v. 66, no. 6, p. 673, pl. 1. Name applied to basalt flow interstratified in Ellensburg formation. Occurs at higher stratigraphic level than Selah Butte flow (new). Average thickness about 35 feet in area mapped; thickens eastward into widespread lava sheet in Black Rock Spring quadrangle. Map bracket shows Ellensburg and associated basalt flows as Miocene and Pliocene. Text states that much or all of the Ellensburg and its associated intercalated basalt flows are regarded as Pliocene.

Flow crops out on Elephant Mountain, eastern continuation of Rattlesnake Ridge, Yakima East quadrangle.

Eleventh Street Limestone

Pennsylvanian (Des Moines Series): Northern Oklahoma.

R. C. Moore, 1937, Kansas Geol. Soc. Guidebook 11th Ann. Field Conf., p. 102. Limestone in upper part Des Moines subseries; occurs at or near horizon of Lenapah limestone.

R. H. Dott, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 8, p. 1593. Abandoned in favor of Lenapah limestone. Credits name to F. E. Greene. Gives area and derivation of name.

Crops out on East Eleventh Street (U.S. Highway 66), about one-half mile east of intersection of East Eleventh Street and Sheridan Road, NE¼ sec. 11, T. 19 N., R. 13 E., Tulsa, Tulsa County.

†Elgin Limestone (in Maquoketa Group)[1]

Elgin Shaly Limestone Member (of Maquoketa Formation)

Upper Ordovician: Northeastern Iowa and western Wisconsin.

Original reference: S. Calvin, 1906, Iowa Geol. Survey, v. 16, p. 60, 98.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2 (column 50). Shown on correlation chart as shaly limestone member of Maquoketa formation. Underlies Clermont shale member; overlies Dubuque dolomite.

Named for exposures near Elgin, Fayette County, Iowa.

Elgin Sandstone Member (of Vamoosa Formation)

Elgin Sandstone[1]

Pennsylvanian (Virgil Series): Southern Kansas and central northern and central Oklahoma.

Original reference: Erasmus Haworth, 1898, Kansas Univ. Geol. Survey, v. 3, p. 64.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 67. In southern Kansas, much of the interval between the Lecompton and Oread formations is occupied by sandstone, sandy shale, and red shale collectively called Elgin sandstone.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped as sandstone member of Vamoosa formation.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 32–34. Elgin in Pawnee County consists of four sandstone beds and numerous sandstone lenses within Kanwaka shale member of Vamoosa.

Well exposed near Elgin, Chautauqua County, Kans.

Eliot Formation (in Merrimack Group)

Eliot Slate[1]

Probably Ordovician and Silurian: Southwestern Maine and southeastern New Hampshire.

Original reference: F. J. Katz, 1917, Washington Acad. Sci. Jour., v. 7, p. 198.

Jacob Freedman, 1950 Geol. Soc. America Bull., v. 61, no. 5, p. 450, 453 (fig. 2), 454–456, 488. Termed formation since slate not abundant in Mount Pawtuckaway quadrangle, New Hampshire. Includes light- and dark-gray phyllite, green phyllite, quartzite, and quartz-sericite schist. Calef member at top. Silurian(?).

M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000): U.S. Geol. Survey. Included in Merrimack group in New Hampshire. Age designated as probably Ordovician and Silurian.

M. P. Billings, 1956, Geology of New Hampshire, pt. 2, Bedrock geology: Concord, New Hampshire State Plan. Devel. Comm., p. 40–41. Age tentatively considered Silurian, probably Middle Silurian.

Named for developmnet at Eliot, York County, Maine.

Elizabeth Gabbros[1]

Precambrian: Eastern New York.

Original reference: G. H. Chadwick, 1930, Geol. Soc. America Bull., v. 41, p. 82.

Named for development around Elizabethtown, Essex County.

Elizabeth Furnace Conglomerate Member (of Gettysburg Shale)[1]

Upper Triassic: Southeastern Pennsylvania.

Original reference: A. I. Jonas and G. W. Stose, 1930, Pennsylvania Geol. Survey, 4th ser., Topog. and Geol. Atlas 168.

M. E. Kauffman, 1960, Pennsylvania Geologists Guidebook 25th Ann. Field Conf., Oct. 22 and 23, p. 23. Basal member of Gettysburg shale. Pebbly sandstone and conglomerate up to 2,500 feet thick. Underlies unnamed shale member.

Forms prominent ridge, Elizabeth Furnace Hill, northeast of Mount Hope, Lancaster County.

Elizabethtown Gabbro[1]

Precambrian: Northeastern New York.

Original reference: G. H. Chadwick, 1930, Geol. Soc. America Bull., v. 41, p. 82.

Occurs around Elizabethtown, Essex County.

Elizaville Shales

Upper Cambrian and Lower Ordovician(?): Southeastern New York.

J. D. Weaver, 1957, Geol. Soc. America Bull., v. 68, no. 6, p. 739–743, pl. 1. Mainly light gray but ranges from light greenish gray to dark gray approaching black. Coarse shaly or fine silty texture with all variations from fine phyllitic shale to coarse siltstone. Upper part contains horizon with many bands of brown quartzite ranging from 3 inches to 12 inches in thickness, at intervals of 2 or 3 feet. Also contains banding consisting of thin layers of ferruginous and dolomitic material an inch or so apart, and characterized by fine irregular crumpling, with crenulations of amplitude about one-half inch; this crumpling is somewhat similar to that in Pine Plains dolomites. Thickness about 90 feet.

Named from village of Elizaville, southeast corner of Catskill quadrangle. Described in Copake quadrangle.

Elk Fire Clay (in Conemaugh Formation)[1]

Pennsylvanian: Southern West Virginia.

Original reference: C. E. Krebs and D. D. Teets, Jr., 1914, West Virginia Geol. Survey Rept. Kanawha County, p. 179.

Named for Elk River, near Charleston, Kanawha County.

Elk Basin Sandstone Member (of Telegraph Creek Formation)[1]

Upper Cretaceous: Southern Montana and central northern Wyoming.

Original reference: C. J. Hares, 1917, Washington Acad. Sci. Jour., v. 7, p. 430.

Forms rims from Park City to Elk Basin and Shoshone River, Yellowstone and Bighorn Counties.

Elk Butte Member (of Pierre Shale)

Upper Cretaceous: Central South Dakota and northeastern Nebraska.

W. V. Searight, 1937, South Dakota Geol. Survey Rept. Inv. 27, p. 50–55, pls. 2, 3. Includes all beds in South Dakota between top of Mobridge member (new) and base of Fox Hills formation. Essentially medium-gray flaky shale with small ferruginous concretions. Thickness 70 to 290 feet.

A. L. Moxon, O. E. Olson, and W. V. Searight, 1939, South Dakota State Coll. Agriculture and Mech. Arts Tech. Bull. 2, p. 20, 26. Overlies Interior member, used in this report in preference to Mobridge member.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 16. Geographically extended into northeastern Nebraska.

A. L. Moxon, O. E. Olson, and W. V. Searight, 1939, South Dakota State Coll. Agriculture and Mech. Arts Tech. Bull. 2 (revised), p. 20, 25. Overlies Mobridge member, which name is now accepted in place of Interior.

Type locality: Along U.S. Highway 12, near Elk Butte, Corson County, S. Dak. Section begins a little less than 1½ miles west and continues to 5 miles west of Wakpala.

Elk City Member (of Quartermaster Formation)

Elk City Sandstone Member (of Quartermaster Formation)[1]

Permian: Western Oklahoma.

Original reference: H. L. Griley, 1933, Pan-Am. Geologist, v. 59, no. 3, p. 234.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped in western Oklahoma as Elk City member of formation; upper member of formation; overlies Doxey member.

Well exposed in SE¼ sec. 3, T. 11 N., R. 19 W., [Washita County].

Elk Creek Basalt

Miocene and (or) Pliocene: Northwestern Wyoming.

A. D. Howard, 1937, Geol. Soc. America Spec. Paper 6, p. 33-36, 78 (table 9), pl. 4. Highly porphyritic basalt; the phenocrysts of feldspar are tabular, and average about one-quarter inch in size. Normally blue black. Intensely altered locally. Color of altered phases is lighter and in some places is almost white. Younger than Crescent Hill basalt (new) and older than Lost Creek trachyte (new).

Well exposed at southeast base of Crescent Hill ,near mouth of Elk Creek where it forms a bench, Yellowstone National Park.

†Elk Creek Beds (in Cheyenne Sandstone)[1]

Lower Cretaceous (Comanche Series): Central southern Kansas.

Original reference: F. W. Cragin, 1895, Am. Geologist, v. 16, p. 361, 366.

Named for Elk Creek, Kiowa County.

Elk Creek Gabbro

Jurassic-Cretaceous: Central California.

D. C. Ross, 1958, California Div. Mines Spec. Rept. 53, p. 11, pl. 1. Distinguished by extreme dark color, prominent hornblende, and marked variation in grain size; most striking feature is local development of poikilitic brown hornblende crystals as large as 6 inches across. Relation to other named plutonic rocks in area not determined.

Crops out in four small masses about a square mile in area along and near Elk Creek, an intermittent stream northwest of Ash Mountain Park headquarters, Sequoia National Park.

Elk Falls Limestone[1]

Pennsylvanian: Southern Kansas.

Original reference: E. Haworth, 1898, Kansas Univ. Geol. Survey, v. 3, p. 65-66, 105.

Named for Elk Falls, Elk County.

†Elkgarden Formation[1]

Pennsylvanian: Northeastern West Virginia and western Maryland.

Original reference: N. H. Darton and J. A. Taff, 1896, U.S. Geol. Survey Geol. Atlas, Folio 28.

Well exposed on Elkgarden Plateau, Mineral County, W. Va.

Elk Hill Complex[1]

Precambrian: Southeastern Virginia.

Original reference: S. Taber, 1913, Virginia Geol. Survey Bull. 7, p. 57.

C. B. Brown, 1937, Virginia Geol. Survey Bull. 48, p. 15, pl. 2. Precambrian.

Complex is from 1 to 1½ miles wide where it crosses James River at Elk Hill; well exposed in bluffs three-quarters mile below Elk Hill, Goochland County.

Elkhorn Basalt

Tertiary: Southwestern Wyoming.

R. E. Wilcox, 1944, Geol. Soc. America Bull., v. 55, no. 9, p. 1054, 1060, pl. 1. Oldest of three basalts in area—that is, older than Cataract basalt (new) and Sheepeaters basalt (new). Not included in Gardiner River rhyolite-basalt complex (new). Porphyritic rock, slightly reddish in some phases and locally carrying numerous amygdules of zeolite; dense in lower part; grades upward into scoriaceous and cindery basalt near contact with overlying Cataract basalt. Relationships indicate Elkhorn is intermediate in age between Castle rhyolite (new) and Cataract basalt.

Present near Sevenmile Bridge on Gardiner River, Yellowstone Park.

Elkhorn Formation (in Richmond Group)[1]

Elkhorn Limestone (in Richmond Group)

Elkhorn Shale (in Medina Group)

Upper Ordovician: Southern and eastern Indiana and western Ohio.

Original reference: E. R. Cumings, 1908, Indiana Dept. Geology and Nat. Resources 32d Ann. Rept., p. 678.

Wilber Stout, 1941, Ohio Geol. Survey, 4th ser., Bull. 42, p. 31, 32, table facing p. 46. Medina group as used here includes two members: Elkhorn shale and Clinton sandstone, which are correlatives respectively with Queenstown shale and Whirlpool sandstone of New York section.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2 (column 45). Correlation chart shows Elkhorn limestone at top of Richmond group above Whitewater-Saluda formations.

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.

Type locality: About 3½ miles southeast of Richmond, Wayne County, Ind.

Elkhorn Limestone

See **Milligen Formation.**

Elkhorn Shale[1] or Hornstone[1]

Upper Cambrian: Western central Montana.

Original reference: W. H. Weed, 1901, U.S. Geol. Survey 22d Ann. Report., pt. 2, p. 434, 437, map.

Well exposed in a hanging-wall crosscut of Elkhorn mine, Elkhorn mining district.

Elkhorn Volcanics

See **Elkhorn Mountains Volcanics.**

Elkhorn Mountains Volcanics

Upper Cretaceous: Southwestern Montana.

M. R. Klepper, R. A. Weeks, and E. T. Ruppel, 1957, U.S. Geol. Survey Prof. Paper 292, p. 4 (table), 26 (table), 31–41, pls. 1, 2, 3. Sequence of volcanic rocks that differs from place to place. In region east of Boulder batholith, volcanic rocks divisible into three unnamed members of which only lower and middle are present in area of this report [southern Elkhorn Mountains, Jefferson and Broadwater Counties]: lower member that consists mainly of andesitic fragmental rocks with a few andesitic and basaltic flows and a few thin welded ash flow tuffs of andesitic to calcic quartz latitic composition, thickness probably more than 3,000 feet; a middle member that consists essentially of units of welded tuff alternating with units of ash-fall crystal tuff and water-laid volcanic ejectamenta, thickness at least 2,500 feet; and third member that consists largely of water-laid andesitic volcanic sediments that is missing in mapped area. Total thickness of volcanics in excess of 10,000 feet. In area mapped, more than 5,000 feet. Overlie Slim Sam formation. Where Slim Sam formation is absent, Elkhorn Mountains volcanics rest with angular unconformity on beds as old as the Morrison. In lower parts of area, Elkhorn Mountains volcanics are overlain with strong angular unconformity by poorly consolidated sedimentary rocks of lower Oligocene or Quaternary age. Maximum original thickness probably nowhere preserved. Billingsley (1921, Geol. Soc. America Bull., v. 32, p. 465, fig. 7) considered volcanic rocks in and adjacent to mapped area a separate volcanic field and used name Elkhorn volcanics. Usage has not been followed by others and is not recommended here because name Elkhorn is preempted as formation name. Alexander (1951, unpub. thesis) extended name Livingston into Whitehall area and included in the formation more than 9,600 feet of andesitic flows and tuffs that are continuous with Elkhorn Mountains volcanics. These, he stated, are unconformable on folded and truncated Madison formation. These volcanic rocks in Whitehall area are assigned to Elkhorn Mountains volcanics. Adel Mountain volcanics (Lyons, 1944) are younger than Elkhorn Mountains volcanics. Although volcanic rocks of Elkhorn Mountains are partial age equivalents of and compositionally similar to Livingston formation of type area, their modes of origin are distinctly different, and separate formation names are needed.

No single section has been designated as type section. Widely distributed in and around Elkhorn Mountains in plateaulike accumulation, Broadwater and Jefferson Counties.

Elkhorn Ridge Argillite[1]

Lower Permian: Northeastern Oregon.

Original reference: James Gilluly, 1937, U.S. Geol. Survey Bull. 879.

C. W. Merriam and S. A. Berthiaume, 1943, Geol. Soc. America Bull. 54, no. 2, p. 162. Elkhorn Ridge argillite contains "Fusulina" and is apparently at least in part Pennsylvanian. May be comparable in age to Spotted Ridge formation of central Oregon.

A. J. Eardley, 1947, Jour. Geology, v. 55, no. 4, p. 322. Overlies Burnt River schist and underlies Clover Creek greenstone. Thickness about 5,000 feet. Pennsylvanian on basis of fusulinid fossils.

W. H. Taubeneck, 1955, Northwest Sci., v. 29, no. 3. p. 97–100. Age determination of fusilinids, in conjunction with regional Pacific Coast stratigraphic relations, are considered sufficient evidence to assign Permian age to all strata included by Gilluly (1937) in Elkhorn Ridge argillite. Permian age is somewhat less certain for part of formation that underlies the fossiliferous limestone. However, base of argillite has not been found nor have the strata been observed in contact with older formations. In areas bordering Pacific Coast of North America, Pennsylvanian marine formations are characteristically lacking, hence, Pennsylvanian age is improbable for any part of Elkhorn Ridge argillite stratigraphically below fusulinid limestone.

W. H. Taubeneck, 1957, Geol. Soc. America Bull., v. 68, no. 2, p. 195. Cut by Black Bear quartz gabbro (new) in area of Bald Mountain batholith.

Named for exposures on Elkhorn Ridge, Sumpter quadrangle, Baker County. Argillite can be traced almost continuously for 70 miles from vicinity of Lookout Mountain westward to Greenhorn Mountains.

Elkins 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 and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Shown on correlation chart below Valley Head sandstone and above "Portage" formation.

Well exposed on State road 3 miles northwest of Elkins, Randolph County.

Elkins Fork Shale[1] (in Breathitt Formation)

Pennsylvanian: Eastern Kentucky.

Original reference: W. C. Morse, 1931, Kentucky Geol. Survey, ser. 6, v. 36, p. 296, 297.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 82. Marine shale in Breathitt formation. Probably equivalent to marine Seth limestone, West Virginia.

Named for exposures opposite Elkins Fork School in northern Pike County.

Elkland parvafacies[1]

Devonian or Carboniferous: Northern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 31.

Probably named for Elkland, Tioga County.

Elk Lick Clay[1] (in Conemaugh Formation)

Elk Lick underclay member

Pennsylvanian: Pennsylvania, Ohio, and West Virginia.

[Original reference]: R. E. Lamborn, 1930, Ohio Geol. Survey, 4th ser. Bull. 35, p. 157–158.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 94 (table 11), 150. Member of Elk Lick cyclothem in report on Athens County. Average thickness about 2 feet. Conemaugh series.

Named from its overlying coal. Type area of coal is near Elk Lick, Somerset County, Pa.

Elk Lick cyclothem

Pennsylvanian (Conemaugh Series): Southeastern Ohio.

M. T. Sturgeon and others, 1958. Ohio Geol. Survey Bull. 57, p. 94 (table 11), 147–150. Embraces interval between Duquesne cyclothem (new) below and Little Clarksburg cyclothem (new) above. Includes (ascending) Birmingham redbed, Upper Grafton shale and sandstone, Elk Lick limestone, Elk Lick underclay, and Elk Lick coal members. Consists essentially of redbed and shale and sandstone members, the Elk Lick members being poorly represented. Intricate facies relationship exists between Birmingham redbed and Upper Grafton shale and sandstone, and their thicknesses may be represented largely or entirely by redbed, by bedded shale and sandstone, by massive sandstone, or by variable combination of redbed and bedded shale and sandstone. Thickness about 53 feet. In area of this report, Conemaugh series is discussed on cyclothemic basis; 15 cyclothems are named. [For sequence see Mahoning cyclothem.]

Outcrops of members of cycle occur in Alexander, Ames, Athens, Canaan, and Dover Townships, Athens County.

Elk Lick Limestone Member (of Conemaugh Formation)[1]

Elk Lick limestone member

Upper Pennsylvanian: Western Pennsylvania, eastern Ohio, and northern West Virginia.

Original reference: F. Platt, 1877, Pennsylvania 2d Geol. Survey Rept. H_3, p. 60.

R. E. Lamborn, 1951, Ohio Geol. Survey, 4th ser., Bull. 49, p. 33. Recognized only in Jefferson County. Where present on outcrop, maximum thickness does not exceed 2 feet and average is much less. Lies about 25 feet above Skelly limestone and 48 feet below Clarksburg coal. Conemaugh series.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 94 (table 11), 148–150. Member of Elk Lick cyclothem in report on Athens County. Poorly exposed. Conemaugh series.

Named for relations to Elk Lick coal, which was named for Elk Lick, Somerset County, Pa.

Elkmont Sandstone (in Great Smoky Group)

Precambrian (Ocoee Series): Southeastern Tennessee.

P. B. King and others, 1958, Geol. Soc. America Bull., v. 69, no. 8, p. 955 (table 1), 958, 959 (fig. 4). Fine-grained feldspathic sandstone. First formation above Greenbrier fault, base not visible; variable thickness present under Thunderhead sandstone—a few thousand feet on east, about 5,000 feet near Elkmont, and as much as 9,000 feet south of Cades Cove. Intertongues laterally with Thunderhead so that its top in eastern exposures lies at least several thousand feet higher than in western; much of western section differs only slightly from overlying Thunderhead. In southeastern part of mountains where stratigraphic base of Great Smoky group emerges, the Elkmont has not been identified, and it is uncertain to what part of this sequence it is related.

Type locality: Along Little River from Tennessee Highway 73 southward past Elkmont to base of Thunderhead sandstone. Named for community of Elkmont, 5 miles southwest of Gatlinburg, Sevier County. Crops out on lower and northern spurs of Great Smoky Mountains, from Greenbrier Pinnacle on east to beyond Cades Cove on west.

Elk Mountain Porphyry[1]

Tertiary, lower: Central Colorado.

Original reference: S. F. Emmons, 1898, U.S. Geol. Survey Tenmile Spec. Folio 48.

Ogden Tweto, 1951, Geol. Soc. America Bull., v. 62, no. 5, p. 509, 510–511. Sills of Pando area comprise four types of quartz monzonitic porphyries (ascending): Pando (new), Elk Mountain, Lincoln, and Eagle River, all of early Tertiary age.

Ogden Tweto, 1956, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–34. Mapped as early Tertiary in Tennessee Pass area where sequence of porphyries is (ascending) Pando, Elk Mountain, Sacramento, Lincoln, and Eagle River.

Named for Elk Mountain.

Elk Mountain Sandstone[1] Member (of Catskill Formation)

Upper Devonian: Northeastern Pennsylvania.

Original reference: Bradford Willard, 1936, Geol. Soc. America Bull., v. 57, no. 4, p. 561, 574–577.

Bradford Willard *in* Bradford Willard, F. M. Swartz, and A. B. Cleaves, 1939, Pennsylvania Geol. Survey, ser. 4, Bull. G–19, p. 283. Summary discussion. Included in Upper Devonian Catskill facies group.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 3. Pennsylvania Geological Survey currently limits use of term Catskill to thick brownish- and grayish-red units which characterize middle and upper parts of Middle and Upper Devonian red-bed sequence. Light-colored sandstones, such as Honesdale and Elk Mountain members, known only in east, are included in Catskill only in those areas where they are underlain by thick all-red unit.

Named for Elk Mountains, Susquehanna County.

Elk Mountain transition group[1]

Upper Devonian or Mississippian: Northeastern Pennsylvania.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. G_5, p. 235.

Crops out around slopes of North and South Knobs of Elk Mountains, southeastern Susquehanna County.

Elko Shale[1] or Group[1]

Eocene: Northeastern Nevada.

Original reference: S. F. Emmons, 1877, U.S. Geol. Expl. 40th Par., v. 2, p. 551–564.

Elko Prince Rhyolite[1]

Tertiary: Central northern Nevada.

Original reference: E. H. Rott, Jr., 1931, Nevada Univ. Bull., v. 25, no. 5.

Occurs in both east and west walls of Elko Prince vein in Gold Circle or Midas mining district, western Elko County.

Elk Peak Leucocratic Quartz Monzonite

Lower Cretaceous(?): Northeastern Oregon.

W. H. Taubeneck, 1957, Geol. Soc. America Bull., v. 68, no. 2, p. 210–211, 235. Uniform-grained slightly pinkish rock. Intrudes Bald Mountain tonalite-Anthony Lake granodiorite transition zone.

Present on summit and southeast slopes of Elk Peak, in Elkhorn Mountains [Grant County]. Forms part of Bald Mountain batholith.

Elk Point Group

Elk Point Formation

Middle Devonian: Subsurface in Alberta and Saskatchewan, and surface and subsurface in Manitoba, Canada, and subsurface in northeastern Montana, northwestern North Dakota, and northwestern South Dakota.

J. R. McGehee, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 4, p. 603–613. Study based on sample determinations of 12 wells, one of which is in Saskatchewan and 11 in plains of Alberta, shows sequence of strata of questionable age that is herein referred to as Elk Point formation. Consists of two conspicuous red shales, anhydritic dolomites, and thin slightly fossiliferous argillaceous silty limestones, in addition to three salt members. Maximum thickness about 1,557 feet. Underlies Upper Devonian Waterways formation. Overlies Ordovician, Cambrian, or Precambrian rocks. Considered to be Silurian although upper part may be Middle Devonian.

J. R. McGehee, 1952, Billings Geol. Soc. Guidebook 3d Ann. Field Conf., p. 64. Geographically extended into Manitoba. Tentative Silurian age abandoned in favor of Middle Devonian.

H. R. Belyea, 1952, Canada Geol. Survey Paper 52–27, p. 7–12. Rank raised to group but subdivisions not named.

A. D. Baillie, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 2, p. 444–452; 1953, Manitoba Dept. Mines and Nat. Resources Mines Br. Pub. 52–5, p. 10–13, 18–21. Term Elk Point group is applied to basal major Devonian unit in Williston basin. Group is approximately equivalent to Elk Point formation in Alberta. In Williston basin, includes (ascending) Ashern, Elm Point, and Winnipegosis formations of outcrop area and their subsurface equivalents and also main Middle Devonian salt and anhydrite section for which name Prairie evaporite is proposed. Upper limit is top of evaporite section or top of Winnipegosis formation where the evaporites are not present. Underlies Manitoba group. Middle Devonian.

C. A. Sandberg and C. R. Hammond, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 10, p. 2299 (fig. 2), 2302–2303 (fig. 4), 2304–2307. In the U.S. part of the Williston basin and adjacent areas, Elk Point group consists of Winnipegosis formation and overlying Prairie formation. Underlies Dawson Bay formation.

First described from wells in Elk Point area, near North Saskatchewan River, Alberta, Canada.

Elk Ridge Limestone Member (of Minturn Formation)

Elk Ridge Limestone

Pennsylvanian: Northwestern Colorado.

A. H. Koschmann and F. G. Wells, 1946, Colorado Sci. Soc. Proc., v. 15, no. 2, p. 62 (table 1), 67. In Kokomo mining district, includes two limestone beds, separated by 200 to 225 feet of thin-bedded red sandstone and conglomerate; upper limestone is 5 to 7 feet thick, dark bluish gray, and overlain by 10 to 12 feet of black micaceous shale; lower limestone is 12 to 15 feet thick, upper 7 to 8 feet crystalline and light gray, lower 6 to 7 feet mottled dark bluish gray. Underlies unnamed sandstone 250 to 400 feet thick; overlies unnamed sandstone and shale 300 to 500 feet thick.

Ogden Tweto, 1949, Colorado Sci. Soc. Proc., v. 15, no. 4, p. 152 (table 1), 202–203. Limestone, which in Pando area lies 275 feet above Robinson member of Minturn formation, or about 4,800 feet above Belden shale, is known as Elk Ridge limestone at Kokomo and is here designated Elk Ridge limestone member of Minturn formation. In Pando area, member is single limestone bed 7½ feet thick; where thickest, on Radio Ridge, consists of 3 feet of dark fine-grained thin-bedded dolomite, overlain by 10 feet of mottled gray and pink slightly sandy locally oolitic limestone. Lies 150 to 200 feet below White Quail limestone member.

Forms conspicuous outcrops on crest of Elk Ridge, near Kokomo, Summit County.

Elk River Beds[1]

Pleistocene, upper: Southwestern Oregon.

Original reference: J. S. Diller, 1902, U.S. Geol. Survey Bull. 196, p. 30–31.

E. M. Baldwin, 1945, Jour. Geology, v. 53, no. 1, p. 35, 42–43. Elk River beds of Cape Blanco region, as currently used, include deposits of late- to post-Pleistocene age and beds of middle Pliocene age which unconformably underly them. Name Elk River beds is restricted to terrace deposits in accordance with Diller's original definition. Name Port Orford formation is proposed for beds of middle Pliocene age; name Coquille formation is proposed for estuarine deposits that unconformably underlie Elk River beds (restricted) just north of mouth of Coquille River.

Named for occurrences at mouth of Elk River, near Cape Blanco, Curry County.

†Elk River Series[1]

Pennsylvanian: West Virginia.

Original reference: I. C. White, 1891, U.S. Geol. Survey Bull. 65, p. 70–98.

Ellenburger Group

Ellenburger Limestone[1]

Lower Ordovician: Central Texas.

Original reference: S. Paige, 1911, U.S. Geol. Survey Bull. 450, p. 24.

V. E. Barnes and P. E. Cloud, Jr., 1944, Texas Univ. Bur. Econ. Geology Mineral Resources Circ. 34, p. 1–2. Ellenburger group subdivided into (ascending) Tanyard, Gorman, and Honeycut formations.

P. E. Cloud, Jr., V. E. Barnes, and Josiah Bridge, 1946, Texas Univ. Bur. Econ. Geology Pub. 4301, p. 133, 139–148, 151–153, 156–159, pls. 5, 6 [1945]. Group of this report is derived by revision of Ellenburger limestone (Paige, 1911) which by subsequent usage had come to include not only all Lower Ordovician dolomites and limestones in Llano region and adjacent subsurface but the immediately subjacent carbonate rocks of Upper Cambrian as well. Term Ellenburger is here restricted to beds of Lower Ordovician age. Cambrian dolomites formerly included in Ellenburger are here named Pedernales dolomite member of Wilberns formation. Maximum thickness approximately 1,820 feet in vicinity of Johnson City, southeastern part of uplift; thins north and west by truncation of upper beds to 970 feet in Mason County and about 800 feet in McCulloch County; truncation was essentially pre-Middle Devonian and probably pre-Devonian. Overlapped by Devonian, Mississippian, and Cretaceous.

P. E. Cloud, Jr., and V. E. Barnes, 1948, Texas Univ. Bur. Econ. Geology Pub. 4621, p. 473, plates [1946]. Type section, standard section, and local stratigraphy, including underlying Cambrian formations, described in detail.

Type section: Composite Tanyard-Gorman section adjoining the Ellenburger Hills. This section is relatively inaccessible. Combined Moore

Hollow and Warren Springs sections south of Llano, Llano County, are designated as standard section. Named for Ellenburger Hills, Burnet County.

Ellensburg Formation[1]

Pliocene, lower: Central Washington.

Original reference: I. C. Russell, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 2, p. 100–137, map.

J. H. Mackin, 1947, (abs.) Northwest Sci., v. 21, no. 1, p. 33. Includes Selah tuff member (new) which underlies Wenas basalt member.

A. C. Waters, 1955, Geol. Soc. America Bull., v. 66, no. 6, p. 671, 673–675, pl. 1. Described and mapped in Yakima East quadrangle where it interfingers with underlying Yakima basalt. Includes interstratified basalt flows (ascending) Wenas basalt, Selah Butte flow (new), and Elephant Mountain flow (new). 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 the base of Ellensburg; in some areas, exact position of contact is 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. Much or all of Ellensburg and its associated intercalated basalt flows is regarded as Pliocene. Map bracket shows Miocene and Pliocene.

D. R. Mullineaux, L. M. Gard, and D. R. Crandell, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 3, pt. 1, p. 694–695. Formation is alluvial deposit of volcanic detritus at least 1,600 feet thick that was transported eastward into central Washington from position of present Cascades. Formation was first assigned late Miocene age by Smith (1903, U.S. Geol. Survey Geol. Atlas, Folio 86) on basis of fossil leaves and *Hipparion* remains. Waters (1955) considered formation to be lower Pliocene on basis of new finds of vertebrate fossils and freshwater gastropods, and suggested that base of Ellensburg is probably placed at different stratigraphic positions in different areas. Problem of age is further complicated by fact that paleobotanists and other paleontologists are not agreed upon placement of Miocene-Pliocene boundary. Hence, exact age of Ellensburg is uncertain but formation likely contains both upper Miocene and lower Pliocene strata.

Forms floor of Kittitas Valley, Kittitas County, in which town of Ellensbur is situated.

Ellerslie Fire Clay (in Allegheny Formation)[1]

Pennsylvanian: Western Maryland.

Original references: C. K. Swartz, W. A. Price, and H. Bassler, 1919, Geol. Soc. America Bull., v. 30, p. 572.

Georges Creek Basin.

Ellerslie Sandstone (in Allegheny Formation)[1]

Pennsylvanian: Western Maryland.

Original reference: C. K. Swartz, W. A. Price, and H. Bassler, 1918, Geol Soc. America Bull., v. 30, p. 572.

At Ellerslie, Allegany County.

Ellett Formation

Middle Ordovician (Mohawkian): Western Virginia.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 62, chart 1 (facing p. 130). Name proposed for dark-gray limestones between Knox [group] and Botetourt formation (above) in belt east of Roanoke Valley. Name attributed to B. N. Cooper and G. A. Cooper.

Type section: In fields west of County Road 615, about 899 feet north of Virginian Railway, near Ellett Station, Blacksburg (15') quadrangle, Montgomery County.

Ellicott Shale Member[1] (of Chadakoin Formation)

Upper Devonian: Southwestern New York and northwestern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 66–70, table opp. p. 61.

I. H. Tesmer, 1955, New York State Mus. Sci. Service Circ. 42, p. 10 (fig. 1), 15. Lies above Dexterville member; underlies Panama conglomerate member of Cattaraugus formation. Thickness in Cherry Creek quadrangle about 270 feet.

Type occurrence: In roadside cuts along Hunt Road, between Ashville and Jamestown, N.Y. This is in town of Ellicott, Chautauqua County.

Ellicott City Granite[1]

Upper Devonian(?): Northeastern Maryland.

Original reference: E. B. Knopf and A. I. Jonas, 1929, Maryland Geol. Survey Baltimore County Rept., p. 134–135.

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 Maryland rocks. The oldest granites are the probable migmatites associated with Baltimore gneiss. Those of second period cut Glenarm series. Rocks of third period are represented by Woodstock, Ellicott City, and at least part of Sykesville granite. The Ellicott City is a biotite-quartz monzonite.

Named for exposures at Ellicott City, Baltimore County. Crops out in a narrow mass extending southwestward from Ellicott City to Orange Grove, Howard County.

Ellicottville Conglomerate[1]

Pennsylvanian: New York.

Original reference: J. P. Lesley, 1875, Pennsylvania 2d Geol. Survey Rept. I, p. 89, 96.

Occurs at Ellicottville, Cattaraugus County.

Elliott 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, 376.

D. A. Zimmerman and G. D. Glover, 1956, Soc. Econ. Paleontologists and Mineralogists Permian Basin Sec. [Guidebook] Spring Mtg., p. 73 Largely bluish-gray clays. Thickness 100 feet. Overlies Burnt Branch bed; underlies Shadrick Mills sandstone. Strawn series.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 58, pl. 27. Drake (1893) separated rocks of Strawn group [division] into 20 units of alternating sandstone and shale beds. He gave local names to these units, or "beds" as he termed them, and numbered them from 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 Elliott Creek, Lampasas County.

Ellis Formation[1] or Group

Middle and Upper Jurassic: Montana and northwestern Wyoming.

Original reference: A. C. Peale, 1893, U.S. Geol. Survey Bull. 100, map.

W. A. Cobban, R. W. Imlay, and J. B. Reeside, Jr., 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 4, p. 451–453. Thickness 297 feet at type section herein designated. Underlies Morrison formation; overlies Tensleep(?).

W. A. Cobban, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 9, p. 1262–1303. Rank raised to group and subdivided into (ascending) Sawtooth, Rierdon, and Swift formations (all new). Name is restricted to marine Jurassic beds. In Sweetgrass arch area, north-central Montana, unconformably overlies marine Mississippian beds and underlies Upper Jurassic continental deposits (Morrison) or Lower Cretaceous continental deposits (Kootenai). Middle and Upper Jurassic (Bathonian-Argovian).

R. W. Imlay and others, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart. 32. Group, in south-central Montana, comprises (ascending) Piper (new), Rierdon, and Swift formations.

J. D. Weir, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 4, p. 547–563. Three-fold division of Ellis group into Swift, Rierdon, and Sawtooth formations recognizable and applicable in Alberta. Known only in subsurface in southern Alberta Plains [area of this rept.].

J. D. Vine and W. J. Hall, Jr., 1950, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 108. Group, in Hobson area, central Montana, consists of (ascending) Piper, Rierdon, and Swift formations. Entire group less than 100 feet thick, and commonly only Swift formation represented. Overlies Amsden formation; underlies Morrison formation.

C. A. Moritz, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 8, p. 1802–1810. Marine Jurassic rocks of southwestern Montana have heretofore been mapped as Ellis formation, but study of these beds indicates that subdivisions recognized by Cobban (1945) in Sweetgrass arch region are present in area considered in this report. Proposed that Ellis of this region be raised to group rank and that formation names of Sweetgrass arch region be used in southwestern Montana. Thickness 236 feet, Little Water Creek section, Beaverhead County. Overlies Lower Triassic Thaynes formation.

R. W. Edmund, 1951, Augustana Libr. Pub. 23, p. 8 (fig. 5). Stratigraphic section of northern end of Teton Range, Wyo., shows that Ellis formation, 400 feet thick, comprises (ascending) Nugget sandstone, Twin Creek limestone, and (?) Stump sandstone members. Overlies Chugwater formation; underlies Lower Cretaceous sandstones, shales, and siltstones.

J. A. Mann, 1954, Yellowstone-Bighorn Research Proj. Contr. 190, p. 25–30. Ellis, in Gravelly Range, is thin, 13 to 41 feet, and is not differentiated into formations. Underlies Morrison formation; overlies Thaynes(?).

Type section: On north side U.S. Highway 10 on north side of Rocky Creek Canyon about 3.7 miles southeast of site of Fort Ellis, or 7 miles southeast of Bozeman Court House, in sec. 19, T. 2 S., R. 7 E., Gallatin County, Mont.

Ellison 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. A. Harder, 1948, Geol. Soc. America Bull., v. 59, no. 9, p. 944, 947–948, 951. In Lead district, consists of phyllites, schists, and large amount of dark quartzites; thickness 3,000 to 5,000 feet. Overlies Homestake formation; underlies Northwestern formation. In Rochford district, where Northwestern formation is missing, underlies Flag Rock formation.

Named for exposures on road to Homestake mine office and Ellison shaft, Lead district, Lawrence County.

†Ellisville phase[1]

Oligocene(?) and Miocene: Southern Mississippi and southern Louisiana.

Original reference: L. C. Johnson, 1893, Science, v. 21, p. 90–91.

Named for Ellisville, Jones County, Miss.

Ellsworth Formation (in Dakota Group)

Cretaceous (Comanche Series): Central Kansas.

R. C. Moore, 1935, Rock formations of Kansas *in* Kansas Geol. Soc.: Wichita, [Am. Assoc. Petroleum Geologists 20th Ann. Mtg., Mar. 21–23]. Yellow-brown sandstone and reddish or varicolored shale mostly non-marine. Thickness 25 to 200 feet. Includes Rocktown sandstone above and Terra Cotta shale below. Unconformable below Solomon formation (new) and above Belvidere formation.

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.

Probably named for occurrences in vicinity of Ellsworth, Ellsworth County.

Ellsworth Schist[1]

Precambrian or Cambrian: South-central and southeastern Maine.

Original reference: G. O. Smith, E. S. Bastin, and C. W. Brown, 1907, U.S. Geol. Survey Geol. Atlas, Folio 149, p. 1–2.

G. H. Chadwick, 1944, New York Acad. Sci. Trans., ser. 2, v. 6, no. 6, p. 172. Name abandoned; it was incorrectly applied to unit earlier named Bartletts Island.

W. T. Forsyth, 1953, Maine State Geologist Rept. 1951–1952, p. 34–37, 41–46. Includes massive pyritiferous quartzite not previously reported. No direct evidence of age known.

L. A. Wing, 1957, Maine Geol. Survey GP. and G. Survey 1, sheet 1. In Hancock and Penobscot Counties, Knox gneiss and Copeland formation (new) appear to be older than surrounding formations but not necessarily equivalent to Ellsworth.

P. S. Wingard, 1958, Kansas Acad. Sci. Trans., v. 61, no. 3, p. 330–333. Ellsworth formation, previously designated as Precambrian (Smith, 1907) should now be considered pre-Middle Silurian. Underlies Castine formation.

Named for exposures near Ellsworth, Hancock County.

Ellsworth Shale[1]

Upper Devonian and Lower Mississippian: Central western Michigan.

Original reference: R. B. Newcomb, 1932, Am. Assoc. Petroleum Geologists Bull., v. 16, no. 2, p. 159.

G. V. Cohee, 1951, U.S. Geol. Survey Oil and Gas Inv. Chart OC–41, sheet 5. Because upper part of Antrim shale is known to grade laterally westward into lower part of Ellsworth and upper part of Antrim shale is considered to be of lower Mississippian age (Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5), the Upper Devonian and Mississippian time boundary appears to be within Ellsworth shale in western Michigan and within Antrim in eastern Michigan.

Type section: Petoskey Portland Cement Co. quarry, NE¼NE¼ sec. 26, T. 32 N., R. 8 W., about 1½ miles south of Ellsworth, Banks Township, Antrim County.

El Luis Ridge Group

Age unknown: Southern California.

K. J. Hsu, 1955, California Univ. Dept. Geol. Sci. Bull., v. 30, no. 4, p. 296–298, geol. map. Includes metasedimentary rocks that are enclosed in El Dorado Ridge gneissose quartz diorite (new). On El Luis Ridge and in Stoddard Canyon, rocks are predominantly calc-silicate and quartzitic; a thin layer of metamorphosed argillaceous rock is intercalated. In San Antonio Canyon, rocks are predominantly feldspathic and migmatitic. Relations of group to Aurela Ridge granulite (new) are not certain.

Exposed in Los Angeles and San Bernardino Counties.

Elm Member (of Nachusa Formation)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., figs. 3, 15B, 15C. Shown on columnar section as underlying Everett member (new) and overlying Eldena member (new). Thickness as much as 3 feet.

Occurs in Dixon-Oregon area.

Elm Branch Shale[1]

Pennsylvanian: Eastern Kansas and southeastern Nebraska.

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. Guidebook 6th Ann. Field Conf., p. 85, 90, 97.

Derivation of name not stated.

Elm Creek Limestone (in Canyon Group)[1]

Pennsylvanian: Central northern Texas.

Original reference: E. Böse, 1918, Texas Univ. Bull. 1758, p. 18.

Occurs in middle part of Elm Creek, Wise County.

Elm Creek Limestone (in Cherokee Shale)[1]

Pennsylvanian: Northeastern Oklahoma and southeastern Kansas.

Original reference: S. Weidman, 1932, Oklahoma Geol. Survey Bull. 56, p. 25–26.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 107. Abandoned by Oklahoma Geological Survey. Name preoccupied. Weidman's name has not been replaced.

Named from occurrences along Elm Creek, south of road, in NW¼SE¼ sec. 10, T. 29, N., R. 22 E., Ottawa County, Okla. Also occurs a few miles north of Kansas State line.

Elm Creek Limestone Member (of Belle Plains Formation)

Elm Creek Limestone (in Belle Plains Group)

Elm Creek Limestone Member (of Admiral Formation)[1]

Lower Permian (Leonard Series) : Central and central northern Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 421, 424.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 96. Rank raised to formation in Belle Plains group. Overlies Jim Ned shale (new); underlies Jagger Bend limestone. Leonard series.

R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80. Described in Colorado River valley where it is classified as member of Belle Plains formation. Overlies Jim Ned shale member; underlies Voss shale member (new). Consists of closely spaced beds of gray medium-grained partly foraminiferal limestone, that weather light brown. Beds range in thickness from 1 to 5 feet, and except locally, are noncherty. Thickness about 45 feet at Colorado River. Note on type exposure.

P. T. Stafford, 1960, U.S. Geol. Survey Bull. 1081–G, p. 273, pl. 11. Member of Belle Plains formation. Thickness 55 to 95 feet in Brazos River valley. Overlies Jim Ned shale member; underlies Voss shale member.

Type exposures: On lower Elm Creek near its confluence with Colorado River, south of Leaday, Coleman County. Forms prominent escarpment in western Coleman County. Named for Elm Creek, Brown County.

Elm Creek Silts

Pleistocene (Illinois? or Sangamon?) : West-central Texas.

M. M. Leighton, 1936, Medallion Papers 24, p. 8–11, 39 (fig. 5). Consists of series or regularly thick-bedded and nearly uniformly textured silts and sandy silts with minor amounts of sand and gravel. Unconformably overlie Durst silts (new). Show evidence of human occupation.

Extensively exposed along Elm Creek, which flows into Clear Fork of Brazos River and heads into Edwards Plateau about 12 miles southwest of Abilene, Taylor County.

†Elmdale Formation or Shale (in Wabaunsee Group)[1]

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

Original reference: J. W. Beede, 1902, Kansas Univ. Sci. Bull., v. 1, p. 178.

U.S. Geological Survey has abandoned the terms Elmdale Shale and Formation.

Named for exposures east of Elmdale, Chase County, Kans.

Elm Grove cyclothem

Permian (Washington Series): Southeastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 203 (table 14), 204, 205 (map 26). Lowest recognized cyclothem in Washington series. Occurs below Waynesburg "A" cyclothem (new). Thickness 15½ feet. Normal sequence includes (ascending) shale and sandstone, redbed, Elm Grove limestone, underclay, Elm Grove coal, and Elm Grove roof shale, but in Athens County cycle is poorly developed. In area of this report, Washington series is discussed on a cyclothemic basis; the following cyclothems are named (ascending): Elm Grove, Waynesburg "A," Little Washington, and Washington.

Recognized in two measured sections in Troy and Carthage Townships, Athens County.

Elm Grove Limestone Member (of Washington Formation)[1]

Elm Grove Limestone (in Washington Group)

Elm Grove limestone member

Pennsylvanian: Northern West Virginia, southeastern Ohio, and southwestern Pennsylvania.

Original reference: G. P. Grimsley, 1907, West Virginia Geol. Survey Rept. Ohio, Brooke and Hancock Counties, p. 68.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 135–145. Elm Grove limestone occurs 13 feet above base of Washington group. Overlies Cassville shale; underlies Waynesburg sandstone. Thickness as much as 5 feet.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 10 (fig. 3), 90–91, geol. map. In Morgan County, Elm Grove limestone member of Washington series overlies Cassville shale member and underlies Waynesburg sandstone and shale member. Thickness about 4 feet.

Named from exposures in vicinity of Elm Grove, Ohio County, W. Va.

Elmo Limestone Member (in Sumner Group)[1]

Permian: Central Kansas.

Original reference: C. O. Dunbar, 1924, Am. Jour. Sci., 5th, v. 7, p. 176, 178–208.

Named for occurrence about 3 miles south and one-half mile east of village of Elmo, Dickinson County, where it caps Insect Hill.

El Modeno Volcanics

Miocene: Southern California.

J. E. Schoellhamer and others, 1954, U.S. Geol. Survey Oil and Gas Inv. Map OM–154. A series of volcanic rocks. Subdivided into three members: the oldest, an olivine basalt flow; the second, a palagonitic tuff and tuff breccia; and the upper, a calcic andesite flow and flow breccia. Locally one or more of members may be missing. Thickness ranges from about 100 feet to 750 feet; average thickness about 300 feet. Unconformably underlie La Vida member (new) of Puente formation;

overlie Topanga formation. Volcanics probably straddle boundary between middle and late Miocene.

R. F. Yerkes, 1957, U.S. Geol. Survey Prof. Paper 274–L, p. 313–324, pl. 46. Detailed description of unit. Maximum outcrop thickness 850 feet. Middle to early late Miocene. Tentatively correlated with Glendora volcanics 25 miles to northwest.

Exposed in hills just east of El Modeno, Orange County. Cover an area of approximately 4 square miles.

Elmont Limestone Member (of Emporia Limestone)

Elmont Limestone (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. 30.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 17. Areai extent of formation noted.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2274 (fig. 1), 2276. Rank reduced to member status in Emporia limestone here recognizde and used as originally defined. Overlies Harveyville shale member; underlies Willard shale.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 58–60. Described in Pawnee County. As currently defined (Moore, 1949, Kansas Geol. Survey Bull. 83), the Elmont overlies Harveyville shale and underlies Willard shale. In Pawnee County, overlying shale is the Gano. Thickness 20 to 34 feet. Traced across Pawnee County into Payne County, but southern extent not known.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 12–13, fig. 5. Formation in Wabaunsee group. Underlies Willard shale; overlies Harveyville shale. Consists of two limestone beds separated by fossiliferous gray shale. Upper bed nodular and argillaceous; lower bed, dark blue gray, sublithographic. Thickness about 2 feet.

First described from occurrence on hills near Elmont, Shawnee County, Kans. [Condra refers to this as type locality.]

Elmwood Member (of Manlius Limestone)

Elmwood Beds[1] (in Manlius Group)

Lower Devonian: Central New York.

Original reference: Burnett Smith, 1929, New York State Mus. Bull. 271, p. 26, 27–31.

G. H. Davis 3d, 1953, New York State Mus. and Sci. Ser. Circ. 35, p. 10. Discussion of contact between Manlius limestone and Coeymans limestone in upper New York State. In section measured at Perrysville, Madison County, members of Manlius proposed by Smith (1929) are distinguished (ascending): Olney, Elmwood, Clark Reservation, Jamesville, and Pools Brook limestone. Top of quarry lies stratigraphically in Onondaga limestone which rests on Coeymans, the Oriskany sandstone being absent.

L. V. Rickard, 1955, New York State Geol. Assoc. Guidebook 27th Ann. Mtg., p. 7. Manlius formation subdivided into (ascending) Thacher (new), Olney, Elmwood, Clark Reservation, and Jamseville. Thacher is only member present in eastern New York. Higher limestone members, all named by Smith (1929), pass laterally into Coeymans limestone of eastern New York and, hence, are undoubtedly Devonian in age.

L. V. Rickard, 1956, Dissert, Abs., v. 16, no. 1, p. 102. West of Cherry Valley, Coeymans formation splits into three parts. Lower part, for which name Dayville is proposed, grades laterally into Olney limestone of Syracuse area. Middle part grades into Elmwood, Clark Reservation, and Jamesville members of Manlius.

Type section: At Sweet's quarry, about one-half mile northeast of Onondaga Hill and in belt between St. Agnes Cemetery and Elmwood Park, Onondaga County.

Elmwoods Limestone Member (of Manlius Limestone)

See Elmwood Limestone Member (of Manlius Limestone).

El Pasan series[1]

Ordovician: Southern New Mexico and western Texas.

Original reference: C. R. Keyes.

El Paso Limestone[1] **or Formation**

El Paso Group

Lower Ordovician: Western Texas, Arizona, and southern New Mexico.

Original reference: G. B. Richardson, 1904, Texas Univ. Min. Survey Bull. 9, p. 29.

V. C. Kelley and Caswell Silver, 1952, New Mexico Univ. Pub. in Geology 4, p. 31 (table), 40–56. Rank raised to group. Comprises (ascending) Sierrite limestone and Bat Cave formation (both new). Overlies Bliss formation (sandstone); underlies Montoya group.

F. E. Kottlowski, 1956, New Mexico Bur. Mines Mineral Resources Mem. 1, p. 7 (table 2), 16–23. Acceptance of group status for El Paso not predicated on discriminating Sierrite and Bat Cave subdivisions of Kelley and Silver (1952) but on succession of faunas and lithic units as outlined by Flower (1955, New Mexico Geol. Soc. Guidebook 6th Field Conf.). Group in New Mexico can be subdivided into three lithic units of probable formational rank which correspond closely with faunal zones. Thickness as much as 760 feet. Ordovician (Canadian).

F. F. Sabins, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 3, p. 472–475. Formation geographically extended into southeastern Arizona where it conformably overlies Bolsa quartzite and underlies Portal formation (new); contact is disconformity representing time interval from Middle Ordovician through Middle Devonian; no angular discordance at contact. Thickness 340 to 715 feet. Term formation used because in this area [Chiricahua-Dos Cabezas Mountains] El Paso beds are predominantly dolomite rather than limestone. Upper Cambrian-Lower Ordovician:

Elliot Gillerman, 1958, New Mexico Bur. Mines Mineral Resources Bull. 57, p. 11 (table 2), 21–24, table 1. Limestone described in central Peloncillo Mountains where it is about 550 feet thick; overlies Bolsa quartzite and underlies Montoya limestone. Age of limestone in this area, based on fossils collected and correlation with Chiricahua section, is late Cambrian and early Ordovician; thus, it contains beds which are older than any heretofore included in the El Paso in New Mexico.

Named for exposures in Franklin and Hueco Mountains, El Paso quadrangle, Tex.

El Portal Glaciation

El Portal Stage[1]

Pleistocene: Eastern California.

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

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

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

Named for occurrence in vicinity of El Portal, entrance to Yosemite Park.

El Rayo Formation

El Rayo Volcanics (in Mayagüez Group)

Upper Cretaceous: Southwestern Puerto Rico.

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 limstones, mudstones, tuffs, and sedimentary rocks derived from the 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). El Rayo and Sabana Grande formations unconformably underlie Ensenada and Río Yauco formations. Complex ranges in age from Senonian to late Paleocene, possibly Eocene.

P. H. Mattson, 1958, Dissert, Abs., v. 18, no. 1, p. 197; 1960, Geol. Soc. America Bull., v. 71, no. 3, p. 339–340, pl. 1. El Rayo volcanic rocks were defined by Slodowski as feldspathic olivine basalt porphyry (90 percent) with interbedded lenses (about 10 percent) of volcanic conglomerate and dark massive limestone. In Mayagüez area, the dark massive limestone has been named Melones limestone, and the El Rayo volcanic rocks are considered within the Mayagüez group. The El Rayo rocks include about 1,000 meters of basalt lava, andesite breccia, and lava, and minor conglomerate and wacke. Conformable with underlying Yauco mudstone. Within area of outcrop of El Rayo volcanics and bordering it on the west are volcanic rock and limestone of San Germán formation believed to unconformably overlie the El Rayo. Campanian to Maestrichtian.

Forms part of north limb of Tea syncline, Mayagüez area.

El Reno Group

El Reno Formation[1]

Permian: Western Oklahoma.

Original reference: C. M. Becker, 1929, Am. Assoc. Petroleum Geologists Bull., v. 13, p. 955.

Henry Schweer *in* O. E. Brown, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 12, p. 1553 (fig. 9). El Reno group used to include Duncan-Chickasha sequence from top of Hennessey formation to base of Whitehorse group. Duncan-Chickasha sequence grades laterally into Flower Pot shale, Blaine gypsum, and Dog Creek shale.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 97–98. Shown on correlation chart of north-central Texas as El Reno (San Andres) group. Includes (ascending) San Angelo sandstone, Flower Pot shale, Blaine gypsum, and Dog Creek shale. On east side of Permian basin, name El Reno group appears to have priority and to be more appropriate on a facies basis than recently proposed San Andres group for beds of Leonard age from base of San Angelo sandstone to top of Dog Creek shale.

F. E. Lewis, 1941, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 1, p. 80, 81, 83, 84. El Reno group extends across Red River and can be traced southward across Texas 250 miles before it is lost under Cretaceous rocks. Unconformably overlies Clear Fork group. Considered Guadalupe in age; boundary between Guadalupe and Leonard should be drawn at base of San Andres-El Reno groups.

Robert Roth, 1945, Geol. Soc. America Bull., v. 56. no. 10, p. 893–894. Pease River group includes San Angelo, Flowerpot, Blaine, and Dog Creek formations as exposed in Texas. Formations form natural group bounded by disconformities. However, formations change facies so rapidly that any group name becomes a facies name. Examples: Pease River group, evaporite facies; El Reno, clastic facies; San Andres of Sacramento Mountains, dolomite facies; and Cherry Canyon formation, clastic and limestone facies. All these appear to be variants of the Word.

G. L. Scott, Jr., and W. E. Ham, 1957, Oklahoma Geol. Survey Circ. 42, p. 12–13, pl. 1. Group comprises (ascending) Duncan sandstone, Flowerpot shale, Blaine formation (redefined), and Dog Creek shale. Overlies Hennessy shale; underlies Whitehorse group. In Oklahoma, El Reno outcrop forms "V-shaped" pattern; one limb of group passes along north side of Wichita Mountains, including Carter area (this report), and the other limb swings northwestward through west-central Oklahoma into Kansas. This outcrop pattern results from synclinal folding of Anadarko basin. Within southeastern margin of basin is a pronounced facies change that has led to recognition of numerous stratigraphic problems [see bibliography this report]. It is now generally believed that the Chickasha-Duncan complex is near-shore coarse-clastic equivalent of the shale-gypsum-anhydrite-dolomite strata comprising the El Reno on both sides of the basin to the north and west. The fact that the two evaporite areas are separated by nonevaporite sediments has resulted in establishment of dual nomenclature, one set being applied to members of the Blaine, and another set in the Carter area and elsewhere in southwestern Oklahoma. This report follows classification used by Schweer (1937) and older stratigraphic concept of the Blaine is revised. [For outcrop pattern see Geologic map of Oklahoma (Miser, 1954).]

C. O. Dunbar and others, 1960, Geol. Soc. America Bull., v. 71, no. 12, pt. 1, chart 6 (columns 75, 76, 77). Correlation chart uses Pease River group in Texas in preference to El Reno group. Group in Oklahoma comprises in southwestern part of State—Duncan sandstone and Chickasha formation; in west-central part—Flowerpot shale, Blaine formation, and Dog Creek shale; in north-central part—Cedar Hill sandstone, Flowerpot shale, Blaine formation, and Dog Creek shale. Overlies Hennessey shale; underlies Marlow formation of Whitehorse group.

Probably named for El Reno, Canadian County, Okla.

El Rito Formation

Tertiary (Eocene ?): North-central New Mexico.

H. T. U. Smith, 1938, Jour. Geology, v. 46, no. 7, p. 937 (fig. 4), 940–944, 958. Composed of sandstone, conglomerate, and breccia—all have a characteristic brick-red color. Well consolidated; commonly stands in steep cliffs. Maximum thickness about 200 feet. Underlies Abiquiu tuff. Rests on Precambrian to Jurassic rocks with angular unconformity.

A. J. Budding, C. W. Pitrat, and C. T. Smith, 1960, New Mexico Geol. Soc. Guidebook 11th Field Conf., p. 82–84. Described in southern part of Chama Basin. Estimated that at least a 400-foot thickness of formation is present east of Madera Canyon. Overlies older formations (Cutler, Agua Zarca, Chinle, Entrada, and Mancos shale) with angular unconformity. Underlies Abiquiu tuff member of Santa Fe formation. Age uncertain; likely early Tertiary, possibly Eocene.

Principal localities: Ortega Mountains along both branches of El Rito Creek; badland west of the Cerro de las Minas; north bank of the Chama about 5 miles west of Abiquiu.

Elsinore Metamorphic Series[1]

Triassic: Southern California.

Original reference: P. H. Dudley, 1932, Geol. Soc. America Bull., v. 43, no. 1, p. 223.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 480–481, table 4. Described as including metasediments and metavolcanics. Most of metasediments are dark-gray slates and phyllites, gray quartzites which lie mostly above the slates, and some chert, all representing generally uniform low-grade metamorphism. May be younger than Diamond Valley complex (new).

René Engel, 1959, California Div. Mines Bull. 146, p. 24. Proposed that name Santa Ana formation be continued to designate Upper(?) Triassic metasedimentary rocks in preference to name "Elsinore formation", as proposed by Dudley (1935, California Div. Mines Rept. 31).

Occurs in Riverside-Elsinore-Coahuila area, Riverside County.

Elsmere Member (of Repetto Formation)

Pliocene, lower: Southern California.

U. S. Grant, 4th and L. G. Hertlein, 1943, California Div. Mines Bull. 118, pt. 2, p. 202 (fig. 85) [preprint 1941]. Shown on correlation chart as lying within Pico and Repetto formations in Ventura basin.

G. B. Oakeshott, 1950, California Jour. Mines and Geology, v. 46, no. 1, p. 51 (table 1), 54 (fig. 2), 55. Consists of coarse marine sandstone, conglomerate, siltstone, and mudstone. The Elsmere dips off crystalline basement rocks on which it lies unconformably; overlaps on Modelo and Mint Canyon formations; underlies siltstone member of Repetto and may be in part contemporaneous with it. Maximum thickness about 100 feet. Type locality designated.

G. B. Oakeshott, 1958, California Div. Mines Bull. 172, p. 22 (fig. 2). 75, 77, 79, pl. 1. Member reaches its maximum thickness of 1,400 feet, from its contact on pre-Tertiary crystalline rocks to overlying base of Pico formation, in upper Elsmere Canyon. Thins rapidly northward and is overlapped by Pico before reaching Whitney Canyon. Southeastward becomes folded and faulted in complexities of Santa Susana fault zone and is overlapped by Pacoima formation near Olive View. Unconformably overlies Domengine sandstone. Present only south of San Gabriel fault. "Towsley formation" (Winterer and Durham) includes "Elsmere member."

Type locality: Elsmere Canyon, Los Angeles County. Occurs to south and east around western border of San Gabriel Mountains.

†Elstone Formation[1]

Eocene: Southern Texas.

Original reference: R. A. Liddle, 1921, Texas Univ. Bull. 1860, p. 75, map, columnar section.

Typically exposed near Elstone, Media County.

Elves Chasm Tongue (of Mauv Formation)

Lower and (or) Middle Cambrian: Northwestern Arizona.

E. D. McKee, 1945, Carnegie Inst. Washington Pub. 563, p. 14 (fig. 1), 29, 87–88. Snuff-brown massive crystalline dolomite which passes down into beds of buff fine-grained crossbedded glauconitic sandstone in vicinity of Bass trail. Thickness at Bass Canyon 12 feet; at Fossil Rapids 35 feet; and at Gateway Canyon 50 feet. Older than Garnet Canyon tongue (new); younger than Meriwitica tongue (new).

A. H. McNair, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 3, p. 513, 515 (fig. 2). Cited as tongue of Mauv formation.

Excellent horizon marker throughout most of east-central Grand Canyon. Can be traced eastward from Bass Canyon to and beyond Hermit Canyon. Named for canyon of same designation.

Elvins Group[1]

Elvins Formation

Upper Cambrian: Southeastern Missouri.

Original references: E. O. Ulrich and H. F. Bain, 1905, U.S. Geol. Survey Bull. 260, p. 234; Bull. 267, p. 12, 17, 23–26.

Josiah Bridge, 1937, U.S. Geol. Survey Prof. Paper 186–L, p. 234 (table 1). Rank raised to group. Includes (ascending) Davis formation, Derby dolomite, and Doe Run dolomite. Underlies Potosi dolomite; overlies Bonneterre dolomite.

E. B. Branson, 1944, Missouri Univ. Studies, v. 19, no. 3, p. 30. Term Elvins as introduced by Ulrich is not recognized as valid in this report. As a group it would include the Davis and Derby and probably part of the Potosi.

V. E. Kurtz, 1960, Dissert, Abs., v. 21, no. 3, p. 595. Referred to as Elvins formation comprising (ascending) Davis, Derby, and Docrun members. Separated from underlying Bonneterre dolomite by disconformity; shows facies relationships with underlying Potosi formation. Contains four faunal zones. Upper Cambrian.

Named for exposures at Elvins, St. Francois County.

Elvira Group

Mississippian (Chester Series): Southern Illinois and western Kentucky.

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), 835, 841. Includes eight alternating sandstone and limestone-shale formations of upper Chester series (descending): Kinkaid limestone, Degonia sandstone, Clore limestone, Palestine sandstone, Menard limestone, Waltersburg sandstone, Vienna limestone, and Tar Springs sandstone. Latter three are considered equivalent to Baldwin formation in some areas.

Name derived from Elvira township, Johnson County, Ill., where all formations of standard Mississippian section are well developed.

Elway Limestone

Elway Limestone Member (of Lurich Formation)

Middle Ordovician: Southwestern Virginia.

B. N. Cooper, 1945, Virginia Geol. Survey Bull. 66, p. 42–43, 45 (fig. 8), pls. 9, 18, 23. Consists of dove-gray to dark-bluish-gray fine-grained argillaceous limestones containing chert which weathers into characteristic blocks. Average thickness 35 to 40 feet. Underlies Five Oaks limestone; overlies Blackford formation which is herein restricted to exclude zone of blocky chert here named Elway.

Marshall Kay, 1956, Geol. Soc. America Bull., v. 67, no. 1, p. 61, 72. Rank reduced to member status in Lurich formation (new).

L. D. Harris and R. L. Miller, 1958, U.S. Geol. Survey Geol. Quad, Map GQ–111. As described in Duffield quadrangle, includes about 15 feet of limestone that may be equivalent to Five Oaks limestone as used by Cooper (1945) in Scott County. This uppermost unit is a medium-light-gray lutite textured limestone with interbedded medium light-gray calcareous shale and dark-gray lutite-textured limestone.

Type section: Along State Highway 80, near Blackford, Russell County. Name derived from settlement along U.S. Route 19 near Lebanon.

Elwren Formation (in West Baden Group)

Elwren Sandstone (in Chester Group)[1]

Elwren Sandstone 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), 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 correlative of three formations of Indiana (ascending); Reelsville limestone, Elwren sandstone and shale, and Beech Creek limestone. Names Reelsville and Elwren are here proposed for the two lower members of Kentucky formation; term *Productus inflatus* zone is used for upper member. Elwren is 40 feet thick near Seree, Breckinridge County, and 3 feet thick at Girkin.

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 of southern Indiana: Ann Arbor, Mich., The Edwards Letter Shop, p. 7, 14. 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 Chester and deserves a name in its own right. Elwren sandstones present through outcrop of lower Chester beneath Beech Creek limestone; continues northward as far as Reelsville, Putnam County, but locally is cut out in part or in entirety and overlapped by the Pennsylvanian northward from Lawrence County. Locally, cuts below level of Reelsville limestone.

T. G. Perry and N. M. Smith, 1958, Indiana Geol. Survey Bull. 12, p. 25, pl. 1. Elwren sandstone in Indiana ranges from 20 to 50 feet in thickness. Lower part of formation is typically light-gray to light-brown commonly rust-spotted thick-bedded to massive locally crossbedded sandstone; drab-gray soft shale is commonly more abundant than sandstone in upper part of formation. In many localities, Elwren beds immediately below Beech Creek limestone are characteristically green-gray thin-bedded soft shale, which contains thin discontinuous beds of brick-red shale. Field identification of Elwren normally is based upon its stratigraphic position between distinctive Reelsville and Beech Creek limestone. Type locality indicated.

H. H. Gray, R. D. Jenkins, and R. M. Weidman, 1960, Indiana Geol. Survey Bull. 20, p. 36 (table 5), 45, pl. 1. Uppermost formation in West Baden group (redefined). Thickness 37 to 52 feet. Overlies Reelsville limestone; underlies Beech Creek limestone of Stephensport group (redefined).

Type locality: Vicinity of Elwren, Monroe County, Ind., where exposures occur in cuts along Illinois Central Railroad within 1 mile of boundary between Greene and Monroe Counties.

Ely Greenstone[1]

Precambrian (Keewatin): Northeastern Minnesota, and Ontario, Canada.

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. 1025–1027. Formation is not uniform, and various areas are not necessarily of same age. Some rocks are effusive, others intrusive, and others fragmental; nearly all are altered and green because of abundant secondary chlorite; ellipsoids common and are safest criterion for recognition of the greenstone. Thickness cannot be estimated unless some underlying formation is clearly recognized. Considered base of earlier division of Precambrian; there is a possibility of a formation below Ely in Canada, but in Minnesota base has not been observed. At many places lower contact is with intrusive granites and gabbro. Soudan iron-formation lies near top and partly within greenstone. Overlain at places by Ogishke conglomerate; Animikie (Gunflint or Biwabik) iron-formation lies directly on Ely east of sec. 27, T. 65 N., R. 4 W. Intruded by Saganaga granite, Duluth gabbro, and Algoman granites.

G. M. Schwartz and I. L. Reid, 1955, Mining Eng., v. 7, no. 3, p. 298. Soudan beds should be considered member of Ely greenstone.

F. F. Grout, R. P. Sharp, and G. M. Schwartz, 1959, Minnesota Geol. Survey Bull. 39, p. 12–15. Occurs only in northwestern part of Cook County as narrow belt across T. 65 N., Rs. 4 and 5 W. This is south of Alpine and Sea Gull Lakes and along north side of Gunflint iron-bearing district. Width of belt ranges from thin lens at east end in sec. 22, T. 65 N., R. 4 W. to maximum of 1¼ miles in secs. 19 and 30. Greenstone is bounded on north throughout most of its length by Saganaga granite which intruded and metamorphosed the greenstone.

Typical exposures are under and adjacent to town of Ely, St. Louis County, Minn. Principal exposures follow Vermilion iron-bearing district from Tower to Gunflint Lake; largest, including type locality, extends 40 miles from Vermilion Lake to Moose Lake; another extends northeast into Hunter's Island, Canada.

Ely Limestone[1]

Ely Group

Upper Mississippian and Lower and Middle Pennsylvanian: Eastern Nevada and western Utah.

Original references: A. C. Lawson, 1906, California Univ. Pub. Bull., Dept. Geol., v. 4, no. 4, p. 295; A. C. Spencer, 1917, U.S. Geol. Survey Prof. Paper 96, p. 26, 27.

E. N. Pennebaker, 1932, Mining and Metallurgy, v. 13, no. 304, p. 164. Ely limestone, in Robinson mining district, is lowermost Pennsylvanian formation. It is practically free from sandy admixture and carries abundant chert as bands, lenses, and nodules. Estimated thickness 1,500 to 3,200 feet. Overlain by series of sandstone and sandy limestone herein designated Rib Hill formation. Most of Rib Hill was formerly included in Ely.

R. H. Dott, Jr., 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 11, p. 2219 (fig. 2), 2234–2248. Rank raised to group in Elko area. Includes Moleen formation below and Tomera formation above (both new). Overlies Tonka formation (new); underlies Strathearn formation (new). Thickness about 3,200 feet. Lower and Middle Pennsylvanian.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 61–63. Described in vicinity of Eureka where it is as much as 1,500 feet thick; overlies Diamond Peak formation and underlies Carbon Ridge formation (new). As exposed in this area, belongs to lower half of Pennsylvanian.

W. M. Winfrey, Jr., 1958, Am. Assoc. Petroleum Geologists, Rocky Mountain Sec., 8th Ann. Mtg., p. 77, 79 (fig. 2). In Egan Range, Nev., unconformably underlies Eocene Sheep Pass formation (new).

R. K. Hose and C. A. Repenning, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 9, p. 2170–2174. Geographically extended into Confusion Range, Utah, where it replaces term Bird Spring formation. Consists of 1,850 to 2,000 feet of alternating resistant thick-bedded limestone and slabby slope-forming limestone. Upper 100 to 350 feet contain early Permian fauna and is commonly more massive and less cherty than remainder of formation, which contains fauna characteristic of lower half of Pennsylvanian and locally Late Mississippian. Overlies Chainman shale; underlies Arcturus limestone.

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 Gold Hill district and Confusion Range, Utah, and Moorman Ranch area, Nevada, overlies Illipah formation.

J. S. Berge, April 1960, Brigham Young Univ. Research Studies, Geology Ser., v. 7, no. 5, p. 9–18, pl. 4. Ely limestone, in Ferguson Mountain area, unconformably overlies Chainman shale and underlies Ferguson Mountain formation (new). Thickness 1,411.4 feet, of this, basal 111.8 feet is Morrowan age, followed by 262.2 feet of Derryan, 120.4 feet of Desmoinesian, 745.6 feet of upper Missourian, and 171.4 feet of Virgilian. In White River valley overlies Butte formation (new). Overlies Ferguson Springs formation (new) at Ferguson Springs.

Grant Steele, 1960, Intermountain Assoc. Petroleum Geologists 11th Ann. Field Conf., p. 93 (chart 1), 99–100, 101. Pennebaker (1932) redefined Ely by placing upper contact at base of yellow and tan sand sequence, formerly assigned to Arcturus limestone, which he named Rib Hill formation; lower contact remained at top of Chainman. Ely is herein restricted to those limestones lying stratigraphically above Chainman shale or Scotty Wash quartzite, whichever is present, and below regional Pennsylvanian unconformity—that is, to those limestones described by Pennebaker as having abundant bedded and nodular chert. Because of nature of unconformity, overlying unit may be South Ridge sandstone (new), or that part of the Ely taken away from the unit as restricted in this paper. Upper 300 feet of massive coralline limestones without chert above the unconformity, and removed from Ely, is here named Riepe Spring limestone. Thickness of Ely (restricted) varies from 2,500 feet at type area to less than 500 feet at north end of Pequop Range. At reference section, herein designated, Ely overlies Scotty Wash quartzite (Illipah sandstone) and underlies Riepe Spring limestone. Disconformably underlies Ferguson Springs formation (new) at type locality of that unit. On basis of fusulinids dated as Pennsylvanian (Morrowan-middle Desmoinesian). Name Rib Hill abandoned.

J. C. Young, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 160, 163–164. Underlies Kinsey Canyon formation (new).

Type area: Ely district, Ely quadrangle. Reference section: Along U.S. Highway 50, between Illipah Creek and Moorman Ranch, secs. 7 and 8, T. 17 N., R. 59 E., White Pine County, Nev. This is 30 miles west of type area.

Ely Springs Dolomite[1]

Middle and Upper Ordovician: Eastern Nevada and southeastern California.

Original reference: L. G. Westgate and A. Knopf, 1932, U.S. Geol. Survey Prof. Paper 171.

J. F. McAllister, 1952, California Div. Mines Spec. Rept. 25, p. 14 (fig. 6), 13–15, pls. 1, 2, 3. Described in Quartz Spring area, northern Panamint Range, Calif., where it conformably underlies Hidden Springs dolomite (new) and overlies Eureka quartzite. Thickness 740 to 940 feet. Upper Ordovician.

H. R. Wanless, 1960, Jour. Paleontology, v. 34, no. 5, p. 862. In Independence quadrangle, California, overlies Middle Ordovician Johnson Spring formation (new) of Eureka group.

U.S. Geological Survey currently designates the age of the Ely Springs as Middle and Upper Ordovician on the basis of a study now in progress.

Named for exposures in Ely Springs Range, Pioche region, Nevada.

†Embar Formation[1] or Group[1]

Permian and Triassic(?): Western and central Wyoming.

Original reference: N. H. Darton, June 1906, Geology Owl Creek Mountains, Wyoming: 59th Cong. 1st Sess., S. Doc. 219, p. 17.

P. T. Walton, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 8, p. 1441–1442. Embar limestone, in subsurface in Oregon basin field, Park County, Wyo., underlies Dinwoody formation and overlies Tensleep sandstone. Name Embar was given by Darton (1906) to all beds between base of Chugwater and top of Tensleep sandstone, which interval is now recognized as consisting of both Triassic and Permian strata. Herein suggested that term Embar is too well established to consider abolishing it when it is applied in its present usage, that is, when used to denote only characteristic limestone section usually correlated with Phosphoria formation of Idaho. Permian.

W. G. Pierce, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 77. Formation mapped in Basin-Greybull area, Big Horn County, Wyo., where it overlies Pennsylvanian Tensleep and underlies Triassic Chugwater formation.

P. W. Richards, 1955, U.S. Geol. Survey Bull. 1026, p. 32–34, pl. 1. Embar and Chugwater formations mapped separately only in southwestern part of area [Bighorn Canyon-Hardin area, Montana and Wyoming] where Embar consists of 100 feet of dolomite, limestone, red siltstone, and sandstone. Elsewhere, a zone of redbeds, gypsum, and thin beds of limestone is seemingly the Embar equivalent. Overlies Tensleep sandstone.

V. E. McKelvey and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 12, 2833, 2835. Name Embar, introduced for beds between Tensleep and Chugwater, has been used for redbeds of Permian and Triassic age in central Wyoming (Lee, 1927, U.S. Geol. Survey Prof. Paper 149). Embar has also been used for Permian rocks only (Andrews and others, 1945, U.S. Geol. Survey Prelim. Map 25; Richards, 1955), and in that sense is synonym for the Phosphoria as used by others in same area. In new nomenclature herein proposed, Darton's Embar formation is considered obsolete.

Named for Embar post office, Big Horn County, on Owl Creek, a short distance south of which formation is extensively developed.

Embarrass Granite[1]

Precambrian (post-Keweenawan): Northeastern Minnesota.

Original reference: C. K. Leith, 1903, U.S. Geol. Survey Mon. 43, p. 186.

Forms core of extreme east end of Giants Range. Named for its lithologic similarity to granite exposed at Embarrass Station on Duluth & Iron Range Railroad just north of Mesabi Range, Mesabi district.

Embudo Granite

Precambrian: Central northern New Mexico.

Arthur Montgomery, 1953, New Mexico Bur. Mines Mineral Resources Bull. 30, p. 37–46, pl. 1. Name introduced to replace Dixon granite of Just (1937); name Dixon preoccupied. Three main granite types distinguished: coarse-grained partly porphyritic biotite granite, light-colored partly porphyritic gneissic granite, and flesh-colored coarse-grained to pegmatitic leucogranite. Has invaded all rocks of Ortega and Vadito (new) formations, and thus is of more recent age.

Borders the Picuris Range on south and on east, Taos County. Name taken from town of Embudo, located 2 miles west of Dixon and 4 miles west of extensive outcrops of the granite.

Emerald Dolomite Member (of Ajax Dolomite)[1]

Upper Cambrian: Central northern Utah.

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

H. T. Morris, 1957, Utah Geol. Soc. Guidebook 12, p. 9. Massive bed of medium-grained creamy- or grayish-white dolomite marked or mottled by irregular zones of coarse-grained gray to white dolomite. Thickness about 30 feet. Overlies lower member 90 to 180 feet thick, and underlies upper member that averages about 450 feet in thickness. Ajax has yielded fossils of Late Cambrian age.

Named for Emerald mine, Tintic district. Continuously exposed from Mammoth to Eureka.

†Emerald Limestone[1]

Middle or Upper Cambrian: Southeastern Arizona.

Original reference: J. A. Church, 1903, Am. Inst. Mining Engrs. Trans., v. 33, p. 3–37.

Tombstone district.

†Emerald Series[1]

Middle or Upper Cambrian: Southeastern Arizona.

Original reference: W. P. Blake, 1902, Tombstone and its mines.

Ajax Mountain, Tombstone district.

Emerson Formation

Middle and Upper Cambrian and Lower Ordovician(?): Central Montana.

M. M. Knechtel, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 8, p. 1994–1995. Name applied to sequence of shale, thin beds of limestone, and intraformational conglomerate overlying Flathead sandstone and underlying Bighorn dolomite. Thickness at type locality estimated not less than 950 feet and not more than 1,100 feet. Approximately lower half is Middle Cambrian in age. Upper part includes 538 feet of strata of Late Cambrian and probably Early Ordovician age.

Type locality: At and near mouth of Emerson Gulch, on Lodgepole Creek, in SW¼ sec. 20, T. 36 N., R. 25 E., Phillips County, and about 4½ miles south-southwest of Lodgepole Subagency of Fort Belknap Indian Reservation.

Emery Sandstone Member (of Mancos Shale)[1]

Upper Cretaceous: Central eastern Utah.

Original reference: E. M. Spieker and J. B. Reeside, Jr., 1925, Geol. Soc. America Bull., v. 36, p. 439.

J. G. Bartram, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 7, p. 908. Suggests that name Emery be abandoned and unit included in proposed Eagle group.

C. B. Hunt and R. L. Miller, 1946, Utah Geol. Soc. Guidebook 1, p. 8 (table). Generalized section of sedimentary rocks exposed in Henry Mountains shows Emery sandstone member above Blue Gate shale member and below Masuk shale member. Thickness 200 feet.

C. B. Hunt, Paul Averitt, and R. L. Miller, 1953, U.S. Geol. Survey Paper 228, p. 36 (table), 84–85, pls. In southern part of Castle Valley (type area), the Emery is about 800 feet thick, at north end of valley thins to 100 feet and grades eastward into marine shale. In Henry Mountains structural basin, Emery is about 250 feet thick. Here it underlies Masuk member and overlies Blue Gate shale member. Between type locality and Henry Mountains region, the sandstone has been removed by erosion and cannot be traced into this region, but name as used in this report is applied to beds in same stratigraphic position, which are lithologically like type Emery and which overlie shale beds containing marine fauna equivalent to fauna in beds beneath type Emery. Name Bluegate sandstone was used by Gilbert (1877). Probably never extended very far east of Henry Mountains.

Named for exposures southwest of Emery, Emery County.

Emery Peak Basalt or Flow (in Clayton Basalt)

Late Cenozoic: Northeastern New Mexico.

Brewster Baldwin and W. H. Muehlberger, 1959, New Mexico Bur. Mines Mineral Resources Bull. 63, p. 115–118, pl. 1–b. Ten basalt flows in what is termed Folsom sequence of Clayton basalt area are named and mapped. Stratigraphic position of six of these basalts has been determined. Emery Peak is oldest in known sequence; followed by Big Hill basalt.

Emery Peak is in northwestern Union County.

Emigrant Formation[1]

Middle and Upper Cambrian: Southwestern Nevada.

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

U.S. Geological Survey currently designates the age of the Emigrant Formation as Middle and Late Cambrian on the basis of a study now in progress.

Well developed to south of Emigrant Pass, in northern part of Silver Peak Range, Esmeralda County.

Emigration Formation[1]

Middle Triassic: Central northern Utah.

Original reference: A. A. L. Mathews, 1931, Oberlin Coll. Lab. Bull., new ser., no. 1.

G. B. Richardson, 1941, U.S. Geol. Survey Bull. 923, p. 28. Mathews separated the Thaynes, on the basis of fossil evidence, into two units to which he applied names Pinecrest and Emigration formations. He assigned the Emigration to Middle Triassic.

Bernhard Kummel, Jr., 1943, Am. Jour. Sci., v. 241, no. 5, p. 325. Fauna from Emigration formation has never been described or illustrated, therefore Mathews' age determination cannot be checked from the literature.

Named for Emigration Creek east of Salt Lake City.

Emily Member (of Crow Wing Formation)[1]

Precambrian: Central Minnesota.

Original reference: C. Zapffe, 1930, Lake Superior Min. Inst. Proc., v. 28, p. 101–106.

F. F. Grout and others, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 1021 (table 3). Table shows sequence (ascending) Ogishke, Agawa, Emily, and (Carlton). Units are marked with asterisk(*) which, according to footnote, means uncertain as to place.

Named for occurrence at village of Emily, Crow Wing County.

Eminence Dolomite[1]

Upper Cambrian: Southeastern Missouri.

Original reference: E. R. Buckley, 1908, Am. Min. Cong. Rept. Proc. 10th Ann. Sess., p. 286.

Josiah Bridge, 1930, Missouri Geol. Survey and Water Resources, 2d ser., v. 24, p. 75–97, table 2, geol. map. Described in Eminence and Cardareva quadrangles. Maximum thickness 250 feet; average about 200. Overlies Potosi dolomite or overlaps Potosi and rests on Precambrian; unconformably underlies Gunter sandstone member of Van Buren formation. Fauna described.

O. R. Grawe, 1945, Missouri Geol. Survey and Water Resources, 2d ser., v. 30, p. 53–55. Overlies Potosi, dolomite; underlies Gasconade formation. In this report, Gasconade is used in its earlier unrestricted sense to include all strata between the Eminence and the Roubidoux.

R. D. Knight, 1954, Missouri Geol. Survey and Water Resources Rept. Inv. 17, p. 57. Reprinted from Kansas Geol. Soc. Guidebook 17th Ann Field Conf., 1954. Underlies Gunter member of Gasconade formation.

Named for exposures at Eminence, Shannon County.

†Emma Creek Formation

Pliocene, middle and upper: Central Kansas.

S. W. Lohman and J. C. Frye, 1939, (abs.) Econ. Geology, v. 34, no. 8, p. 943. Sands, gravel, clays, and silts of middle and upper Pliocene age. Underlies McPherson formation (redefined). Deposits formerly referred to the McPherson formation.

S. W. Lohman and J. C. Frye, 1940, Econ. Geology, v. 35, no. 7, p. 849–851. Brown, buff, and gray channel sand and gravel, and floodplain sandy silt and clay. Thickness 10 to 180 feet. Interfingers with Ogallala formation to southwest. Derivation of name stated.

C. C. Williams and S. W. Lohman, 1949, Kansas Geol. Survey Bull. 79, p. 56. Name abandoned. Beds at type locality are Pleistocene. Some beds assigned to Emma Creek have proved to be of Pliocene age and are here designated Delmore formation.

Named from exposures along Emma Creek, southeastern McPherson County.

Emmett Formation[1]

Pleistocene: Southwestern Idaho.

Original reference: V. R. D. Kirkham, 1928, Idaho Bur. Mines and Geol. Pamph. 29, p. 1.

Probably named for town of Emmett, Gem County.

Emmitsburg facies[1]

Upper Triassic: Western Maryland.

Original reference: G. E. Dorsey, 1919, Geol. Soc. America Bull., v. 30, p. 155–156.

Probably named for occurrence at or near Emmitsburg or Emmitsburg Junction, Frederick County.

Emmons Peak Quartzite[1]

Precambrian: Northeastern Utah and northwestern Colorado.

Original reference: H. E. Wood 2d, 1934, Am. Mus. Nat. History Bull., v. 67, p. 244.

Probably named from Emmons Peak, Uinta Mountains, Utah.

†Emory Sandstone[1]

Pennsylvanian: Southeastern Tennessee.

Original reference: J. M. Safford and J. B. Killebrew, 1900, Elements of geology of Tennessee, p. 153.

Forms top stratum of Tracy City Measures in water gaps of Big Emory River at Harriman, Roane County.

Emperador Limestone[1] Member (of La Boca Formation)

Emperador Limestone Member (of Culebra Formation)

Miocene, lower: Panamá.

Original reference: D. F. MacDonald, 1913, (abs.) Geol. Soc. America Bull., v. 24, p. 709.

W. P. Woodring and T. F. Thompson, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 2, p. 237, 238, 246 (fig. 2). Member of Culebra formation. Massive cream-colored limestone. Limestone is rare along the Panamá Canal and is so conspicuous in the predominantly tuffaceous rocks that such beds in different regions were formerly correlated with the Emperador. As a result of these correlations, limestones in Caimito and La Boca formations, and even in Gatuncillo formation in Madden basin, were designated Emperador limestone. Even when limestones in other formations are eliminated there remains residue of limestones in the Culebra, the relative stratigraphic position of which is uncertain. Early Miocene. Formerly exposed in shallow quarries at Empire. Unit was termed Empire limestone by Hill (1898).

W. P. Woodring, 1957, U.S. Geol. Survey Prof. Paper 306–A, p. 34, 36–37, 39, 51. Limestone agreeing with descriptions of the Emperador is still exposed along canal. These beds of relatively pure coralliferous limestone probably are at different horizons in upper part of Culebra formation and probably grade southeastward into calcareous sandstone. Should it be demonstrated that the name is being used for limestone at different horizons, the name should be abandoned, except for limestone at type locality.

U.S. Geological Survey currently classifies the Emperador Limestone as a member of La Boca Formation on the basis of a study now in progress.

Type region: Quarries at Empire, now unrecognizable.

Empire Formation[1]

Pliocene(?): Southwestern Oregon.

Original reference: J. S. Diller, 1896, U.S. Geol. Survey 17th Ann. Rept., pt. 1, p. 475.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 195–197. Consists of approximately 1,050 feet of brownish-gray massive concretionary medium- to coarse-grained moderately indurated sandstones which are involved in a northerly plunging synclinal fold situated on south side of Coos Bay. Sandstones rest with marked angular unconformity on Tunnel Point sandstones. Cannot be distinguished on faunal basis from Coos conglomerate. Pliocene.

W. P. Woodring, Ralph Stewart, and R. W. Richards, 1940, U.S. Geol. Survey Prof. Paper 195, p. 109–110. Empire fauna is more probably Pliocene than Miocene.

C. E. Weaver and others, 1944, Geol. Soc. America Bull., v. 55, no. 5, p. 590, chart 11. Coos conglomerate is lens in Empire.

J. W. Durham, 1953, (abs.) Geol. Soc. America Bull., v. 64, no. 12, pt. 2, p. 1504–1505. Examination of section of marine fossiliferous strata along south side of Cape Blanco, referred to Empire formation (Pliocene) by Diller (1903) and other workers, revealed unconformity dividing formation into two parts. The unconformity, marked by moderately coarse conglomerate, is exposed in sea cliff about one-half mile south of the Cape and a short distance stratigraphically above 25-foot tuff member noted by Diller. *Securella* [*Chione*] *securis-Anadara trilineata* fauna is restricted to beds above the conglomerate. Name Empire should be applied only to these upper beds.

Well exposed on beach 3 miles southwest of Empire City, between Pigeon Point and Fossil Point.

Empire Formation (in Missoula Group)

Empire Member (of Spokane Formation)

Empire Shale[1] or Formation (in Piegan Group)

Precambrian (Belt Series) : West-central Montana.

Original reference: C. D. Walcott, 1899, Geol. Soc. America Bull., v. 10, p. 199–215.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc. America Bull., v. 48, no. 12, p. 1898. Member of Spokane formation which is included in Meagher facies (new) of Belt series. Member consists of argillites, thickly bedded, siliceous, greenish-gray, with some sandstones and limestones. Thickness about 600 feet. Overlies Prickly Pear member (new).

Adolph Knopf, 1950, Am. Mineralogist, v. 35, nos. 9–10, p. 835–837. Marysville stock is surrounded by Precambrian rocks of Belt series (ascending) : Empire formation, Helena limestone (renamed dolomite), Marsh formation, and Greenhorn Mountain quartzite (new). Area contains type section of Empire "shale." Empire formation, or "shale" as Walcott (1899) called it, was named for exposure west of Empire mine, at head of Lost Horse Gulch in western part of Marysville district. Lowermost beds exposed here are intruded by granodiorite of Marysville stock. All rocks in type section are hornfelsed, dark weathering, and are crackle breccias ramified with tremolite veinlets and quartz veins. They are well within contact-metamorphic aureole of Marysville stock and are overlain conformably by white diopsidic hornfels of Helena dolomite. Walcott mentioned occurrence of Empire shale on Drumlummon Hill, in eastern part of district, but rock there is a superb scapolite-diopside hornfels. Barrell (1907, U.S. Geol. Survey Prof. Paper 57) in his account of Marysville district, ignored type section of Empire and described formation as exposed on Long Creek in north-central part of Marysville area, outside of contact aureole, where it consists of finely laminated, soft limy shale, grayish-green or buff-colored with a few reddish bands. As observed in present study, the Empire there consists of pale-green hard argillite alternating with mud-cracked rose or lavender argillites. Top of Empire is light colored and weathers pale buff and yellowish. Section at this locality is bottomed by fault; Barrell measured 520 feet of Empire and accepted Walcott's figure of 600 feet at total thickness. However, base of Walcott's section is an intrusive contact. In present work formation was found to be best exposed in section that extends east-west through U.S.G.S. bench mark 4450 in Scratchgravel Hills, northwest of Helena where it consists of pale-green argillite, deep-red argillites, and fine-grained light-green and white quartzite. Thickness about 1,000 feet. Conformable contacts with Spokane shale below, where first appearance of quartzite in section is taken to mark base of Empire. Transition to overlying Helena is abrupt, taking place within stratigraphic thickness of 20 feet.

C. P. Ross, D. A. Andrews, and I. J. Witkind, 1955, Geologic map of Montana (1:500,000): U.S. Geol. Survey. Provisionally included in Piegan group.

M. R. Klepper, R. A. Weeks, and E. T. Ruppel, 1957, U.S. Geol. Survey Prof. Paper 292, p. 6, pls. 1, 2. Empire shale intertongues with and grades downward into Spokane shale and underlies Flathead quartzite in southern Elkhorn Mountains, Jefferson and Broadwater Counties. Thickness about 600 feet.

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

Type localities: On ridge north of Empire, between Lost Horse Gulch, and in canyon walls just below Marysville, Lewis and Clark County.

Empire Limestone[1]

Miocene: Panamá.

Original reference: R. T. Hill, 1898, Mus. Comp. Zool. Harvard College Bull., v. 28, no. 5, p. 195–196.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 335. Limestone in Gaillard Cut area now referred to lower Miocene. MacDonald (1913, Isthmian Canal Comm., Ann. Rept., app. S. p. 564–582) renamed unit Emperador limestone. Credits name to R. T. Hill.

Named for Empire, now abandoned, a village on original line of Panama Railroad near Culebra and about one-half mile west of Gaillard Cut.

Empire Gulch Rhyolite[1]

Tertiary: Colorado.

Original reference: W. Cross, 1886, U.S. Geol. Survey Mon. 12, p. 351.

Named for occurrence on south side of Empire Gulch, south of Leadville, Lake County.

†Emporia Blue Limestone[1]

Pennsylvanian: Northeastern Kansas.

Original reference: A. J. Smith, 1903, Kansas Acad. Sci. Trans., v. 18, p. 100.

Named for Emporia, Lyon County.

Emporia Limestone (in Wabaunsee Group)[1]

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

Original reference: M. Z. Kirk, 1896, Kansas Univ. Geol. Survey, v. 1, p. 72–85.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2274 (fig. 1), 2276. As originally defined and now again recognized, the Emporia comprises beds between Willard shale above and Auburn shale below. Thickness ranges from 7 to 40 feet. Includes (ascending) Reading limestone, Harveyville shale, and Elmont limestone members. Kirk did not define type section or locality; reference section given.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 55–60. Emporia limestone of Kansas comprises (ascending) Reading limestone, Harveyville shale, and Elmont limestone members. Moore (1949, Kansas Geol. Survey Bull. 83) correlated the Reading, Harveyville, and Elmont of Kansas with lower, middle, and upper units of Stonebreaker formation in Osage County, Okla. Name Stonebreaker has been discarded as formation name in north-central Oklahoma in favor of name Emporia. Kansas subdivisions of Emporia are recognizable in Pawnee County; southern extent is not known. Average thickness 90 feet in Pawnee County. Overlies Auburn shale; underlies Gano shale.

Reference section exposed in roadcut on Kansas Highway 10 in NW¼ sec. 31, T. 11 S., R. 14 E., Shawnee County, Kans.

†Emporia (reservoir) Shales[1]

Pennsylvanian: Eastern Kansas.

Original reference: L. C. Wooster, 1905. The Carboniferous rock system of eastern Kansas.

Probably named for Emporia, Lyon County.

Endeavor Granite[1]

Precambrian: Wisconsin.

Original reference: C. C. Wang, 1932, Geol. Soc. China Bull., v. 11, no. 4, p. 426–428.

Endee shale[1]

Triassic(?): Northeastern New Mexico.

Original reference: C. R. Keyes, 1905, Am. Jour. Sci., 4th, v. 20, p. 424.

Derivation of name not stated.

Endicott Diorite[1]

Devonian or Carboniferous: East-central New Hampshire.

David Modell, 1936, Geol. Soc. America Bull., v. 47, no. 12, p. 1899–1901, pl. 1. Holocrystalline dark-colored fine- to coarse-textured pegmatitic diorite. Shown on map as diorite breccia. Brecciated and intruded by Conway granite and Cobble Hill phase of Belknap syenite. Older than Conway granite and Belknap syenite at Cobble Hill; younger than Gilford gabbro. Assigned to White Mountain magma series.

Typical exposures on Endicott Hill in Belknap Mountains.

Enebro Sandstone Lens (in Johnson Peak Formation)

See Johnson Peak Formation.

Enfield facies subgroup[1]

Upper Devonian: Southern central New York.

Original reference: K. E. Caster, 1933, Geol. Soc. America Bull., v. 44, pt. 1, p. 201.

Ithaca region.

Enfield Formation

†Enfield Shale Member (of Portage Formation)[1]

Upper Devonian: South-central New York.

Original reference: H. S. Williams, 1906, Science, new ser., v. 24, p. 365–372.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1758, chart 4. As represented on correlation chart, Enfield formation lies between the Ithaca below and the Chemung above and, according to Chadwick (1935, Am. Midland Nat., v. 16), is eastern representative of Rhinestreet-Hatch sequence. This correlation differs from that published by Caster (1933, Geol. Soc. America Bull., v. 44, pt. 1), which showed that Enfield of Ithaca region consisted of Van Etten and Hatch.

R. E. Stevenson, 1948, New York State Sci. Rept. Inv. 1, p. 2 (chart). Shown on chart as upper member of Naples formation. Overlies Ithaca formation.

J. W. Wells, 1952, Jour. Paleontology, v. 26, no. 1, p. 120–122. Referred to as formation. Starfish *Ptilonaster* collected from middle of formation about 400 feet below base of Chemung and about same distance above top of Ithaca formation.

Wallace de Witt, Jr., and G. W. Colton, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2826. In area south of Cayuga Lake, the Sonyea formation occupies upper four-fifths of rock sequence that was designated Enfield shale member of Portage formation by Williams and others (1909, U.S. Geol. Survey Geol. Atlas, Folio 169).

Typically exposed at town of Enfield, west of Ithaca, Tompkins County.

Engadine Dolomite[1]

Middle Silurian (Niagara Series) : Northern Michigan.

Original reference: R. A. Smith, 1916, Michigan Geol. Survey Pub. 21, p. 151.

G. M. Ehlers *in* K. K. Landes, G. M. Ehlers, and G. M. Stanley, 1945, Michigan Dept. Conserv., Geol. Survey Div. Pub. 44, Geol. Ser. 37,, p. 35, 36. In Straits of Mackinac region, underlies Pointe aux Chenes formation (new).

G. M. Ehlers and R. V. Kesling, 1957, Michigan Geol. Soc. [Guidebook] Ann. Field Excursion, p. 2 (table), 23, 29. Youngest unit of Middle Silurian in Northern Peninsula. Thickness 200 to 250 feet. Overlies Cordell dolomite with contact sharply defined in some area; underlies Pointe aux Chenes shale with contact not exposed.

Named for exposures at and around Engadine, Mackinac County.

Engle coal group (in Vermejo Formation)[1]

Upper Cretaceous: Eastern Colorado.

Original reference: R. C. Hill, 1899, U.S. Geol. Survey Geol. Atlas, Folio 58.

Elmoro region.

Englevale Channel Sandstone[1]

Englevale Sandstone Member (of Labette Shale)

Pennsylvanian (Des Moines Series) : Southeastern Kansas and western Missouri.

Original reference: W. G. Pierce and W. H. Courtier, 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 7, p. 1061–1064.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 197. Englevale sandstone member of Labette shale is one of several bodies of sandstone, collectively referred to as Warrensburg sandstone. Lies in middle and lower part of Labette shale.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 6. Geographically extended into southwestern Missouri, Bates County and probably elsewhere.

Well exposed in vicinity of Englevale, Crawford County, Kans., along north-south road on east side of town and along east-west road one-half mile north of town.

Englewood Formation

Englewood Limestone[1]

Devonian and 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. 76–77. Mississippian system is 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.

U.S. Geological Survey currently classifies the Englewood as a formation and designates the age as Devonian and Mississippian on the basis of a study now in progress.

Name derived from Englewood, Lawrence County, S. Dak.

English River Formation (in Hannibal Group)

English River Sandstone Member (of Hannibal Shale)[1]

English River Siltstone Member (of Hannibal Formation)

Lower Mississippian (Kinderhook): Western Illinois and southeastern Iowa.

Original reference: H. F. Bain, 1895, Am. Geologist, v. 15, p. 322.

L. A. Thomas, 1949, Geol. Soc. America Bull., v. 60, no. 3, p. 408–409. Referred to as siltstone member. In southeastern Iowa, overlies Maple Mill shale with apparent conformity; at Burlington, underlies McCraney (McKerney) limestone with boundary indicated by leached yellow part at top of English River; in western Louisa County, underlies Wassonville limestone, which overlies Maple Mill near Kalona, northern Washington County. Conodont assemblage indicates Lower Mississippian.

M. A. Stainbrook, 1950, Am. Jour. Sci., v. 248, no. 3, p. 209, 212. English River siltstone is not member of Hannibal formation. Kinderhook succession in upper Mississippi valley seems to be (ascending) Maple Mill shale, English River siltstone, Louisiana limestone, Hannibal shale and siltstone, and Chouteau limestone.

L. E. Workman and Tracey [Tracy] Gillette, 1956, Illinois Geol. Survey Rept. Inv. 189, p. 8 (fig. 1), 27–28. Top formation in Hannibal group in Illinois. Conformably overlies Maple Mill shale; conformably underlies and is gradational into McCraney (McKerney) limestone. Present in western Illinois in north-south belt about 25 miles wide extending from Henderson to Pike Counties. Thickness 30 to 43 feet along middle of belt; less than 10 feet along western border of state; wedges out eastward.

Named for exposures along English River, Washington County, Iowa.

Englishtown Formation (in Matawan Group)

Englishtown Member (of Matawan Formation)

Englishtown Sand (in Matawan Group)[1]

Upper Cretaceous: New Jersey and Delaware.

Original reference: H. B. Kummel, 1907, New Jersey Geol. Survey Paleontology, v. 4, p. 17, footnote.

C. W. Carter, 1937, Maryland Geol. Survey, v. 13, pt. 6, p. 243 (fig. 22), 256–258. Geographically extended into Delaware where it is present along Chesapeake and Delaware Canal. Underlies Marshalltown formation; overlies Crosswicks clay.

W. B. Spangler and J. J. Peterson, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 1, p. 8, (fig. 4), 24, 28–30. Member of the Matawan which is here reduced to formational rank. Conformably overlies Woodbury member; conformably underlies Marshalltown member. It is believed that Carter's interpretation of stratigraphy in Chesapeake and Delaware Canal is in error and that beds referred to Englishtown by him are Wenonah.

M. E. Johnson and H. G. Richards, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 11, p. 2150–2160. Here considered of formational rank. Report is a discussion of paper by Spangler and Peterson (1950).

J. P. Minard and J. P. Owens, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B184, B185. Formation in Matawan group. Overlies Woodbury clay; underlies Marshalltown formation. Average dip SE 38 feet per mile. Thickness 20 to 140 feet; thickens northeast in outcrop.

Named for development in vicinity of Englishtown, Monmouth County, N.J.

†Enid Formation[1]

Permian: Western Oklahoma, western Kansas, and western Texas.

Original reference: C. N. Gould, 1905, U.S. Geol. Survey Water-Supply Paper 148, p. 39–44, map.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 99. Listed with names abandoned by Oklahoma Geological Survey.

Named for Enid, Garfield County, Okla.

†Enochkin Formation[1]

Middle and Upper Jurassic: Southwestern Alaska.

Original reference: T. W. Stanton and G. C. Martin, 1905, Geol. Soc. America Bull., v. 16, p. 397.

Typically exposed on eastern shore of Enochkin [Iniskin] Bay.

Ensenada Shale[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. 252.

J. D. Weaver, 1956, *in* R. Hoffstetter and others, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2b, p. 325. Limy shale about 650 feet thick. Contains fragments of *Radiolites* and foraminifera. Stratigraphical relations not known. Upper Cretaceous.

T. R. Slodowski, 1958, Dissert, Abs., v. 18, no. 1, p. 200–201. In Yauco area, the younger complex, more than 9,000 meters thick, has been divided into eight formations: Sabana Grande, El Rayo, Ensenada, Río Yauco, Río Loco, Río Blanco, San Germán, and Jicara. Ensenada is considered to have been deposited in a southern basin penecontemporaneously with deposition of Río Yauco and Río Blanco formations in a northern basin. Ensenada and Río Yauco formations overlie Sebana Grande and El Rayo formations unconformably and are separated from overlying San Germán and Jicara formations, at least locally, by unconformities.

Named for exposures at Ensenada, on Guanica Bay.

Ensign Lake Green Slates, Tuffs, and Graywackes

Precambrian (Knife Lake Series): Northeastern Minnesota.

J. W. Gruner, 1941, Geol. Soc. America Bull., v. 52, no. 10, p. 1583 (table 1), 1605–1606. Name applied to green slates and tuffs that form a large part of Ensign Lake Basin and extend eastward to [Duluth] gabbro. Beds commonly only a fraction of an inch thick; bands are light and dark green and gray with some pink. Locally formation is injected by granite and pegmatite dikes. Quartz veins from paper thin to 10 feet in width permeate rock in places. Isoclinally folded. Thickness may be 4,000 feet or more. In this report, Knife Lake series is divided into 20 members. Table of approximate chronological sequence (ascending) shows Ensign Lake green slates as unit 10 occurring above Amoeba Lake graywackes and below Kekekabic Lake tuffs, agglomerates, slates, and andesite porphyry.

Report covers a belt in eastern part of Vermilion district more or less parallel to international boundry.

Ensign-Snowbank Lake Agglomerate

Precambrian (Knife Lake Series): Northeastern Minnesota.

J. W. Gruner, 1941, Geol. Soc. America Bull., v. 52, no. 10, p. 1583 (table 1), 1593. Dark greenish gray on fresh surface and light gray on weathered surface; not uniform in texture and structure; appears homogeneous on fresh surface; when weathered may appear massive, fragmental, or banded; contains a number of "blow-outs" and dikes of feldspar porphyry; bedding indistinct; gradational bedding rare. Thickness variable; probably 4,000 feet maximum. In practically all occurrences, overlies slates and graywackes. In this report, Knife Lake series is divided into 20 members. Table of approximate chronological sequence (ascending) shows Ensign-Snowbank Lake agglomerate as unit 12 occurring above Kekebabic Lake tuffs, agglomerates, slates, and andesite porphyry and below unnamed feldspar porphyry intrusions.

Occurs in vicinity of Snowbank and Ensign Lakes, Lake County.

†Enterprise Green Marl (in Claiborne Group)[1]

Eocene, middle: Southeastern Mississippi.

Original reference: O. Meyer, 1885, Am. Jour. Sci., 3d, v. 30, p. 435.

Wythe Cook, 1925, U.S. Geol. Survey Prof. Paper 141–E, p. 135. Because name Enterprise is preoccupied, Winona sand is here redefined to include typical "Winona sand" of Montgomery County and typical "Enterprise marl" of Clarke County, but to exclude sands at base of Tallahatta formation in Lauderdale County.

Named for exposures at town of Enterprise, Clarke County.

†Enterprise Sandstone (in Boggy Shale)[1]

Pennsylvanian: Central eastern Oklahoma.

Original reference: S. W. Lowman, 1932, Summaries and abstracts of technical papers presented before Tulsa Geological Society 1932, unpaged.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 107. Abandoned by Oklahoma Geological Survey. Name of the Haskell County village was given to unit now known as Bluejacket sandstone. Name preoccupied.

†Enterprise Shale (in Sumner Group)[1]

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

Original reference: J. W. Beede, 1909, Kansas Acad. Sci. Trans., v. 21, pt. 2, p. 253.

Name not used on Geologic map of Oklahoma (1954). The Enterprise or its equivalents transferred to Chase Group.

Named for Enterprise, Dickinson County, Kans.

Entrada Sandstone (in San Rafael Group)[1]

Upper Jurassic: Southern, southeastern, and northeastern Utah, northeastern Arizona, western, central, and southeastern Colorado, and northwestern New Mexico.

Original reference: J. Gilluly and J. B. Reeside, Jr., 1926, U.S. Geol. Survey Press Bull. 6064, March 30.

A. A. Baker and others, 1927, Am. Assoc. Petroleum Geologists Bull., v. 11, no. 8, p. 787, 799, 804, 805. In Moab region, Utah, includes Moab tongue (new).

James Gilluly and J. B. Reeside, Jr., 1928, U.S. Geol. Survey Prof. Paper 150–D, p. 76–78. A thick series of earthy sandstones and subordinate shales. Thickness 312 feet at type locality; 844 feet at Muddy River on west flank of San Rafael Swell; 405 feet at Black Dragon Canyon; 498 feet at mouth of San Rafael River. Overlies Carmel formation; underlies Curtis formation. Extends into Colorado.

A. A. Baker, 1933, U.S. Geol. Survey Bull. 841, p. 49–50, pls. In Moab region, the Entrada consists of massive crossbedded medium-grained sandstone. Moab tongue is white; remainder of formation is banded orange and white with rows of solution cavities parallel to normal bedding. Thickness 360 to 405 feet. Underlies Summerville formation; overlies Carmel formation.

A. A. Baker, C. H. Dane, and J. B. Reeside, Jr., 1936, U.S. Geol. Survey Prof. Paper 183, p. 7–8, pls. Summary of results of recent fieldwork in eastern Utah and adjacent parts of Arizona, New Mexico, and Colorado and revision of interpretations and correlations of Jurassic formations of area. The Entrada extends eastward from type area into, and in the north, across Rocky Mountain province in Colorado and a relatively short distance southward into New Mexico and Arizona. A sandy zone above the Carmel in southwestern Utah has position and lithology of the Entrada and is here correlated with it. The Entrada in San Rafael Swell is deep-red fine-grained earthy sandstone that weathers into small bosses, "stone babies," and other rounded forms and at many localities is not much more resistant than shale. This facies occurs also in southwestern Utah. Eastward from San Rafael Swell, this earthy facies passes into less earthy irregularly bedded sandstone. This, in turn, passes eastward into sandstone composed of clean fine- to medium-sized lime-cemented quartz grains, red, orange-red, or gray, banded at many places with zones of color in sharp distinction to uniform coloring of the Navajo and Wingate. Moab sandstone tongue present at top of Entrada in vicinity of Moab, Utah. Maximum thickness about 1,000 feet near Circle Cliffs, Utah; thins southward. Rests on Carmel formation as far east as Bush Canyon in Colorado. Farther east rests successively upon Navajo sandstone, Kayenta formation, and Wingate sandstone and upon Dolores formation where Wingate sandstone is not recognized. Lower boundary arbitrary where Carmel formation is present; elsewhere it is sharp. Contact with overlying Curtis formation in San Rafael Swell is erosional unconformity, but elsewhere upper boundary is only moderately sharp and probably not an unconformity. Lower member of La Plata sandstone of Cross (1898, U.S. Geol. Survey 18th Ann. Rept., pt. 3) at many localities in southwestern Colorado is Entrada, and so also is entire La Plata of north-central Colorado. San Rafael group. Upper Jurassic.

R. L. Heaton, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 8, p. 1153–1177. Results of this study show that basal sandstone of the "Jurassic" of northern Colorado is probably partly Entrada and partly Upper Triassic, that the latter grades into redbeds southward and the former continues into New Mexico where it is identical with the so-called Wingate; and that it does not extend westward to the Arizona line but can be correlated with lower La Plata of San Juan Mountains in Colorado. Further, the so-called Nugget of northwestern Colorado is Nugget and Entrada separated by thin remnant of Carmel formation.

H. D. Thomas and M. L. Krueger, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 8, p. 1277–1278. In Uinta Mountains, Preuss red beds grade into crossbedded Entrada sandstone.

A. A. Baker, C. H. Dane, and J. B. Reeside, Jr., 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 9, p. 1664–1668. Report is revised correlation of Jurassic formations of parts of Utah, Arizona, New Mexico, and Colorado. Entrada sandstone, with more or less typical lithologic character and in normal sequence with underlying Carmel formation, and Navajo, Kayenta, and Wingate formations of Glen Canyon group are recognized at Navajo Mountain, Utah, Kayenta and Rough Rock, Ariz., Boundary Butte, Utah, and Beclabito dome, New Mexico. Overlying Todilto limestone is not recognized at Navajo Mountain, is absent at Boundary Butte, but crops out at Kayenta, Red Rock, Ariz., and Beclabito dome. Southward from Red Rock, the Todilto is present at Toadlena and at its type locality at Todilto Park. Underlying Entrada thickens southward from Red Rock to Toadlena and to Todilto Park, where it is the thick cliff-forming sandstone which all previous workers, including authors of present report, have correlated with Wingate sandstone of Fort Wingate region. This cliff-forming sandstone which crops out along Arizona-New Mexico State line at Todilto Park, Window Rock, Hunters Point, and Lupton and in cliffs north of Fort Wingate, N. Mex., is thus equivalent to sandstone called Entrada over most of Utah and Colorado. Evidence shows that the sandstone extends north ward to Chama Basin and is same sandstone that crops out at Mesa Alta, Navajo Canyon, El Rito, and Rio Canones in Chama Basin. These new conclusions as to correlation pose problem of stratigraphic nomenclature. Strict application of principles of priority would require that name Wingate sandstone now be applied to unit heretofore called Entrada and would require a new name to be applied to Wingate sandstone of Utah and adjacent regions. However, it is believed that abandonment of this nomenclature through application of principles of priority would be confusing. Hence, name Entrada is extended to include sandstone at type locality of the Wingate, and name Wingate is retained for the sandstone forming lower part of Glen Canyon group, with the understanding that original type locality of the Wingate has been abandoned.

W. L. Stokes and D. A. Phoenix, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 93. Entrada sandstone mapped in Egnar-Gypsum Valley area, San Miguel and Montrose Counties, Colo.

H. E. Gregory, 1950, U.S. Geol. Survey Prof. Paper 220, p. 51 (table), 94–96, pls., strat. sections. In Zion Park region, light-red white-banded fine even-grained thin-bedded gypsiferous friable sandstone 70 to 220 feet thick. At type section, consists chiefly of thick-bedded red sandstones, among them several massive crossbedded sandstones 13 to 30 feet thick; no gypsum beds included; thickness 312 to 844 feet. Overlies Carmel formation; unconformably underlies Curtis formation.

W. B. Hoover, 1950, New Mexico Geol. Soc. Guidebook 1st Field Conf., p. 77–80. Entrada and its members may be considered as representing the whole of San Rafael group where the Carmel is absent. Entrada, at type locality, is overlain by Curtis and Summerville. The Curtis apparently grades into Summerville, and the Summerville, in part, grades into Moab tongue of Entrada. Farther south, the Entrada divides again into a lower bed, the Entrada proper, and Bluff sandstone member. Term Red Mesa is here introduced for sandstone beds, 100 feet thick, between Entrada proper and Bluff member. Crinkly beds of the Red Mesa are similar in appearance to the Carmel at Moab which led Stokes (1944) to conclude that the Bluff and Entrada were one and same bed.

H. E. Wright, Jr., and R. M. Becker, 1951, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 3, p. 610 (fig. 2). Discussion of correlation of Jurassic formations along Defiance monocline, Arizona-New Mexico. Cross section shows Entrada overlying Carmel formation and underlying Summerville formation and Todilto limestone.

C. B. Hunt, Paul Averitt, and R. L. Miller, 1953, U.S. Geol. Survey Prof. Paper 228, p. 38 (table), 70–72, pls., strat. sections. Described in Henry Mountains region where it overlies Carmel formation and unconformably underlies Curtis formation. Thick-bedded and crossbedded sandstone; thinner bedded earthy sandstone to north. Thickness 300 to 700 feet.

T. G. McLaughlin, 1954, U.S. Geol. Survey Water-Supply Paper 1256, p. 88–92, pls. 1, 2. Extended into Baca County, southeastern Colorado. Disconformably overlies Dockum group; underlies Morrison. These beds have been referred to as Exeter sandstone. Thickness 0 to 380 feet.

F. W. Cater, Jr., 1955, U.S. Geol. Survey Geol. Quad. Map GQ–64. Mapped in Horse Range Mesa quadrangle, Colorado.

J. W. Harshbarger, C. A. Repenning, and J. H. Irwin, 1957, U.S. Geol. Survey Prof. Paper 291, p. 3 (fig. 2), 35–38, strat. sections. In most of Navajo country comprises three members which represent two distinct depositional facies. Lower sandy member is a sandy crossbedded facies, in part eolian, present only in northwestern part of area;

medial silty member approximates lithology of type section and is present in central and eastern parts of area; upper sandy member, a cross-bedded facies, is present in eastern part of area. A thin (50-foot) eastward extension of medial silty member and a thick (253-foot) sequence of upper sandy member constitute upper half of original type section of Wingate sandstone. In southwestern area, it is difficult to differentiate from underlying Carmel formation. In some areas, underlies Cow Springs sandstone, in others Summerville formation or Todilto limestone. Thickness as much as 303 feet.

R. B. Johnson, 1959, U.S. Geol. Survey Bull. 1071–D, p. 94–95, pls. 4, 5, 6. Described in Huerfano and Custer Counties, Colo., where it is 70 to 100 feet thick; disconformably overlies Sangre de Cristo formation and disconformably underlies Morrison. In this area and adjacent parts of New Mexico, replaces names Exeter and Ocate sandstones.

E. B. Ekren and F. N. Houser, 1959, U.S. Geol. Survey Mineral Inv. Map MF–221. Mapped in Moqui SE quadrangle where it consists of two units: upper sandstone 70 to 80 feet thick, pale brown and light pink at top grading to white and finally to orange in lower part; and lower argillaceous fine-grained brick-red sandstone 25 to 35 feet thick. Underlies Summerville formation; overlies Navajo formation.

R. B. Johnson and E. H. Baltz, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 12, p. 1895, 1897, 1898 (fig. 2). In Sangre de Cristo Mountains, Colo., unconformably overlies Johnson Gap formation (new), Lykins(?), or Sangre de Cristo formations.

Named for exposures on Entrada Point, in northern part of San Rafael Swell, Utah.

Enumclaw Volcanic Series[1]

Miocene, upper: Western Washington.

Original reference: C. E. Weaver, 1916, Washington Geol. Survey Bull. 13, p. 84.

Well exposed from Enumclaw to Cedar Lake, in southwestern part of King County.

†Eolian Limestone[1]

Cambrian and Ordovician: Southwestern Vermont.

Original reference: E. Hitchcock, 1861, Vermont Geologist Rept., v. 1, p. 396–419.

Named for Mount Eolus (Dorset Mountain) in Pawlet quadrangle.

Eolian Limestone Member (of Pueblo Formation)[1]

Pennsylvanian: Central northern Texas.

Original reference: F. B. Plummer and R. C. Moore, 1922, Texas Univ. Bull. 2132, p. 24, 31, 171–173, pl. 2, table 2.

Named for exposures near Eolian, Stephens County.

Eoline Member (of Coker Formation)

Eoline Formation (in Tuscaloosa Group)

Upper Cretaceous: West-central Alabama.

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. 194–197. Formation includes the marine beds which lie between the apparently nonmarine Cottondale formation (new) and the Coker formation (new). Consists of glauconitic fine- to medium-grained sand and laminated gray clay; sand and clay beds are lenticular and of doubtful persistence, but upper part is commonly more clayey and lower part more sandy; *Halymenites* borings locally present, chiefly in upper half; weathered exposures commonly bright rusty red; updip exposures in Cottondale quadrangle chiefly purple and red sand with little or no glauconite and no *Halymenites*. Thickness 50 to 150 feet. In many places, upper contact is abrupt locally showing as much as 40 feet of channeling and in such places commonly overlain by nonglauconitic sand; at other places, contact is more obscure and laminated clay of Eoline is overlain by massive clay of Coker; at such places, contact is undulating surface having about 10 feet of relief. Lignitized logs and macerated plant remains near top have been determined as Upper Cretaceous.

C. W. Drennan, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 3, p. 528, 529. Rank reduced to member status in Coker formation (revised). Sediments heretofore designated Cottondale are included in Eoline member.

Named for exposures in cuts along Alabama Highway 6, about 30 miles southeast of Tuscaloosa, and 1½ miles east of community of Eoline, Bibb County.

Eolus Granite[1] (in Front Range Granite Group)

Precambrian: Southwestern Colorado.

Original reference: W. Cross and E. Howe. 1905, U.S. Geol. Survey Geol. Atlas, Folio 131.

Composes Mount Eolus, Needle Mountain quadrangle.

Ephraim Conglomerate (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.

G. R. Mansfield, 1952, U.S. Geol. Survey Prof. Paper 238, p. 40–42, pl. 1. In Paradise Valley quadrangle, Idaho, is sole representative of group. Contained in small slice of rocks in zone between middle and east branches of Bannock overthrust. Thickness 1,025 feet. Overlies Stump sandstone. Upper Jurassic and Lower Cretaceous.

H. R. Wanless, R. L. Belknap, and Helen Foster, 1955, Geol. Soc. America Mem. 63, p. 55–56, pl. 21. Referred to as conglomerate member of Gannett group in Jackson Hole area. Underlies Peterson limestone member; overlies Stump formation. Lower Cretaceous.

W. W. Rubey, 1958, U.S. Geol. Survey Geol. Quad. Map GQ–109. Described in Bedford quadrangle, Wyoming, where it is a conspicuous unit composed of sandy siltstone and shale; contains crossbedded coarse-grained sandstone and prominent conglomerate lentils. Thickness, where least disturbed by faulting or other deformation, 350 to 500 feet. Overlies Stump sandstone; underlies unit referred to as Draney-Peterson limestone. Lower Cretaceous.

Named for Ephraim Valley, sec. 36, T. 10 S., R. 45 E., Boise meridian, Crow Creek quadrangle, Idaho.

Epitaph Dolomite (in Naco Group)

Lower Permian: Southeastern Arizona.

James Gilluly, J. R. Cooper, and J. S. Williams, 1954, U.S. Geol. Survey Prof. Paper 266, p. 25–27, 41; James Gilluly, 1956, U.S. Geol. Survey Prof. Paper 281, p. 8, 44–46, pl. 5. Lowest member of formation consists of about 200 feet of dolomite which ranges from medium to light gray on fresh fracture and weathers to various shades of gray—light to very dark. Characterized by presence of knots of silica, which are suggestive of being silicified fossils—weather to brown or tan. Toward the top of this part of formation, partings of red shale occur in dolomite; overlying beds generally poorly exposed sandy limestone or limy sandstone with higher porportion of maroon shale and much less dolomite. Uppermost part of formation is assemblage of dolomite, limestone, red shale, and thin sandy layers. Thickness at type locality 783 feet. Unconformably underlies Glance conglomerate or other rocks of Comanche age; overlies Colina limestone (new) with gradational contact.

Type locality: On dip slope of Colina Ridge, west of Epitaph Gulch (from which dolomite takes its name), 1 mile south of Horquilla Peak, central Cochise County.

Epler Formation (in Beekmantown Group)

Lower Ordovician: Southeastern Pennsylvania.

J. P. Hobson, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 12, p. 2716 (fig. 3), 2718, 2719–2720, 2721. Proposed for interbedded limestone and dolomite overlying Rickenbach formation (new) and underlying dolomite beds here termed Ontelaunee formation. Divided into two unnamed members: upper characterized by large proportion of calcarenite with bioclastics and limestone pebbles, and lower in which calcilutite is common; both members contain interbedded dolomite with much larger percentage in lower member. Thickness 800 feet in type section. Contact with underlying Rickenbach transitional, and boundary set at base of first limestone above solid dolomite body of the Rickenbach; contact with overlying Ontelaunee is placed at top of first limestone bed beneath lowest chert bed of Ontelaunee, and in Berks County this contact is 100 feet below lowest chert bed; contact zone gradational.

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 approximately 1,000 feet thick.

Type section: Continuous with type section of upper member of Rickenbach formation, east of Epler School, near Reading, Berks County.

Epworth Gravel Member (of San Pedro Formation)

Pleistocene, lower: Southern California.

California State Water Resources Board, 1953 (revised 1956), California State Water Resources Board Bull. 12, v. 2, p. B–103, pls. B–1C, B–2. Consists of up to 300 feet of gravel, gravelly clay, and silt, grading westward and southward into silt and clay. Gravels occur near top of formation and have been folded and partly eroded.

Occurs in a limited area around Moorpark, Ventura County.

†Equity Quartz Latite (in Alboroto Group)

†Equity Quartz Latite (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. Upper part is biotite-hornblende latitic rhyolite; includes Equity and Phoenix Park quartz latites [both part of Alboroto group] of Creede district.

U.S. Geological Survey has abandoned the term Equity Quartz Latite on the basis of a study now in progress.

Named for development near Equity mine. Creede district.

Eramosa Member[1] (of Lockport Dolomite)

Middle Silurian: Ontario, Canada and western New York.

Original reference: M. Y. Williams, 1915, Canada Geol. Survey Mus. Bull. 20, Geol. Ser. 29, p. 1–4.

E. R. Cummings, 1939, Geologie der Erde, North America, v. 1, p. 596 (fig. 7), 597. Uppermost member of Lockport dolomite. Thickness 15 feet. Overlies Suspension Bridge member (new). Underlies Guelph dolomite. Forms crest of Niagara Falls.

B. F. Howell and J. T. Sanford, 1947, Wagner Free Inst. Sci. Bull., v. 22, no. 4, p. 34. Member of Lockport formation. Underlies Oak Orchard member (new); overlies Goat Island member (new). Term Goat Island replaces preoccupied name Suspension Bridge.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. Formation in Lockport group. Overlies Goat Island limestone; underlies Devils Hole dolomite (new). Lockportian stage. Middle Silurian.

Well exposed along banks of Eramosa River between Rockwood and Guelph, Ontario.

Erath Member (of Anahuac Formation)

Oligocene, upper, or Miocene, lower: Southern Louisiana (subsurface).

H. C. Goheen, 1959, Gulf Coast Assoc. Geol. Soc. Trans., v. 9, p. 91–97. Term proposed for so-called deep water facies of down-dip Anahuac formation, which is regarded as upper Oligocene or lower Miocene. Predominantly shale unit containing some sandstone. Characterized by two foraminiferal zones, *Planulina palmerae* and Abbieville. These biostratigraphic zones serve to define Erath member, the same way *Marginulina* and *Discorbis* zones are used to limit type Anahuac. No single well log at present satisfactorily includes entire member. Reference log designated.

Reference log: Texas Co. Erath Unit 38, No. 7, Erath field, Vermilion Parish. Near Erath townsite.

Ericson Sandstone[1] or **Formation** (in Mesaverde Group)

Upper Cretaceous: Southwestern Wyoming and northeastern Utah.

Original reference: J. D. Sears, 1926, U.S. Geol. Survey Bull. 781, p. 20, pl. 5.

W. R. Hansen and M. G. Bonilla, 1954, Colorado Sci. Soc. Proc., v. 17, no. 1, p. 4 (fig. 1), 9, 10. Geographically extended into Daggett County, Utah, where it is 290 feet thick in Flaming Gorge area, overlies Rock Springs formation and unconformably underlies Fort Union(?) formation; 800 feet thick in Clay Basin.

W. R. Hansen, 1957, U.S. Geol. Survey Geol. Quad. Map GQ–101. Described as formation in Clay Basin quadrangle, where it is about 800 feet thick, and consists of three massive gray sandstone beds separated by earthy punky dark-gray shale; locally basal beds are shale. Underlies Fort Union formation.

Named for exposures near old Ericson Ranch, on Salt Wells Creek, sec. 31, T. 16 N., R. 102 W., Sweetwater County, Wyo.

Erie Clay[1]

Pleistocene: New York and Ohio, and Ontario, Canada.

Original reference: W. E. Logan, 1863, Canada Geol. Survey Repts. 1843–1863, p. 887, 896–907.

Occurs along north shore of Lake Erie from Long Point westward to Detroit River, and appears to underlie whole country between this part of lake and main body of Lake Huron. Also occurs at Owen Sound and along Nottawasaga River, along shores of Lake Ontario and east far as Brockville.

Erie Group[1]

Erie Series[1] or Erian Series

Middle Devonian. New York and West Virginia.

Original reference: E. Emmons, 1842, Geology of New York, pt. 2, div. 4, geol. 2d dist., p. 100, 429.

H. P. Woodward, 1943, West Virginia Geol. Survey, v. 15, p. 253, 254, 308–311. Erie group (Erian) of West Virginia contains two members, Marcellus black shale below and Hamilton formation above. Name, which is currently in use by New York State Museum but not by U.S. Geological Survey, is here adopted to resolve a difficulty which otherwise would call for erection of a new term or transfer of another term not yet known to be wholly appropriate. To serve as the name of the Marcellus-Hamilton group of this report (that is, the Hamilton group of Pennsylvania) recourse is had to Erie, or Erian, early used by Emmons (1842) and redefined by Clarke and Schuchert (1899 Science, new ser., v. 10) expressly for this service—namely, for the rocks between the Onondaga and Tully limestone.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1729–1794, chart 4. Erian series, Middle Devonian. Comprises (ascending) Cazenovia, Tioughnioga, and Taghanic (Taughannock) stages. Follows Ulsterian series and precedes Senecan series.

Named for Lake Erie.

†Erie Limestone[1]

Pennsylvanian: Eastern Kansas.

Original reference: E. Haworth and M. Z. Kirk, 1894, Kansas Univ. Quart., v. 2, p. 108, 118.

Named for Erie, Neosho County.

†Erie Shale[1]

Upper Devonian: Northern Ohio.

Original reference: J. S. Newberry, 1870, Ohio Geol. Survey Rept. Prog. 1869, p. 20.

Named for exposures on shores of Lake Erie from mouth of the Vermillion to Dunkirk.

Erin Shale[1]

Erin Slate Member (of Talledega Series)

Carboniferous (probably Early Pennsylvanian): Eastern Alabama.

Original reference: Charles Butts, 1926, Alabama Geol. Survey Special Rept. 14, p. 217.

R. H. Griffin, 1951, Alabama Geol. Survey Bull. 63, p. 28, 31. Described in Hillabee area where Talladega series is divided into Cheaha quartzite, Erin slate, and group of quartzites, phyllites, and slates lying below, between, and above the two members. Thickness at type locality 2,800 feet; true thickness cannot be measured since upper limit is determined by Whitestone fault.

Type locality: Vicinity of Erin, Clay County.

Ermont Formation[1]

Upper Devonian: Southwestern Montana.

Original reference: P. J. Shenon, 1931, Montana Bur. Mines and Geology Bull. 6.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1742. Upper Devonian.

In vicinity of Ermont mine, Argenta district, Beaverhead County.

Erna Member (of Wilberns Formation)

Upper Cambrian: Central Texas.

F. B. Plummer, [1942], Texas Univ. Bur. Econ. Geology Mineral Resources Circ. 22, p. 1, 2, map. Medium- to coarse-grained well-sorted well-rounded friable poorly cemented sand, 10- to 25-feet thick, near middle part of formation. Due to complicated system of normal faults which occurs in region, outcrop is repeated three times so that three narrow belts of the sand can be traced across Cambrian area.

Best exposures are on middle belt along east bluff of Leon Creek, 2 miles southeast of Erna, Mason County.

Ervay Carbonate Rock Member or **Tongue** (of Park City Formation)

Ervay Member (of Goose Egg Formation)

Ervay Tongue or **Member** (of Phosphoria Formation)[1]

Upper Permian: Northwestern Wyoming.

Original reference: H. D. Thomas, 1934, Am. Assoc. Petroleum Geologists Bull., v. 18, no. 12, p. 1664, 1666.

V. E. McKelvey and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 12, p. 2832 (fig. 3), 2844; 1959, U.S. Geol. Survey Prof. Paper 313–A, p. 3 (fig. 1), 19–20, pls. 2, 3. In this report, beds that Thomas (1934) called Phosphoria in Wind River Mountains are designated Park City formation; hence, Ervay is considered member of Park City. Extends to northern Wind River Mountains where it is 30 to 40 feet thick; north and west of this, grades into upper member of Shedhorn sandstone; west of Big Piney, grades into Tosi chert member of Phosphoria. Mostly limestone in its western area and dolomite in its eastern area. Underlies Dinwoody formation. [Members of Phosphoria, Park City, and Shedhorn formations are referred to as tongues in areas where they occur singly or are subordinate parts of the interval.]

U.S. Geological Survey also classifies the Ervay as a member of the Goose Egg Formation on the basis of a study now in progress.

Type section: Casper Creek, Natrona County. Crops out a few hundred feet west of Evray, a post office in Natrona County, near north end of Rattlesnake Hills.

Ervine Creek Limestone[1] Member (of Deer Creek Limestone)

Pennsylvanian (Virgil Series): Southeastern Nebraska, southwestern Iowa, northeastern Kansas, and northwestern Missouri.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 40, 43, 49, 50.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2035 (fig. 5). Uppermost member of Deer Creek; overlies Burroak shale member; underlies Calhoun formation. Virgilian series. 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. 22. Member persists from Adair County, Iowa, to Oklahoma. Thickness 14 to 18 feet. Type exposures noted.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 17–19, fig. 3. In Missouri, interval between Rock Bluff limestone member and uppermost limestone of the Deer Creek is occupied by shale. This shale has been treated by Missouri Geological Survey as occupying the Rock Bluff-Ervine Creek interval, with implication that intervening Haynies limestone is absent in Missouri. This shale interval is here termed Larsh-Burroak. Missouri Geological Survey recognizes the possibility that Burroak shale member may be absent in Missouri and that uppermost limestone of Deer Creek formation may include both Haynies and Ervine Creek limestone members.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 17, fig. 5. Massive- to wavy-bedded fossiliferous light-gray limestone, often chert bearing; algal and oolitic beds near top. Thickness 10 to 14 feet. Overlies Burroak shale member; underlies Calhoun shale.

H. G. O'Connor, 1960, Kansas Geol. Survey Bull. 148, p. 46, pl. 1. Member, in Douglas County, is 13 to 17 feet thick. Overlies Larsh-Burroak shale member; underlies Calhoun shale.

Type exposures: On Ervine Creek about 5 miles northeast of Union, Cass County, Nebr.

Erving Hornblende Schist[1]

Pre-Triassic: Central Massachusetts.

Original reference: B. K. Emerson, 1917, U.S. Geol. Survey Bull. 597, p. 60, 72–74, map.

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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 as fine-grained hornblende schist with interbedded feldspathic quartzite. Thinly layered amphibolite grades into overlying Joshua schist through narrow zone of quartzitic mica schist which contains small widely separated layers of amphibolite. Overlies Poplar Mountain gneiss with gradational contact. Pre-Triassic.

Robert Balk, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–93. Restricted. Unit mapped as Erving by Emerson (1917) in Millers Falls quadrangle is considered amphibolite member at top of Crag Mountain formation. Relation of Erving to amphibolite lenses in Poplar Mountain gneiss not known.

Named for occurrence at Erving, Millers Falls quadrangle.

Erwin Quartzite[1] **or Formation**[1] (in Chilhowee Group)

Lower Cambrian(?): Eastern Tennessee, western North Carolina, and southwestern Virginia.

Original reference: A. Keith, 1903, U.S. Geol. Survey Geol. Atlas, Folio 90, p. 5.

G. W. Stose and A. I. Jonas, 1938, Virginia Geol. Survey Bull. 51–A, p. 7–22. In Great Valley of Virginia, Erwin quartzite underlies Shady dolomite. In vicinity of Austinville, Lower Cambrian dolomite overlies Erwin. Proposed to extend Pennsylvania names Vintage dolomite, Kinzers formation, and Ledger dolomite to this fossil-bearing series of beds, which although equivalent to Shady dolomite of Great Valley, is different sedimentary facies deposited to southeast of main Appalachian geosyncline, and has been carried northwestward by thrust faulting to rest on typical Shady dolomite.

P. B. King and others, 1944, Tennessee Div. Geology Bull. 52, p. 29–35. Formation in northeastern Tennessee consists of interbedded layers of white vitreous quartzite, ferruginous quartzite, siltstone, and shale. Formation extends from overlying Shady dolomite to base of widely traceable white quartzite bed that contains *Scolithus* in many places. As thus defined, it has rather uniform thickness of 1,200 to 1,400 feet throughout region. Includes Helenmode member (new) in Iron and Holston Mountains. The Helenmode consists of the so-called "transition beds" of earlier reports. Overlies Hampton formation; underlies Shady dolomite.

S. S. Oriel, 1950, North Carolina Div. Mineral Resources Bull. 60, p. 12, 14–16. Formation, as mapped in this report [Hot Springs Window], includes upper part of Murray slate and Hesse quartzite as mapped by Keith (1904, U.S. Geol. Survey Geol. Atlas, Folio 116). Base of formation is placed beneath resistant ledge-forming white quartzite series of beds that overlie upper shale member of Hampton formation. *Scolithus* tubes not noted except at one locality. Except for Helenmode member at top, Erwin beds are not subdivided in this area. Overlies Hampton formation; underlies Shady dolomite. Two sets of formation names for Lower Cambrian clastic rocks are in current use 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.

P. B. King and H. W. Ferguson, 1960, U.S. Geol. Survey Prof. Paper 311, p. 28, 32, 41–45, pls. 1, 19. Uppermost unit of Chilhowee group. Consists of interbedded layers of white vitreous quartzite, dark ferruginous quartzite, siltstone, and shale. Thickness 1,220 feet at type locality; between 1,200 and 1,500 feet on Holston Mountain and Iron Mountain; 1,000 feet in Stone Mountains; about 600 feet on Nowhere Ridge. Includes (ascending) Nebo quartzite, Murray shale, Hesse quartzite, and Helenmode members. Overlies Hampton formation; underlies Shady dolomite. Lower Cambrian.

W. B. Brent, 1960, Virginia Div. Mineral Resources Bull. 76, p. 19–20, pl. 1. In this report [Rockingham County], term Erwin quartzite is used in preference to Antietam sandstone. Consists almost entirely of thick beds of clean well-sorted grains of white quartz sand which are cemented with silicia. Thickness 800 to 1,000 feet. Overlies Hampton (Harpers) formation; underlies Shady (Tomstown) dolomite.

Type locality: On Nolichucky River, southeast of Unaka Springs. Named for exposures near Erwin, Unicoi County, Tenn.

Escabrosa Limestone[1]

Lower and Upper(?) Mississippian: Southeastern Arizona and southwestern New Mexico.

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

James Gilluly, J. R. Cooper, and J. S. Williams, 1954, U.S. Geol. Survey Prof. Paper 266, p. 2–13. Crops out in northwestern Mule Mountains, Tombstone Hills, in many fault blocks in southeastern end of Dragoon Mountains, and along main ridge of Dragoon Mountains and in parts of Little Dragoon Mountains, Gunnison Hills, and Johnny Lyon Hills. Overlies Martin limestone or Abrigo limestone; underlies Horquilla limestone (new), or Black Prince limestone. Thickness 585 to 755 feet. Lower Mississippian.

F. F. Sabins, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 3, p. 476 (fig. 6), 480–481. Described in Chiricahua and Dos Cabezas Mountains where it consists of cherty crinoidal limestone 630 to 730 feet thick. Overlies Upper Devonian Portal formation (new); underlies Upper Mississippian Paradise formation.

Elliot Gillerman, 1958, New Mexico Bur. Mines Mineral Resources Bull. 57, p. 11 (table 2), 28–29, table 1. In central Peloncillo Mountains, about 460 feet thick; overlies Percha shale and underlies Paradise formation. Unit resembles Escabrosa of Bisbee area much more closely than it does Lake Valley limestone; hence, term Escabrosa is used here even though it is at variance with nomenclature used throughout rest of New Mexico. Kinderhookian-Meramecian.

D. W. Peterson, 1960, U.S. Geol. Survey Geol. Quad. Map GQ–128. Thickness about 300 feet in Haunted Canyon quadrangle, Arizona. Overlies Martin limestone; underlies Naco limestone.

U.S. Geological Survey currently designates the age of Escabrosa Limestone as Lower and Upper(?) Mississippian.

Named for exposures on Escabrosa Ridge, Bisbee quadrangle, Ariz.

Escacado Limestone

Upper Devonian (Rockfordian): Southeastern Arizona.

[C. R.] Keyes, 1942, Pan-Am. Geologist, v. 77, no. 3, p. 227, 228 (table). Name applied to lower 100 feet of Martin limestone of Ransome (1904).

Characterized by occurrence of Iowa Rockford fauna. Younger than Berenda formation; underlies Patagonia limestone (new).

In Bisbee region.

Escanaba Limestone[1]

Middle Ordovician: Michigan.

Original reference: A. C. Lane, 1909, Michigan Geol. Survey Rept. 1908, p. 47.

Escanaba and St. Mary's Rivers.

Escanaba River Group

Middle Ordovician: Northwestern Michigan.

R. C. Hussey, 1950, Michigan Geol. Soc. [Guidebook 14th] Ann. Geol. Excursion, introd. Proposed for Middle Ordovician rocks of Michigan.

Middle Ordovician rocks are well exposed along Escanaba River from hydroelectric power station at Bony Falls almost to mouth of stream, Upper Peninsula.

Escobar Sandstone

Eocene, upper: Northwestern California.

C. E. Weaver, 1953, Washington [State] Univ. Pubs. in Geology, v. 7, p. 19 (chart), 44–48, pls. 4A, 4B, 4C. Proposed for massive thick-bedded grayish and yellowish-brown medium-grained sandstones with subordinate amounts of interstratified brown silty shales which overlie Muir sandstone (new) and underlie Alhambra formation (new). Thickness at type section approximately 1,200 feet.

Type section: In west limb of Pacheco syncline in cut along Industrial Highway, east of Alhambra Valley, and in cuts along Santa Fe Railway, Contra Costa County. Forms crest of ridge in west limb from Martinez southward nearly to town of Walnut Creek. Also exposed in east limb of syncline.

Escondido Formation (in Navarro Group)[1]

Upper Cretaceous (Gulf Series): Southern Texas.

Original reference: E. T. Dumble, 1892, Geol. Soc. America Bull., v. 3, p. 227–229, 230.

L. W. Stephenson, 1937, U.S. Geol. Survey Prof. Paper 186–G, p. 137. In Medina County, Escondido formation (marl facies), 34 feet thick, unconformably overlies Anacacho limestone.

L. W. Stephenson and others, 1942, Geol. Soc. America Bull. v. 53, no. 3, chart 9. Shown on correlation chart above Olmos formation in longitude of Eagle Pass and above Anacacho limestone in longitude of Anacacho Mountain and D'Hanis, and above Corsicana marl in latitude of Castroville. Navarro group.

Named for exposures on Escondido River below Eagle Pass, Maverick County.

†Escondido Series[1]

Miocene, middle: Southern California.

Original reference: O. H. Hershey, 1902, California Univ. Pub., Dept. Geol. Bull., v. 3, pl. 1, map.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 518, table 4. Succession of volcanic rocks and continental sediments, the former being mainly basaltic and andesitic lava flows with considerable associated agglomerate. Middle Miocene.

Type section: Tick Canyon, Los Angeles County.

Escondido Creek Leucogranodiorite

Cretaceous: Southern California.

E. S. Larsen, Jr., and N. B. Keevil, 1947, Geol. Soc. America Bull., v. 58, no. 6, p. 489. Named in report on study of batholith of southern California.

E. S. Larsen, Jr., 1948, Geol. Soc. America Mem. 29, p. 87–89, pl. 1. Fine-grained light-colored rock that ranges in composition from leucogranodiorite to leucotonalite and averages granodiorite. Along most of its contact, it intrudes Santiago Peak volcanics but in some places intrudes both Green Valley tonalite and San Marcos gabbro. Derivation of name given.

Named from its excellent and characteristic development in canyon of Escondido Creek, San Diego County. Largest exposed mass of this rock occupies area about 7 square miles mostly in drainage of Escondido Creek.

Escudo Sandstone

Miocene, middle (Relizian): Central California.

Martin Van Couvering and H. B. Allen, 1943, California Div. Mines Bull. 118, pt. 3, p. 496–500. Poorly sorted buff calcareous fossiliferous sandstone. Maximum thickness 150 feet. Underlies Alferitz formation (new); unconformably overlies Hannah formation (new).

Occurs in Devils Den oil field district, northwestern Kern County, adjacent to Kings County line, about 40 miles east of Paso Robles and about 60 miles northeast of Bakersfield.

Eshamy Granite[1]

Mesozoic(?): Southeastern Alaska.

Original reference: U.S. Grant and D. F. Higgins, 1910, U.S. Geol. Survey Bull. 443, p. 34–35, 46.

Practically surrounds Granite Bay and occupies nearly all of neck land between Granite and Eshamy Bays, Prince William Sound region.

Eshe Porphyry

Tertiary: Central Colorado.

J. T. Stark and others, 1949, Geol. Soc. America Mem. 33, p. 81–83, pl. 1. Comprises stocks, dikes, and sill-like sheets of quartz monzonite porphyry and quartz diorite porphyry. Quartz monzonite near Eshe Ranch is light cream to grayish brown. Rock has finely granular goundmass and phenocrysts of feldspar, biotite, hornblende, and quartz.

Prominent around Eshe Ranch, after which rocks are named, in sec. 33, T. 8 S., R. 76 W. Underlies series of ridges and hills in northern and northwestern parts of South Park, Park County.

†Eska Conglomerate[1]

Miocene(?): Central southern Alaska.

Original reference: G. C. Martin and F. J. Katz, 1912, U.S. Geol. Survey Bull. 500, p. 15, 52–54.

F. F. Barnes and T. G. Payne, 1956, U.S. Geol. Survey Bull. 1016, p. 1, 13. Eska conglomerate found to be divisible, at least in Wishbone Hill district, into two formations, Wishbone (new) below and Tsadaka (new) above.

Extends west from valley of Eska Creek, for which it is named, Cook Inlet region.

Eskota Beds[1]

Permian: Central northern Texas.

Original reference: J. W. Beede and W. P. Bentley, 1921, Texas Univ. Bull. 1850, p. 16, 22, 29, 51, 53.

Probably named for Eskota, Fisher County.

Eskota Dolomite[1] or Gypsum[1]

Eskota Dolomite (in Custer Formation)

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.

Robert Roth, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 4, p. 422. In Fisher, Nolan, and Coke Counties, Eskota dolomite occurs from a few feet to 20 feet above base of Custer formation.

Probably named for Eskota, Fisher County.

Eskridge Shale[1] (in Council Grove Group)

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

Original reference: J. W. Beede, 1902, Kansas Univ. Sci. Bull., v. 1, p. 181.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 47. Shale and minor amount of limestone and locally thin coal beds; red and green shale predominant in most exposures; in central Kansas, a seemingly persistent limestone, as much as 2 feet thick, overlain locally by coaly material and underlain by green shale, occurs a few feet from base. Thickness 20 to 40 feet. Underlies Cottonwood limestone member of Beattie limestone; overlies Neva limestone member of Grenola limestone (redefined). Wolfcamp series.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 99–100. Formerly considered top unit of Wabaunsee group. Reclassification of section by Moore (1936, Kansas Geol. Survey Bull. 22) and others has since placed Eskridge in Council Grove group. Overlies Neva limestone; underlies Cottonwood limestone. Identification of Cottonwood in Pawnee County is uncertain and recognition of upper limit of Eskridge is accordingly doubtful. Thickness 80 to 90 feet, increasing southward.

M. R. Mudge and H. R. Burton, 1959, U.S. Geol. Survey Bull. 1068, p. 13 (table 2), 69–71, pls. Thickness 32½ to 38 feet in Wabaunsee County, Kans. Overlies Grenola limestone; underlies Beattie limestone. Note on type locality and probable type section.

Type locality: Vicinity of Eskridge, Wabaunsee County, Kans. Probable type section: About 1⅛ miles south of Eskridge in SW¼NW¼NW¼ sec. 17, T. 14 S., R. 12 E., where upper half of shale is exposed.

Esmeralda Formation[1]

Miocene, upper, and Pliocene, lower: Southwestern Nevada and central eastern California.

Original references: H. W. Turner, 1900, Am. Geologist, v. 25, p. 168–170; 1900, U.S. Geol. Survey 21st Ann. Rept., pt. 2, p. 197–208.

H. G. Ferguson, 1924, U.S. Geol. Survey Bull. 723, p. 43–50. In Manhattan district, subdivided into (ascending) Hedwig breccia, Round Rock, Diamond King, and Bald Mountain lake beds members.

D. I. Axelrod, 1940, Washington Acad. Sci. Jour., v. 30, no. 4, p. 163–170. Lower Pliocene.

H. G. Ferguson, S. W. Muller, and S. M. Cathcart, 1953, Geology of the Coaldale quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–23]. Roughly divisible into two lithologic units: upper, dominantly sedimentary but containing some volcanic material; lower, in which pyroclastic material grading from fine-grained tuff and pumice to coarse rhyolite breccia exceeds the bedded material. Sedimentary rocks include fanglomerate, conglomerate, and coarse sandstone at normal contact with older rocks grading outward into fine-grained sandstone, calcareous and sandy shales, marls, and impure hard limestones. Estimated thickness 1,000 feet in Stewart Valley, probably thicker to south, but estimate of 14,800 feet at type locality is probably excessive. Older than Oddie rhyolite. Upper Miocene and lower Pliocene.

Type locality: Big Smoky Valley, Silver Peak quadrangle, Nevada. Named for development in Esmeralda County, Nev. [before county was subdivided].

Esmond Granite

Mississippian(?) or older: Northeastern Rhode Island.

Alonzo Quinn, R. G. Ray, and W. L. Seymour *in* Alonzo Quinn and others, 1948, Rhode Island Port and Indus. Devel. Comm. Geol. Bull. 3, p 13, 15, geol. map (bedrock). Light-gray, pink, and fresh-colored medium- to coarse-grained slightly gneissic granite. Much of rock may be termed alaskite. Formerly included in Milford granite. Cuts Blackstone series discordantly.

Exposed in western part of Pawtucket quadrangle. Named for village of Esmond located just beyond southwest corner of quadrangle.

Esmont slate facies (of Candler Formation)

Lower Paleozoic(?): South-central Virginia.

W. R. Brown and H. C. Sunderman, 1954, (abs.) Geol. Soc. America Bull., v. 65, no. 12, pt. 2, p. 1356. Facies of Candler formation in James River synclinorium. Age not stated.

W. R. Brown, 1958, Virginia Div. Mineral Resources Bull. 74, p. 8 (fig. 2). Age of Candler formation is shown on columnar section as Lower Paleozoic(?).

Type locality of Candler formation is Candler Mountain, 2 miles south of Lynchburg, Campbell County.

Esopus Grit, Shale, or Siltstone

Esopus Grit or Shale (in Oriskany Group)[1]

Esopus Shale (in Onondaga Group)

Esopus Shale Member (of Onondaga Formation)

Lower or Middle Devonian: Eastern New York, northern New Jersey, and northeastern Pennsylvania.

Original reference: L. Vanuxem, 1842, Geology of New York, pt. 3, p. 127–130.

Bradford Willard, 1938, Pennsylvania Geol. Survey, 4th ser. Bull. G–11, p. 5, 6 (fig. 3), 14–16. Included in Onondaga group in Pennsylvania. Esopus shale (Caudi-galli grit of early writers) consists of not less than 250 feet of gray brown-weathering sandy shale. Overlies Oriskany. Grades upward into Buttermilk Falls limestone (new).

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1758–1759, chart 4. In Onesquethaw stage (new). Lower or Middle Devonian.

Winifred Goldring and R. H. Flower, 1942, Am. Jour. Sci., v. 240, no. 10, p. 677–678, 679, 689–690, 694. Formation restricted, beds formerly classed as upper Esopus are separated into Sharon Springs formation (new).

Winifred Goldring and R. H. Flower, 1944, Am. Jour. Sci., v. 242, no. 6, p. 340. Name Carlisle Center formation proposed for preoccupied name Sharon Springs.

J. M. Berdan, 1950, New York State Water Power and Control Comm. Bull. GW–22, p. 10 (table 2), 17–18. In Schoharie County, Esopus consists of about 80 feet of brownish-gray siltstone. Underlies Carlisle Center formation; overlies Oriskany sandstone. Lower or Middle Devonian.

A. J. Boucot, 1959, Jour. Paleontology, v. 33, no. 5, p. 731 (fig. 2), 732–734. At Highland Mills, N.Y., formation comprises (ascending) Highland Mills member (new), middle member, and Woodbury Creek member (new). Overlies Connelly conglomerate; underlies Kanouse sandstone. Thickness about 200 feet. Lower Devonian. Esopus stage recognized.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Onondaga formation as mapped includes Esopus shale in easternmost part of state.

Named from Esopus settlement and Esopus Creek, Ulster County, N.Y.

†Esopus Millstones[1]

Silurian: Eastern New York.

Original reference: W. W. Mather, 1840, New York Geol. Survey 4th Rept., p. 246–250.

Extends north from Shawangunk Mountain nearly to Kingston. Present village of Esopus is about 10 miles south of Kingston, Ulster County.

Esopus Slate[1]

Lower Devonian: Eastern New York, northern New Jersey, and northeastern Pennsylvania.

Original reference: N. H. Darton, 1894, New York State Geologist 13th Ann. Rept., p. 209–210, 244–245, 302.

Named for Esopus settlement and Esopus Creek, Ulster County, N.Y.

Esopus Stage

Lower Devonian: Eastern North America.

A. J. Boucot, 1959, Jour. Paleontology, v. 33, no. 5, p. 737–739. Proposed for eastern North America. Has been customary to conclude that Esopus formation is either upper Deerpark (Oriskany) or lower Onesquethaw (Schoharie) age. Discovery of Highland Mills and Woodbury Creek member faunas makes it clear that Esopus time is of same order as either Deerpark or Onesquethaw. In eastern New York and Pennsylvania, stage will be represented by relatively unfossiliferous Esopus formation. Elsewhere in eastern United States, strata of this age are absent owing to disconformity between strata of Oriskany and Onondaga age.

Espada Formation

Upper Jurassic and Lower Cretaceous: Southern California.

T. W. Dibblee, Jr., 1950, California Div. Mines Bull. 150, p. 22–23, pls. 1, 2. A series of dark-greenish-brown thin-bedded silty shales and a lesser amount of thin interbeds of hard fine-grained sandstone; locally thin lenses of conglomerate with well-rounded chert pebbles. No complete section exposed at any one locality. At type locality where base is exposed, consists of 1 to 5 feet of dark-brown conglomeratic sandstone resting unconformably on highly sheared clay shale of Honda formation (new); conglomerate is overlain by about 4,000 feet of dark-greenish-brown shale and thin hard sandstone which is unconformably overlain by lower Miocene beds. In San Lucas and Wons Canyons, a maximum thickness of 6,800 feet is exposed; base is in fault or intrusive contact with serpentine; top is unconformably overlain by Eocene beds. Relationship of Espada to Upper Cretaceous Jalama formation (new) not definitely known; but these are believed to be in contact at head of Salsipuedes Canyon, where relationship appears to be an unconformity, and at Nojoqui Canyon, where shales of Espada are in conformable contact with sandstones and shales believed to be the Jalama.

Type locality: South side of Canada Honda about 3 miles east of Point Pedernales, Santa Barbara County. Other exposures: Salsipuedes and El Jaro Canyons, Nojoqui and Alisal Canyons, San Lucas and Wons Canyons.

Esperance Sand Member (of Vashon Drift)

Pleistocene: Northwestern **Washington.**

R. C. Newcomb, 1952, U.S. Geol. Survey Water-Supply Paper 1135, p. 19–25, pl. 1. Largely an advance outwash deposit consisting of sand and gravel up to 400 or 500 feet thick; discontinuous silt beds common. Overlies Admiralty clay (new).

Exposed in scattered areas in western part of Snohomish County.

Esperanza Trachyte[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. 30, map.

Named for Esperanza Canyon, Oatman district.

Espey Creek Limestone Member (of Chappel Formation)

Mississippian: Central Texas.

F. B. Plummer, 1950, Texas Univ. Bur. Econ. Geology Pub. 4329, p. 22, 26, 28. Commonly made up of several layers of hard crystalline crinoidal limestone, each layer having a thickness of from 3 to 8 or 10 inches; in many areas where member is not more than 1 foot thick, it consists of a single layer containing crinoidal debris or coquina somewhat loosely cemented and sparsely fossiliferous. Thickness ranges from 6 inches to 4 feet. Most persistent member of formation and is present almost everywhere along Barnett-Ellenburger contact. Chappel comprises [ascending] King Creek marl (new), Ives conglomerate, Espey Creek limestone, and Whites Crossing coquina (new) 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 Espey Creek limestone member of Chappel formation is same as Chappel limestone of Sellards (1933) and Cloud and Barnes (1948), excluding basal 15 inches referred by him to the Chappel at Espey Creek.

Name derived from exposures along Espey Creek southeast of Hallenbeck ranchhouse, Lampasas County.

Espina Breccia[1]

Miocene, upper(?): Southwestern Nevada.

Original reference: F. L. Ransome, 1909, U.S. Geol. Survey Prof. Paper 66, p. 28, 69.

Forms Espina Hill, Goldfield district.

Espinal formation

[Upper Devonian] (Tombstonian): Southeastern Arizona.

[C. R.] Keyes, 1942, Pan-Am. Geologist, v. 77, no. 3, p. 227, 228 (table).

Name applied to upper 150 feet of Martin limestone of Ransome (1904). Older than Vecol formation (new); overlies Patagonia limestone (new).

Name taken from great intermont plain which washes its outcrops; Bisbee region.

Espinal Grit (in Joserita Member of Lowell Formation)

Lower Cretaceous: Southeastern Ariznoa.

A. A. Stoyanow, 1949, Geol. Soc. America Mem. 38, p. 11–12. Coarse partly conglomeratic grit with imperfectly rounded and subangular pebbles of limestone, quartzite, chert, arkose, and sandstone. Large inclusions of underlying yellow dolomite. Southward grades into sandstone, arenaceous shale, and limestone. Thickness 4 feet. Underlies Corta sandstone (new); overlies unnamed dolomite.

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.

Espinaso Formation or Volcanics

Tertiary: Northwestern New Mexico.

C. E. Stearns, 1943, Jour. Geology, v. 41, no. 5, p. 304 (fig. 2), 309–310. Includes water-laid breccia, conglomerate, and tuff, with massive flows and explosive material in subordinate amounts. Thickness more than 1,000 feet. Overlies Galisteo formation with contact transitional; unconformably underlies Santa Fe formation. Name credited to Kirk Bryan and J. E. Upson (unpub. ms.).

C. E. Stearns, 1953, Am. Jour. Sci., v. 251, no. 6, p. 415–452. Comprises detrital beds deposited by mud flows and streams radiating from centers of contemporaneous eruption in Ortiz Mountains and Cerrillos Hills, with a few interbedded lava flows. Overlies Galisteo formation without stratigraphic break; hence, assigned to Duchesnean (latest Eocene). Thickness as much as 1,450 feet. Underlies Abiquiu(?) formation.

Older than Cieneguilla limburgite (new) and separated from it by time interval during which a small body of augite quartz latite was intruded, solidified, and exposed by subsequent erosion. Type locality stated.

A. E. Disbrow and W. C. Stoll, 1957, New Mexico Bur. Mines and Mineral Resources Bull. 48, p. 5 (table 1), 11–24, pl. 1. Described in detail in Cerrillos area in connection with four major periods of igneous activity that occurred during Espinaso time. Thickness more than 2,000 feet. Extrusion of Espinaso volcanics may span Oligocene and early Miocene time. Mapped as Oligocene(?).

Ming-Shan Sun and Brewster Baldwin, 1958, New Mexico Bur. Mines and Mineral Resources Bull. 54, p. 22. In this report [discussion of volcanic rocks of Cienega area], age of Espinaso volcanics is considered to be some or all of time between and including late Eocene and middle Miocene.

Type locality: Espinaso Ridge along Arroyo Pinovetito. Espinaso de Clotero Montoya (also known as Pinovetito Ridge) is hogback 5 miles long, 11 miles southeast of Cerrillos, Santa Fe County.

Espiritu Santo Formation

Devonian(?): Northern New Mexico.

E. H. Baltz and C. B. Read, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 11, p. 1752–1759, 1766 (fig. 12), 1770, 1771–1772. Name applied to sequence of sandstone, arenaceous limestone, calcarenite, and crystalline dolomitic limestone overlying crystalline rocks of Precambrian age near confluence of Holy Ghost Creek (formerly called Espiritu Santo Creek) and Pecos River at Tererro. Thickness at type locality more than 30 feet; consists of basal sandstone more than 11 feet thick, overlain by interbedded thin sandstone, calcarenite, and sandy limestone 5 feet thick; thin-bedded dolomitic limestone 11 feet thick; at top, sandy limestone, shale, and limestone pebble conglomerate 3½ feet thick. Unconformably underlies Tererro formation (new). Correlated with Devonian rocks on the basis of lithology and stratigraphy only; therefore classed as Devonian(?). Further studies must precede correlation, firm age assignments, and adjustments in terminology of Espiritu Santo, Tererro, and Arroyo Penasco formations.

Type locality: In quarry west of Pecos River about 75 yards north of Holy Ghost Creek at Tererro, San Miguel County.

Esplanade Sandstone Member (of Supai Formation)[1]

Permian: Northern Arizona.

Original reference: D. White, 1929, Carnegie Inst. Washington Pub. 405, p. 11.

Grand Canyon.

Espy Formation (in Washita Group)

Lower Cretaceous: Western Texas.

R. M. Huffington, 1943, Geol. Soc. America Bull., v. 54, no. 7, p. 992 (fig. 2), 1004–1007, pl. 1. Consists of three unnamed members: lowest, 679½ feet thick, is primarily light- to dark-gray and bluish limestone, slightly arenaceous, with small lentils and thin intercalated layers of shale and sandy shale; middle, 340½ feet thick, consists of platy white thin-bedded to laminated arenaceous to argillaceous limestone; upper, about

266½ feet thick, is principally buff and olive-brown sandstone. At type locality, where exposed thickness is 1,021 feet, it is chiefly thin beds of almost pure dense gray limestone, with buff marly limestone, brown sandstone, and a few interbedded shale layers. In northern Quitman Mountain area, base is not exposed, and consequently relationships to underlying formations of Fredericksburg group are not certainly known; in adjacent areas, relations appear conformable; in northern Quitman Mountain area, conformably underlies Etholen formation with sharp contact; in Devil Ridge area, conformably underlies group of shales designated as Eagle Ford.

Type locality: Low hills upheld by Washita strata east of Love Hogback and southeastern part of Devil Ridge, northern Quitman Mountains, Hudspeth County. Name derived from Espy Ranch about 10 miles east of Love Hogback.

Esquibel Member (of Los Pinos Formation)

Miocene(?) or Pliocene(?): Central northern New Mexico.

Fred Barker, 1958, New Mexico Bur. Mines Mineral Resources Bull. 45, p. 45–46. Arkosic sandstone, sandy conglomerate, some thin beds of tuff or tuffaceous siltstone, and felsitic tuff. Thickness 600 feet. Underlies Cordito member (new): overlies Biscara member (new). Name credited to Butler (unpub. dissert.). Biscara and Esquibel members as differentiated by Butler, mapped here as single unit, Biscara-Esquibel member (new).

Exposed westward from near divide on Tusas-Tres Piedras Road.

Essex Limestone[1] Member (of Edgewood Limestone)

Lower Silurian (Albion Series): Northeastern Illinois.

Original reference: T. E. Savage, 1912, Illinois Acad. Sci. Trans., v. 4, p. 100.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53; no. 4, chart 3. Member of Edgewood limestone. Albion series.

Named for Essex, Kankakee County.

Essex Series

Precambrian: Southern California.

J. C. Hazzard and E. F. Dosch, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 308–309. Composed of basal quartz-feldspar-biotite gneiss 1.500 feet thick, 500- to 600-foot marble, quartzite, and schist unit, designated Chubbock marble member, and upper unit of quartz-feldspar-biotite gneiss at least 5,000 feet thick. Overlain by Lower Cambrian(?) quartzite. Older than Fenner granite gneiss (new).

Well exposed in southern Piute Mountains, north of Barrel Spring, in northern Old Woman Mountains, and at Chubbuck on Santa Fe Railroad, San Bernardino County.

Establishment Member (of Mifflin Formation)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., figs. 3, 10, 15A, 16. Limestone, thick-bedded; dolomite, moderately argillaceous and shaly, thin-bedded. Thickness 2 to 7 feet. Shown on columnar section as underlying Hazelwood member (new) and overlying Boarman member (new).

In copy of guidebook used by compiler, a handwritten note states that Brickeys Member overlies Boarman Member. Thus, the sequence would be (descending) Hazelwood, Establishment, and Brickeys. Compiler had no way of determining what change, if any, had been made in other copies of the guidebook.

Occurs in Dixon-Oregon area.

Estelle Tonalite

Estelle Quartz Diorite[1]

Cretaceous: 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. 70, 138, pl. 1. Described as Estelle tonalite, a light-gray rock with grains up to a few millimeters in length. Intrudes Temescal Wash quartz latite porphyry which surrounds it on all sides.

Occurs in first valley east of Estelle Mountain, Riverside County.

Ester Ash Bed

Pleistocene: East-central Alsaka.

T. L. Péwé, 1955, Geol. Soc. America Bull., v. 66, no. 6, p. 713. Gritty 6-inch-thick gray to white pure glass volcanic-ash layer near base of Ester "Island" section. Has sharp contacts with upland silt both above and below.

In "Island" section [sec. 8], T. 1 S., R. 2 W., about 8 miles west of Fairbanks. Named from adjacent Ester Creek.

Ester Lakes Graywackes, Slates, and Tuffs

Precambrian (Knife Lake Series): Northeastern Minnesota.

J. W. Gruner, 1941, Geol. Soc. America Bull., v. 52, no. 10, p. 1583 (table 1), 1611–1613. Name applied to thick series of graywackes, slates, and tuffs above Kekekabic [Lake] tuffs and agglomerates in Knife Lake synclinorium. Conglomerate lenses and agglomerates present. Slates are thin bedded; dark gray on fresh fracture. Graywackes grade into grit on one side and slate on the other; usually weather whitish to dirty brown. Thin bands of red jasper may be found between the tuffs and graywacke layers. They are the only red jasper beds observed in Knife Lake series. Estimated thickness of Ester Lake graywackes several thousand feet. In this report, Knife Lake series is divided into 20 members. Table of approximate chronological sequence (ascending) shows Ester Lake graywackes as unit 14 occurring above feldspar porphyry intrusives and below Crooked Lake pebble conglomerate.

Report discusses a belt in western Vermilion district more or less parallel to international boundary.

Estes System[1]

Precambrian: Southwestern South Dakota.

Original reference: J. J. Runner, 1934, Am. Jour. Sci., 5th, v. 28, p. 354–372.

J. R. Berg, 1946, South Dakota Geol. Survey Rept. Inv. 52, p. 3–4, geol. map. There are three systems of Precambrian sedimentary rocks in Black Hills. According to Runner (1934), these are (ascending) Nemo, Estes, and Lead.

Well exposed along Estes Creek, Black Hills.

Estes Park Beds

Precambrian: Eastern Colorado.

M. F. Boos, 1954, (abs.) Geol. Soc. America Bull., v. 65, no. 12, pt. 2, p. 1372. Estes Park beds of Big Thompson series of metasedimentary formations and Longs Peak (Silver Plume) and Mount Olympus granitic rocks constitute bedrock of Estes Park Valley.

Estes Park Valley east of Rocky Mountain National Park, Larimer County.

Esther Granite[1]

Paleozoic(?): Southeastern Alaska.

Original reference: U. S. Grant and D. F. Higgins, 1910, U.S. Geol. Survey Bull. 443, p. 39–41, 46.

Occupies greater part of Esther Island, at southern end of Port Wells, Prince William Sound region.

Estill Clay[1]

Estill Member (of Crab Orchard Clay Shales)

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

Original references: A. F. Foerste, 1905, Kentucky Geol. Survey Bull. 6, p. 145; 1906, Kentucky Geol. Survey Bull. 7, p. 10, 59.

A. C. McFarlan and D. J. Jones, 1952, Kentucky Geol. Survey, ser. 9, Bull. 10, p. 10, 13, 14. In much of outcrop along eastern flank of Cincinnati arch, Ohio shale rests on Estill clay; elsewhere Boyle limestone intervenes.

R. N. Thomas, chm., 1955, Kentucky Geol. Soc. Field Trip, p. 31 (fig. 11). Shown on generalized section of Serpent Mound region, Adams and Highland Counties, Ohio, as Estill member of Crab Orchard clay shales. Thickness 70 feet. Underlies Ribolt member; overlies Dayton limestone.

Type exposure: Northeast of Estill Springs, Estill County, Ky.

Etchegoin 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. Ocher-brown dirty and pebbly fossiliferous sands; intermediate unit of three overlapping facies. Paso Robles gravels grade laterally to fossiliferous Etchegoin sands, which in turn finger out in diatomaceous Pancho Rico shale.

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

Etchegoin Formation[1]

Etchegoin Beds, Group, or Stage

Pliocene, middle: Southern California.

Original reference (Etchegoin beds, including Etchegoin sands and San Joaquin clays): F. M. Anderson, 1905, California Acad. Sci. Proc., 3d ser., v. 2, p. 178–192.

W. F. Barbat and John Galloway, 1934, Am. Assoc. Petroleum Geologists Bull., v. 18, no. 4, p. 477 (table 1), 482–483. Formation restricted to exclude San Joaquin clay. Highest member of Etchegoin sand has been described as "upper *Mulinia*" zone, and top of upper zone is chosen as base of San Joaquin clay as this zone marks important lithologic and faunal change. Etchegoin sand rests with marked unconformity on Reef Ridge shale on Reef Ridge, southwest of Kettleman Hills.

W. P. Woodring, Ralph Stewart, and R. W. Richards, 1940, U.S. Geol. Survey Prof. Paper 195, p. 26–27, 55–75, pl. 3. There is no general agreement in classification and nomenclature of Pliocene strata underlying Tulare formation. Anderson (1905) originally divided them into two units, San Joaquin clays and Etchegoin sands, but he also used name Etchegoin in group sense (Etchegoin beds) for both. Arnold and Anderson (1910, U.S. Geol. Survey Bull. 398) divided this part of section into two formations, Etchegoin formation and Jacalitos formation, the latter embracing original part of Coalinga beds of Anderson (1905). Mapping in Kettleman Hills has shown desirability of recognizing as a separate unit the upper part of Etchegoin formation of Arnold and Anderson (1910, U.S. Geol. Survey Bull. 398). Because this unit corresponds to F. M. Anderson's San Joaquin clay, that name has recently been revived (Barbat and Galloway, 1934). Nomland (1917, California Univ. Dept. Geology Bull., v. 10, no. 14), Gester and Galloway (1933, Am. Assoc. Petroleum Geologists Bull., v. 17, no. 10), and Barbat and Galloway (1934) extended name to embrace Jacalitos formation—that is, they adopted Anderson's (1908, California Acad. Sci. Proc., 4th ser., v. 3) revised nomenclature with the exception that Etchegoin was not used in group sense. Reed (1933, Geology of California: Tulsa, Okla., Am. Assoc. Petroleum Geologists) raised Etchegoin to group rank and extended name Jacalitos to include Arnold and Anderson's Etchegoin minus the San Joaquin. In view of conflicting opinions and undesirable features of other schemes, a compromise involving restriction of name of Etchegoin to Arnold and Anderson's Etchegoin minus the San Joaquin is adopted in this report. This solution was reached independently by Goudkoff (1934, Am. Assoc. Petroleum Geologists Bull., v. 18, no. 4). Exposed part of formation has thickness of about 700 feet in North dome and estimated exposed thickness of about 600 feet in Middle dome. With exception of freshwater beds near top of formation in North dome, formation consists of marine deposits, principally sandstone and conglomerate, and silt. Faunal zones mapped.

I. F. Wilson, 1943, California Jour. Mines and Geology, v. 39, no. 2, p. 225 (fig. 4), 240–246. Discussion of geology of San Benito quadrangle. Term Etchegoin is herein used as group as Nomland (1917) used it to include the Jacalitos, Etchegoin, and possibly San Joaquin formations of Coalinga district, which cannot be distinguished lithologically in field in this region. One cartographic division is separated, a series of red beds 400 to 600 feet thick on nonmarine origin at base, which is quite different character from rest of group. Group lies chiefly in narrow belt, 2 miles wide, between San Andreas and San Benito fault zones. Here it reaches maximum thickness of 3,500 feet. In Sulphur Creek area, the Etchegoin extends 2 miles farther east, overlapping sediments of Butts Ranch syncline, but with reduced thickness of only 750 feet. Main belt, along San Benito River, continues northwest of quadrangle beneath San Benito gravels and reappears in Lomerias Muertos, northwest of Hollister. To the southeast, belt extends through Priest Valley and Waltham Canyon (where it has thickness of 8,000 feet) into Coalinga district. Basal red beds of main Etchegoin belt rest disconformably upon Santa Margarita formation southwest of San Benito

River. Eastern belt rests with as much as 90° angular discordance upon upper Cretaceous, middle Eocene, and middle Miocene sediments of Butts Ranch syncline. In some areas, in fault contact with Franciscan.

Umberto Young, 1943, California Div. Mines Bull. 118, pt. 3, p. 523, 524, (fig. 224). Unconformably overlies Belridge diatomite in Midway-Sunset area.

J. W. Durham, R. H. Jahns, and D. E. Savage, 1954, California Div. Mines Bull. 170, chap. 3, p. 60 (fig. 2). Chart shows Etchegoin megafaunal "stage" equivalent to Venturian microfaunal stage.

Name derived from Etchegoin Ranch, about 20 miles northeast of Coalinga, where formation is characteristically developed.

†Etchegoin Formation (broad sense)[1]

Pliocene: Southern California.

Original reference: F. M. Anderson, 1905, California Acad. Sci. Proc., 3d ser., v. 2, p. 178–192.

Occurs on summit and flanks of Anticline Ridge and on southeast end of Joaquin Ridge. Named for exposures in vicinity of Etchegoin Ranch, 20 miles northeast of Coalinga, in NW¼ sec. 1, T. 19 S., R. 15 E., Fresno County.

Etchegoin Sands[1]

Pliocene: Southern California.

Original reference: F. M. Anderson, 1905, California Acad. Sci. Proc., 3d ser., v. 2, p. 178–192.

Named for exposures in vicinity of Etchegoin Ranch, 20 miles northeast of Coalinga, in NW¼ sec. 1, T. 19 S., R. 15 E., Fresno County.

Etholen Conglomerate[1]

Etholen Formation (in Washita Group)

Lower Cretaceous: Western Texas.

Original reference: J. A. Taff, 1891, Texas Geol. Survey 2d Ann. Rept., p. 723, 736.

R. M. Huffington, 1943, Geol. Soc. America Bull., v. 54, no. 7, p. 992 (fig. 2), 1007–1009, pl. 1. Described as Etholen formation in northern Quitman Mountains. Consists of gray to black limestone conglomerate, with thin lentils and beds of arenaceous shale, buff to olive-brown sandstone, gray limestone, and red nodular limestone. Greatest thickness, about 500 feet, occurs on Etholen Hill, away from which formation becomes thinner. Conformably overlies Espy formation (new), contact sharp; upper contact of formation not exposed.

R. M. Huffington, 1947, Harvard Univ. Summ. of Theses, 1943–45, p. 196–197. Overlies Lasca formation (new).

Type locality: Etholen Knobs, northwest of Etholen section house, and in nearby small hills south of railway, in Quitman Mountains, Hudspeth County. Formation appears to occupy large syncline upon which central dome of Etholen Hill has been superimposed.

Etna Quartz Monzonite Porphyry[1]

Post-Carboniferous: Central Colorado.

Original reference: R. D. Crawford, 1913, Colorado Geol. Survey Bull. 4, p. 80.

M. G. Dings and C. S. Robinson, 1957, U.S. Geol. Survey Prof. Paper 289, p. 30. Name changed to Mount Aetna quartz monzonite porphyry because name Etna had previously been used elsewhere in United States for a rock unit. Spelling of Etna changed to Aetna to conform to that used on topographic base map of Garfield quadrangle.

Exposed on Mount Aetna (Etna), Garfield quadrangle, Chaffee County.

Etna Sandstone[1]

Pennsylvanian: Central Tennessee and West Virginia.

Original reference: J. J. Stevenson, 1904, Geol. Soc. America Bull., v. 15, p. 125, 201.

Extends on west side of basin north to middle Tennessee and on east side to probably 50 miles north from New River in West Virginia.

†Euchee phase[1]

Miocene, upper(?): Northwestern Florida.

Original reference: L. C. Johnson, 1893, Science, v. 21, p. 90–91.

Named for development at Eucheeanna, Walton County.

Euclid Siltstone Member (of Bedford Shale)

Euclid Sandstone Lentil (in Bedford Shale)[1]

Mississippian: Northern Ohio.

Original reference: W. F. Morse and A. F. Foerste, 1909, Jour. Geology, v. 17, p. 166.

Wallace de Witt, Jr., 1951, Geol. Soc. America Bull., v. 62, no. 11, p. 1356. Termed Euclid siltstone member; unit is of unknown areal extent and composed predominantly of massive light-bluish-gray coarse-grained siltstone and some very fine grained sandstones in beds from 3 to 18 inches thick. Maximum thickness about 20 feet. In lower part of the Bedford below Sagamore siltstone member; separated from underlying Cleveland member of Ohio shale by a few feet of dark-gray and black shale and some thin siltstones.

Named for Euclid Creek east of Cleveland, Cuyahoga County. Exposed from Independence Township Cuyahoga County, northeastward to Willoughby Township, Lake County.

Eudora Limestone[1]

Pennsylvanian: Eastern Kansas.

Original reference: J. Bennett, 1896, Kansas Univ. Geol. Survey, v. 1. p. 113.

Eudora Shale[1] Member (of Stanton Limestone)

Pennsylvanian (Missouri Series): Northeastern Kansas, south-central Iowa, northwestern Missouri, and southeastern Nebraska.

Original reference: G. E. Condra, 1930, Nebraska Geol. Survey Bull. 3, 2d ser., p. 12, 26, 27, 31, 34.

R. C. Moore, 1949, Kansas Geol. Survey Bull. 83, p. 68 (fig. 14), 118. Overlies Captain Creek limestone member; underlies Stoner limestone member (this is classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma, May 1947). Lower part consists of black fissile shale or in some places of dark clay shale containing thin carbonaceous layer: upper part is greenish to bluish gray and is soft and clayey. Thickness ranges from only 1 foot in some northern outcrops to 50 feet in part of Montgomery County, Kans.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 32. In Nebraska, underlies Dyson Hollow limestone zone or member (new) of Stoner limestone. Persistent in Kansas, Missouri, southeastern Nebraska, and south-central Iowa. Type locality stated.

Type locality: West of north-south side road where it joins the east-west Highway about 2 miles east of Eudora, Douglas County, Kans.

†Eufaula sands[1]

Upper Cretaceous: Southwestern Alabama and northeastern Mississippi.

Original reference: E. A. Smith, 1888, Alabama Geol. Survey Rept. Prog. 1884–1888 geographic map of Alabama.

Probably named for exposures at Eufaula, Barbour County, Ala.

Eugene Formation[1]

Oligocene, lower and middle: Northwestern Oregon.

Original reference: W. D. Smith, 1924, Econ. Geology, v. 19, no. 5, p. 462.

H. E. Vokes, P. D. Snavely, Jr., and D. A. Meyers, 1951, U.S. Geol. Survey Oil and Gas Inv. Map OM–110. As interpreted here, name is extended to include all marine Oligocene sands exposed in hills along southern margin of Willamette Valley. Also a few exposures on hills projecting above alluvium of valley floor, a belt of exposures along western margin of Coburg Hills, and a long tongue extending from area east of Spencer Butte southeastward to vicinity of Dorena Dam. Beds exposed in these outcrops form well-defined unit consisting primarily of coarse- to fine-grained highly arkosic, micaceous sandstones weathering to a yellow to orange-brown color. Thickness about 8,000 feet in hills along southern border of Willamette Valley. Beds have prevailing north-northwest strike and a northeast dip that averages between 10° and 15°. At all exposures mapped Eugene rests on tuffs of Fisher formation; contact is marked by soft friable, arkosic and quartzose sandstone that contains fossil wood. Evidence indicates Eugene and Fisher formations are contemporaneous.

R. E. Corcoran and F. W. Libbey, 1956, Oregon Dept. Geology and Mineral Industries Bull. 46, p. 7, pl. 1. Geographically extended into Salem Hills area where exposed thickness is about 2,200 to 2,500 feet. Unconformably overlain by Salem lavas (new).

I. S. Allison and W. M. Felts, 1956, Geology of the Lebanon quadrangle, Oregon (1:62,500): Oregon Dept. Geology and Mineral Industries. Thickness 400 to at least 2,000 feet in Lebanon quadrangle. Cut out by basic intrusives and unconformably overlain by Stayton lavas in northwestern part of quadrangle. Overlies Mehama volcanics. Oligocene.

U.S. Geological Survey currently considers the Eugene Formation to be lower and middle Oligocene.

Typically exposed in city of Eugene, Lane County.

Euless Member (of Woodbine Formation)

Euless Formation (in Woodbine Group)

Upper Cretaceous (Gulf Series): Northeastern Texas.

R. T. Hazzard, B. W. Blanpied, and W. C. Spooner, [1947], Shreveport Geol. Soc. 1945 Ref. Rept., v. 2, p. 475, 476, 477, 480. Defined as surface unit which intervenes between basal Pine Bluff member of the Lewisville and base of the Dexter sands. Upper part of formation is gray and dark fossiliferous shales and sandstones. In subsurface, unconformably overlies South Tyler formation. Designation of base of the Euless (base of Dexter sand member), both in surface and in subsurface, is a matter of opinion; in certain areas, base of the Dexter is considered base of the Gulf Cretaceous.

L. W. Stephenson, 1952, U.S. Geol. Survey Prof. Paper 242, p. 10. Rank reduced to member status and restricted to a shale unit, in part carbonaceous, with interbedded sandstone lenses, that forms upper part of the Euless as originally defined. Estimated thickness 45 or 50 feet.

Type locality: Town of Euless, Tarrant County.

Eulie Shale (in Chattanooga Shale)

Lower Mississippian: Central Tennessee.

Guy Campbell, 1946, Geol. Soc. America Bull., v. 57, no. 9, p. 885, pl. 1. Soft argillaceous shale in three gray, yellowish, or greenish layers, with top layer of nodules at Bransford; it is single layer of greenish shale with nodules at base at Westmoreland. Thickness 6 to 9 inches. Overlies Gassaway shale (new); underlies Westmoreland shale (new). The Eulie and Westmoreland are complementary in their stratigraphic relations; the absence of either would make determination of the status of the other way difficult.

W. H. Hass, 1956, U.S. Geol. Survey Prof. Paper 286, p. 11. Eulie shale is gray to greenish-gray mudstone that contains phosphatic nodules. Campbell held that this shale was of early Mississippian age, but present writer [Hass] classifies this shale as very late Devonian. Name Eulie shale is not used in present report [Chattanooga shale and Maury formation]; beds so named by Campbell are placed in Maury formation and not named.

Identified only at Bransford, Westmoreland, and Eulie, Sumner County.

Eunice Formation

Pleistocene: Southwestern Louisiana.

J. A. Doering, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 8, p. 1831. Name used for formation covering Lake Charles-Ville Platte-Opelousas-Lafayette area. Younger than newly defined Oberlin formation. Unit has been referred to as upper Beaumont.

Town of Eunice, St. Landry Parish, lies approximately in the center of the area.

Euphemia Dolomite[1] (in Durbin Group)

Middle Silurian: Southwestern Ohio.

Original reference: A. F. Foerste, 1917, Ohio Jour. Sci., v. 17, p. 187, 201, 202.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Shown on correlation chart as basal formation of group. Stratigraphically above Lilley formation.

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 Euphemia dolomite, 7 to 15 feet thick, above Massie shale and below Springfield dolomite. Niagaran.

Type locality: At quarry described as Lewisburg stone quarry, 1 mile northwest of Lewisburg, Preble County. Euphemia is one-half mile northwest of Lewisburg.

†Eureka Beds[1]

Pennsylvanian: Eastern Kansas.

Original reference: L. C. Wooster, 1905, The Carboniferous rock system of eastern Kansas.

Probably named for Eureka, Greenwood County.

†Eureka Limestone[1]

Lower, Middle, and Upper Cambrian and Lower Ordovician: Central northern Utah.

Original reference: G. W. Tower, Jr., and G. O. Smith, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 3, p. 622.

Tintic district.

†Eureka Limestone[1]

Pennsylvanian: Southeastern Kansas.

Original reference: E. Haworth, 1898, Kansas Univ. Geol. Survey, v. 3, p. 67, 73.

Named for Eureka, Greenwood County.

Eureka Quartzite[1]

Eureka Group

Middle to Upper(?) Ordovician: Northern Nevada, eastern California, and western Utah.

Original reference: A Hague, 1883, U.S. Geol. Survey 3d Ann. Rept., p. 253, 262.

C. W. Merriam, 1940, Geol. Soc. America Spec. Paper 25, p. 8 (table 1), 10–11. Underlies Hanson Creek formation (new) and overlies Pogonip limestone in Roberts Mountains region, Nevada.

G. S. Campbell, 1951, Utah Geol. Soc. Guidebook 6, p. 20, 21 (fig. 4). Underlies Fish Haven dolomite in Millard County, Utah. Thickness about 850 feet.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 29–32, pl. 2. Described in Eureka district where it is 300 to 350 feet thick, underlies Hanson Creek formation and overlies Pogonip group, but in some areas overlies Goodwin limestone and in others Antelope Valley limestone (new). Kirk (1933, Am Jour. Sci., 5th, v. 26) recognized inadequacy of outcrops in Eureka district proper and proposed that section along west base of Lone Mountain be chosen as new type locality. This redesignation has been accepted by U.S. Geological Survey and Lone Mountain section is commonly regarded as an appropriate standard section for comparative purposes.

R. L. Langenheim, Jr., and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2086 (fig. 2), 2087 (fig. 3), 2092–2095. In Independence quadrangle, California, Eureka group includes Barrel Spring formation, about 150 feet thick, in lower part and an undifferentiated part, about 200 feet, above. Overlies Pogonip group; underlies Ely Springs formation. Mohawkian.

J. F. McAllister, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–95. In Ubehebe Peak quadrangle, California, overlies Pogonip limestone and underlies Ely Springs dolomite. Thickness, 2½ miles north of quadrangle, 400 feet.

G. W. Webb, 1956, Utah Geol. and Mineralog. Survey Bull. 57, p. 13–14; 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 10, p. 2340–2342, 2343–2359. In Lone Mountain area, Eureka quartzite is restricted to the higher 181 feet of Kirk's (1933) section; lowermost 40 feet of post-Pogonip beds are placed in Copenhagen formation. Restricted Eureka is divided into three members which differ from Kirk's subdivision. Lower 35 feet is designated lower discolored quartzite member; middle 95 feet, white quartzite member; upper, gray quartzite member. Normally overlain by dark dolomites generally considered to be Cincinnatian. Correlations discussed.

H. R. Pestana, 1960, Jour. Paleontology, v. 34, no. 5, p. 109–112. Group includes Johnson Spring formation (new) which is name proposed for undifferentiated upper part of Eureka group of Langenheim and others (1956). Middle Ordovician.

F. L. Humphrey, 1960, Nevada Bur. Mines Bull. 57, p. 10 (fig. 3), 23–24, pl. 1. In White Pine district, overlies Pogonip formation of Mount Hamilton group (new); underlies Hanson Creek dolomite. Thickness 250 to 400 feet. Age of formation probably Middle Ordovician but may be Upper Ordovician in upper part.

U.S. Geological Survey currently considers the Eureka quartzite as Middle to Upper(?) Ordovician.

Standard section: Kirk's Lone Mountain section which is along west base of Lone Mountain, about 15 miles airline northwest of Eureka, Eureka County. Named for exposures at Eureka, Nev.

†Eureka Shale[1]

Devonian(?): Northern Arkansas.

Original reference: J. C. Branner and F. W. Simonds, 1891, Arkansas Geol. Survey Ann. Rept. 1888, v. 4, p. xiii, 26–27.

Named for Eureka Springs, Carroll County.

Eureka Tuff (in Silverton Volcanic Group)

Eureka Rhyolite (in Silverton Volcanic Series)[1]

Tertiary, middle and upper: Southwestern Colorado.

Original reference: Whitman Cross and Ernest 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, 77–78. Mainly in flows or welded tuffs. Maximum observed thickness near Eureka Gulch of 2,000 feet, thins out to west, north, and east. Typical exposure and geographical extent cited.

U.S. Geological Survey currently classifies the Eureka Tuff as a formation in the Silverton Volcanic Group and designates the age as middle and late Tertiary on the basis of a study now in progress.

Greatest and most typical exposure in steep walls of Animas Valley at and above Eureka Gulch. Widely distributed in Silverton quadrangle and extends eastward down Henson Creek as far as Lake City and for a few miles into San Cristobal quadrangle.

Eutaw Formation[1]

Eutaw Formation (in Selma Group)

Upper Cretaceous: Alabama, western Georgia, eastern and northern Mississippi, and western Tennessee.

Original reference: E. W. Hilgard, 1860, Miss. Geol. and Agric. Rept., p. 3, 61–68.

L. W. Stephenson and W. H. Monroe, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 12, p. 1642 (fig. 2), 1648–1649. Formation includes Tombigbee sand member at top. Underlies (west to east) Coffee sand, Mooreville tongue of Selma chalk, and Blufftown formation. Blufftown formation, as defined here, includes additional beds below Blufftown marl (as originally defined) that were correlated with upper part of Eutaw by Veatch (1909, Georgia Geol. Survey Bull. 18) and with "typical beds of Eutaw" by Stephenson (1911).

C. W. Cooke, 1943, U.S. Geol. Survey Bull. 941, p. 13–17. As herein described, formation in Georgia is restricted to beds that Stephenson (1911, Georgia Geol. Survey Bull. 26) thought lay below Tombigbee sand member but has since discovered that they are equivalent to it. Beds that Stephenson called Tombigbee sand member are herein called Blufftown formation. Eutaw is more than 100 feet thick. Base of formation is littoral deposit of coarse gray or iron-stained crossbedded sand; remainder consists chiefly of platy sandy clay and clayey sand. Unconformably overlies Tuscaloosa formation; uncomformably underlies Blufftown formation.

L. C. Conant and W. H. Monroe, 1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 37. Restricted at base to exclude glauconitic crossbedded sand, gravelly sand, and laminated clay beds herein named McShan formation.

W. E. Belt and others, 1945, Geologic map of Mississippi (1:500,000): Mississippi Geol. Survey. As mapped in Mississippi, includes Tombigbee sand member; overlies Tuscaloosa formation, undifferentiated.

W. H. Monroe, L. C. Conant, and D. H. Eargle, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 2, p. 188 (fig. 1), 207–210. Unconformably overlies McShan formation and apparently overlaps it toward north. Underlies Mooreville chalk. Includes Tombigbee sand member at top. Thickness about 175 feet.

D. H. Eargle, 1955, U.S. Geol. Survey Bull. 1014, p. 23–32. In Georgia, formation in Chattahoochee River valley consists of basal bed containing coarse grains of quartz sand and other detrital materials as well as borings of *Halymenites major*. Basal sand is overlain by dark-gray soft shale interbedded with fine white sand. Toward the east formation apparently becomes nonmarine and consists of pale-tinted sands containing a few thin beds of clay. Thickness about 125 feet in Chattahoochee Valley; thins toward the east, possibly owing in part to overlap, to about 77 feet in Marion County. East of Flint River, cannot be differentiated from overlying Blufftown formation. Overlies Tuscaloosa formation. Crops out along narrow belt from Chattahoochee River to Flint River; east of Flint River, forms base of sequence of rocks so similar lithologically that Eutaw and overlying rocks up to base of Ripley formation cannot be differentiated.

H. L. Reade, Jr., and J. C. Scott, [1948], Profile showing geology along U.S. Highway 331, Montgomery County, Alabama (1:16,000): Alabama Geol. Survey. Map legend shows Eutaw formation in Selma group.

W. S. Parks, 1960, Mississippi Geol. Survey Bull. 87, p. 22 (table 2), 30–40, pl. 3. Eutaw, in this report [Prentiss County], refers to strata between McShan formation below and Coffee formation above and includes two distinct units: the lower typical Eutaw beds, and Tombigbee sand member. Thickness 185 to 225 feet.

Named for Eutaw, Greene County, Ala.

Evacuation Creek Member (of Green River Formation)[1]

Eocene: Northeastern Utah and northwestern Colorado.

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

D. C. Duncan and Carl Belser, 1950, U.S. Geol. Survey Oil and Gas Inv. Map OM–119. Described in Piceance Creek basin, Colorado. Forms upper part of formation and contains alternating brown-weathering siltstone, sandstone, and gray marlstone near base but grades upward to predominantly sandstone and minor marlstone. In some reports, upper part of sequence in central part of basin has been tentatively assigned to Bridger formation. These upper beds are equivalent to upper part of Evacuation Creek member as identified near Parachute Creek. Because no convenient horizon was found to subdivide upper part of sequence penetrated by drilling, it is included in Evacuation Creek member. Thickness about 1,000 feet as recognized in well cuttings and surface sections. Overlies Parachute Creek member.

C. H. Dane, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 3, p. 413–416. Described in Duschesne, Uintah, and Wasatch Counties, Utah, where it is 600 to 865 feet thick and consists chiefly of bedded shale, mudstone, marlstone, siltstone, and sandstone. Includes Horse Bench sandstone bed. Overlies Parachute Creek member. Transitional and intertonguing relationships with overlying Uinta formation. Top of member rises toward central part of Uinta Basin as indicated by correlation of tuff beds. Contact selected arbitrarily and defined by reference to correlatable tuff beds here included in Evacuation Creek.

Named for exposures on Evacuation Creek, Utah.

Evans 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.

Probably named for Mount Evans, Clear Creek County.

Evans Creek coal series[1]

Eocene: Western central Washington.

Original reference: B. Willis, 1886, U.S. 10th Census, v. 15, pls. 81, 84.

Puget Sound region.

Evans Gulch Porphyry[1] (in Gray Porphyry Group)

Upper Cretaceous(?) or early Tertiary: Northern central Colorado.

Original reference: S. F. Emmons, J. D. Irving, and G. F. Loughlin, 1927, U.S. Geol. Survey Prof. Paper 148.

C. H. Behre, Jr., 1953, U.S. Geol. Survey Prof. Paper 235, p. 52–53, 57, pl. 1. Closely resembles Mount Zion porphyry. Probably no Mount Zion porphyry occurs in area here described [west slope of Mosquito Range], but possibly some highly altered rock on south slope of Prospect Mountain, here mapped as Evans Gulch porphyry, should be grouped with Emmons' Mount Zion 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 are either wholly or mainly Tertiary and only possibly in part late Cretaceous or early Pleistocene in age.

Named for exposures in Evans Gluch, east of Leadville, Rake County.

Evans Landing facies[1] (of Carwood Formation)

Lower Mississippian: Southern Indiana.

Original reference: P. B. Stockdale, 1931, Indiana Dept. Conserv., Div. Geology Pub. 98, p. 76, 167–169.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 127–128, pl. 2. Mississippian facies nomenclature discussed. Correlation chart lists Evans Landing as facies of Carwood formation.

Type section: Along steep ravine and cascade, cut into Ohio Valley bluff, north of road, center SE¼ sec. 4, T. 6 S., R. 5 E., 1½ miles north of Evans Landing, Harrison County.

†Evanston coal series[1]

Upper Cretaceous or Eocene: Southwestern Wyoming.

Original reference: C. A. White, 1870, U.S. Geol. and Geog. Survey Terr. 11th Ann. Rept., p. 240–241.

Exposed north of Evanston, Uinta County.

Evanston Formation[1]

Upper Cretaceous and Paleocene: Southwestern Wyoming.

Original reference: L. Lesquereux, 1876, U.S. Geol. and Geog. Survey Terr. Bull. 5, 2d ser., p. 244–248.

H. E. Wood 2d, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 19, pl. 1. Tentatively called Paleocene (Puercan); underlies Almy formation.

J. I. Tracey, Jr., and S. S. Oriel, 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 126–128. Veatch (1907 U.S. Geol. Survey Prof. Paper 56) showed formation limited to three small areas near Evanston. Present mapping shows fairly wide distribution of rocks lithologically and temporally equivalent to the Evanston within Fossil Basin. On east side of basin, unit may be traced for great distances where boulder beds dip 25° to 30° to west and form hogbacks. Along this belt, mapped as Almy formation by Veatch, the Evanston conformably overlies Adaville formation, but north of Kemmerer the boulder beds truncate large syncline in the Adaville. Thickness ranges widely due to lack of uniformity in deposition and to subsequent erosion; 1,200 feet near southern boundary of Kemmerer quadrangle, uppermost several hundred feet not present. Contact with overlying Wasatch formation poorly exposed; apparently gradational at type locality, but angular unconformity present at many places. Latest Cretaceous and Paleocene. Formation is significant because of its relation to structural framework of basin; it indicates that principal period of formation of basin extended from latest Cretaceous (Lance) through Paleocene; also dates at least part of orogeny in thrust belt as Late Cretaceous.

Well exposed north of Evanston, Uinta County.

†Evanstonian series[1]

Paleocene: Wyoming.

Original reference: C. R. Keyes, 1924, Pan-Am. Geologist, v. 41, p. 36. 65–66.

Evansville Sandstone Bed (in Wellington Formation)[1]

Permian: Central northern Oklahoma.

Original reference: J. M. Patterson, 1933, Am. Assoc. Petroleum Geologists Bull., v. 17, no. 3, p. 243, 251.

Exposed three-fourths mile east of Evansville.

Everett Member (of Nachusa Formation)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., figs. 3, 15B. Shown on columnar section as uppermost member of Nachusa formation; overlies Elm member (new); underlies Hazel Green member (new) of Quimbys Mill formation. Thickness 2 to 6 feet.

Occurs in the Dixon-Oregon area.

†Everett Schist[1]

Ordovician: Southwestern Massachusetts and northwestern Connecticut.

Original reference: W. H. Hobbs, 1893, Jour. Geology, v. 1, p. 717–736, 780–802.

Named for fact it has its maximum thickness within area of Mount Everett, Mass.

†Everglades Limestone[1]

Pleistocene: Southeastern Florida.

Original reference: W. H. Dall, 1892, U.S. Geol. Survey Bull. 84, p. 101, 154, 157, 325.

Probably named for the Everglades.

Evergreen 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 Evergreen mine, north of Evergreen Bluff, Ontonagon County.

Evergreen 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).

Occurs in Evergreen mine, north of Evergreen Bluff, Ontonagon County.

Everona Limestone[1]

Lower Ordovician: Northeastern Virginia.

Original reference: A. I. Jonas, 1927, Geol. Soc. America Bull., v. 38, p. 842.

Exposed from Mitchells Ford, on Rapidan River, to southwest of Rivanna River near Charlottesville, Albemarle County. Named for Everona, Orange County.

Eversole Chert[1] Member (of Columbus Formation)

Middle Devonian: Central Ohio.

Original reference: C. R. Stauffer, 1909, Ohio Geol. Survey Bull. 10, p. 72–74.

J. W. Wells, 1944, Geol. Soc. America Bull., v. 55, no. 3, p. 276 (fig. 1). Shown on generalized section as chert member of Columbus formation.

Wilber Stout and R. A. Schoenlaub, 1945, Ohio Geol. Survey, 4th ser., Bull. 46, p. 21. In Delaware County, underlies Klondike member; overlies Bellepoint member. Thickness 10 feet.

J. W. Wells, 1947, Ohio Jour. Sci., v. 47, no. 3, p. 121 (fig. 3). Shown on chart as underlying Delhi (Klondike) member and overying Bellepoint member.

Named for Eversole Run, Delaware County.

Everton Formation

Everton Formation (in Buffalo River Group)

Everton Limestone[1]

Middle Ordovician: Northern Arkansas and southern Missouri.

Original reference: A. H. Purdue, 1907, Geol. Soc. America Bull., v. 18, p. 251–256.

G. C. Branner, 1929, Arkansas Geol. Survey Geol. Map of Arkansas. Includes Calico Rock sandstone member (new).

H. S. McQueen, 1937, Missouri Geol. Survey and Water Resources 59th Bienn. Rept., app. I, p. 6, 9. Everton formation (sandstone and dolomite) included in Buffalo River Group.

J. A. Straczek and D. M. Kinney, 1950, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–1. Mapped in Batesville manganese district. Unconformably underlines St. Peter sandstone. Middle Ordovician.

E. B. Brewster and N. F. Williams, 1951, Guidebook to the Paleozoic rocks of northwest Arkansas: Arkansas Resources Devel. Comm., Div. Geology, p. 12, columnar section. Formation includes Kings River member in lower part and Newton sandstone member in upper part. Thickness about 400 feet. Overlies Powell dolomite; underlies Jasper limestone. Lower Ordovician.

E. E. Glick and S. E. Frezon, 1953, U.S. Geol. Survey Circ. 249, p. 4–6, measured sections. Formation described in Newton County, Ark., where it overlies Powell dolomite and underlies St. Peter sandstone. Thickness about 405 feet. Composed of four lithologic units (ascending): sequence of dolomite and sandstone, 245 feet exposed, base covered; Newton sandstone member, 8 feet thick; sequence of dolomite and sandstone, 80 feet thick; and Jasper member, 55 feet thick. Middle Ordovician.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 117. Basal formation in Buffalo River group. Underlies Jasper formation.

Named from Everton, Boone County, Ark.

Evington Group

Paleozoic(?): South-central Virginia.

W. R. Brown, 1953, Kentucky Geol. Survey, ser. 9, Spec. Pub. 1, p. 91 (fig. 1), 93. Includes (ascending) Candler formation (new), Joshua schist (new), Arch marble (new), Pelier schist (new), Mount Athos formation, and Slippery Creek greenstone (new). Overlies Precambrian. Paleozoic(?).

G. H. Espenshade, 1954, U.S. Geol. Survey Bull. 1008, p. 14, 15 (table 1), pl. 1. Comprises (ascending) Candler formation, Archer Creek formation (new), Mount Athos formation, and unnamed greenstone.

W. R. Brown, 1958, Virginia Div. Mineral Resources Bull. 74, p. 8 (fig. 2), 28–30, pl. 1. Age shown on columnar section as Lower Paleozoic(?).

Type locality: In vicinity of Evington, 11 miles southwest of Lynchburg, Campbell County. Lynchburg quadrangle.

Ewing Limestone Member (of Conemaugh Formation)[1]

Ewing Limestone (in Conemaugh Group)

Ewing limestone member

Upper Pennsylvanian: Southeastern Ohio, western Pennsylvania, and northern West Virginia.

Original reference: E. Orton, 1878, Ohio Geol. Survey, v. 3, p. 889, 890, 897, pls. facing p. 889, 900, 912.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 78, 95, 96, fig. 21. Ewing limestone in Conemaugh group. Overlies Pittsburgh red beds; separated from overlying Ames limestone by Harlem coal. Thickness in Fayette County, 5 to 10 feet.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 10 (fig. 3), 45–46, geol. map. In Morgan County, Ewing limestone member (Conemaugh series) is nonpersistent; stratigraphically overlies Cow Run sandstone and shale member; occurs from 6 to 11 feet below Barton coal and from 30 to 40 feet below Ames limestone. Thickness 6 inches to 4¾ feet.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 95 (table 11), 127–129. Member of Upper Bakerstown cyclothem in report on Athens County. Throughout outcrop area, the Ewing is represented by three lithologic varieties. First is single nodular layer 2 to 12 inches thick of light-gray to gray dense brecciated or sandy micaceous limestone. Second type includes layers but more commonly nodules and veins of limestone distributed in thicknesses of up to 15 feet of sandy shale and shaly sandstone. Third type comprises small nodules of limestone embedded in clay shale. Limestone in any of these types may be ferruginous. In Dover Township, a 6-inch layer of ironstone represents Ewing member. Overlies Cow Run sandstone member. Conemaugh series.

Named for Ewing Site, in Sunday Creek valley, Hocking or Perry County, Ohio.

Excello Formation (in Cabaniss Group)

Excello Formation (in Cherokee Group)

Excello Shale Member (of Senora Formation)

Pennsylvanian (Des Moines Series): Western and northern Missouri, southeastern Kansas, and northeastern Oklahoma.

W. V. Searight *in* W. B. Howe and W. V. Searight, 1953, Missouri Geol. Survey and Water Resources Rept. Inv. 14, pl. 1. Shown on stratigraphic column as uppermost formation in Cabaniss group. Underlies Blackjack Creek limestone member of Fort Scott formation; overlies Lagonda formation. Exposed in Carroll and Livingston Counties.

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 formation in Cabaniss group. Underlies Fort Scott formation of Marmaton group; overlies Mulky formation.

C. C. Branson, 1954, Oklahoma Geol. Survey Guide Book 2, p. 3, 5, 14 (fig. 4). Geographically extended into Oklahoma where it is at top of Senora formation. Overlies Breezy Hill limestone. Cabaniss group.

W. V. Searight, 1955, Missouri Geol. Survey and Water Resources Rept. Inv. 20, p. 31 (fig. 20), 35. Formation composed largely of black fissile shale which contains abundant flattened, phosphatic concretions and large biscuit-shaped concretions which measure a few feet in diameter. Thickness at type section about 4 feet. Underlies Blackjack Creek limestone member of Fort Scott; overlies Mulky formation. Type section designated.

W. B. Howe, 1956, Kansas Geol. Survey Bull. 123, p. 22 (fig. 5), 88–89. Geographically extended into Kansas. Thickness 2 to 5 feet. Uppermost division of Cabaniss subgroup of Cherokee group.

Type section: NW¼ sec. 30, T. 56 N., R. 14 W., 2.6 miles west of U.S. Highway 63, west of Excello, Macon County, Mo., in highwall of coal strip pit.

Excelsior Formation[1]

Middle Triassic(?): Southwestern Nevada.

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

H. G. Ferguson, S. W. Muller, and S. H. Cathcart, 1953, Geology of the Coaldale quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ-23]. Described in Coaldale quadrangle. Dominantly volcanic. Estimated thickness 12,000 feet, but no complete section present. Nowhere in contact with Lower Triassic Candelaria formation, and it is presumed that two are present on different plates of major thrust. In hills near Readlich, greenstone breccia with pillow lavas unconformably overlies Diablo formation and appears to mark base of Excelsior. On southern flank and crest of Pilot Mountains, formation is unconformably overlain by Jurassic Dunlap formation and in adjacent Mina quadrangle is unconformably overlain by Upper Triassic Luning formation. Tentative assignment of formation to Middle Triassic is based on fossils from interbedded limestone lens in volcanic rocks of Gillis Range, about 50 miles northwest, but lack of contact with Candelaria and presence of volcanic rocks of probable Permian age in Toyabe Range, 60 miles northeast, make assignment to Middle Triassic uncertain.

D. I. Axelrod and W. S. Ting, 1960, California Univ. Pub. Geol. Sci., v. 39, no. 1, p. 3. In fault contact with upper Pliocene Wichman formation (new).

Named for Excelsior Mountains, where formation is well exposed in Gold Range mining district, about 6 miles southwest of Mina, Mineral County.

Exeter Diorite[1]

Upper Devonian(?): Southeastern New Hampshire.

Original reference: C. H. Hitchcock, 1870, 2d Ann. Rept. Geol. New Hampshire, map and p. 32.

M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000): U.S. Geol. Survey. Probably belongs to New Hampshire plutonic series of Upper Devonian(?) age.

M. P. Billings, 1956, Geology of New Hampshire, pt. 2, Bedrock geology: Concord, New Hampshire State Plan. and Devel. Comm., p. 66, 187. Has average composition of granodiorite, though still termed diorite. Included in newly named Hillsboro plutonic series which is younger than Lower Devonian(?) and older than Mississippian(?).

Named for occurrence in Exeter Township, Rockingham County.

Exeter Sandstone[1]

Upper Jurassic: Western Oklahoma.

Original reference: W. T. Lee, 1902, Jour. Geology, v. 10, p. 45–46.

R. B. Johnson, 1959, U.S. Geol. Survey Bull. 1071–D, p. 94–95. Entrada sandstone can be traced from Huerfano Park area by surface exposures and subsurface data to type locality of Exeter sandstone in northwestern New Mexico. In view of wide usage of name Entrada sandstone, and general acceptance of correlation of Entrada sandstone with Ocate and Exeter sandstones, names Exeter and Ocate sandstones are herein abandoned for usage in southeastern Colorado and northeastern New Mexico and name Entrada sandstone used.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped in Cimarron County, Okla. Jurassic.

Named for exposures near Exeter post office [now called Johnson], Union County, N. Mex.

Exline cyclothem (in McLeansboro Group)

Pennsylvanian: Illinois and Iowa.

J. M. Weller, 1942, Illinois Acad. Sci. Trans., v. 35, p. 145. Cyclothem in McLeansboro group. In sequence above Gimlet cyclothem and below Trivoli cyclothem.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 119–121. Cyclothem includes Exline limestone and shale. Strata here referred to Exline cyclothem were formerly included in upper part of Gimlet cyclothem.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 54 (table 3). Term discontinued.

Named for Exline, Appanoose County, Iowa.

Exline Limestone (in Appanoose Group)

Exline Limestone (in Henrietta Group)

Exline Limestone (in Pleasanton Group)

Exline Limestone Member (of Modesto Formation)

Pennsylvanian (Missouri Series): Southern Iowa, northern and western Illinois, and northern Missouri.

L. M. Cline, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 62, 65–66. Limestone at top of Henrietta group. Upper 3 inches laminated lower 1 foot massive; dark blue gray, earthy, medium grained; well jointed, weathers brown and slabby; fossiliferous with *Chonetes* and white crinoid stems which contrast strongly with weathered yellow-brown matrix. Separated from underlying Cooper Creek limestone (new) by underclay, coal, and shale. Traced into northern Missouri.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 31). Shown on chart at top of Appanoose group in Iowa.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. v. (fig. 1), 10. In Pleasanton group, Missouri series.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 38, 49 (table 1). Member of Modesto formation (new). In northern western Illinois, overlies Lonsdale limestone member and underlies Trivoli sandstone member. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification independent of rock-stratigraphic classification.

Type locality: About 1½ miles south of southwest corner of Exline, Appanoose County, Iowa. Well exposed in west-flowing tributary ravine of North Shoal Creek, SE¼ sec. 6, T. 67 N., R. 17 W.

Extension Breccia (intrusive)[1]

Tertiary: Central Nevada.

Original reference: T. B. Nolan, 1930, Nevada Univ. Bull., v. 24, no. 4, p. 17.

Well exposed in Tonopah Extension mine, Tonopah district.

Eyer Formation (in Hatter Group)

Eyer Member (of Hatter Formation)

Middle Ordovician (Bolarian): South-central Pennsylvania.

G. M. Kay, 1943, Econ. Geology, v. 38, no. 3, p. 193. Lowermost member of formation. Dark impure limestone, partly calcarenite. Thickness 6 feet in type section. Underlies Grazier member (new); overlies Clover member of Loysburg formation.

G. M. Kay, 1944, Jour. Geology, v. 52, no. 1, p. 7–10. Relationship to Grazier member not definitely known. Unit is either truncated by the Grazier or represents an offlapping unit subsequently overlapped by that member. Thus, beds may be stratigraphically more closely related to Loysburg formation than to the Hatter, but are included in the Hatter because of strong lithologic similarity to Grazier member. Maximum thickness 37 feet. Derivation of name stated.

Marshall Kay, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8 p. [1402], 1407. Rank raised to formation in Hatter group or Hatterian subseries (Bolarian series).

Marshall Kay, 1956, Geol. Soc. America Bull., v. 67, no. 1, p. 82, 102. Discussed as a member.

Type section: On two sides of Pennsylvania Railroad cut north of Union Furnace, Huntingdon County. Named for Eyer, north of Union Furnace.

Fabius Group

Devonian or Mississippian: Missouri, Illinois, Indiana, Iowa, and Kentucky.

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. Proposed for those lower Kinderhookian strata which are variously referred to either Mississippian or Devonian system. In type area, in Mississippi Valley, group consists of (ascending) Grassy Creek shale, Saverton shale, and Louisiana limestone. Unconformably overlies strata ranging from Ordovician to Devonian age and, locally at least, is overlain unconformably by strata of Easley group (new).

L. E. Workman and Tracey [Tracy] Gillette, 1956, Illinois Geol. Survey Rept. Inv. 189, p. 14. Replaced by Champ Clark group (new).

M. G. Mehl, 1960, Denison Univ. Sci. Lab. Jour., v. 45, art. 5, p. 94. Weller and others (1948) proposed that the Kinderhook be considered a series and divided into two groups, the Easley and Fabius. The Easley was to include all Kinderhookian strata which are almost universally recognized to be of Mississippian age and the Fabius to include those Kinderhookian strata which are believed by some to be Mississippian but by others to be Devonian. Position of the committee in establishing two Kinderhook groups based on above distinction does not appear tenable. It is here recommended that terms Fabius and Easley groups be dropped from list of stratigraphic designations in Missouri.

Name derived from South Fabius River which flows from Knox through northern Marion County, Mo., where above formations are well exposed.

Fagasa Gabbro

Pliocene(?): Samoa Islands (Tutuila).

R. A. Daly, 1924, Carnegie Inst. Washington Pub. 340, p. 113–115. Elliptical body of gabbro with diameters of 100 to 200 meters. Cuts across older series of basalts.

H. T. Stearns, 1944, Geol. Soc. America Bull., v. 55, no. 11, p. 1296. Appears to be dike in Pago volcanic series (new), considered to be Pliocene or early Pleistocene(?).

G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 162. Pliocene(?).

Occurs on divide about 300 meters south of Pago Pago-Fagasa trail.

Fagundas Conglomerate[1]

Pennsylvanian: Pensylvania.

Original reference: J. F. Carll, 1875, Pennsylvania 2d Geol. Survey Rept. I, p. 38–40.

Occurs in hill tops at Fagundas, Warren County.

Fairbank Formation or Tongue (of Fountain Formation)

Pennsylvanian: Eastern Wyoming and southwestern South Dakota.

G. E. Condra, E. C. Reed, and O. J. Scherer, 1940, Nebraska Geol. Survey Bull. 13, p. 2 (fig. 2), 3, 32, 35, 44; R. L. Bates, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 10, p. 1990–1991. Consists of red sandstone or quartzite which is locally calcareous. Basal tongue of Fountain formation. Comprises Division VI of Hartville "formation" (Condra and Reed, 1935). Thickness 30 to 100 feet. Underlies Reclamation group (new); overlies Pahasapa limestone.

Type locality: North Platte River bluffs immediately north and northwest of site of abandoned village known as Fairbank, in sec. 27, T. 27 N., R. 66 W., Platte County, Wyo.

Fairbanks Loess

Quaternary: Central eastern Alaska.

T. L. Péwé, 1958, U.S. Geol. Survey Geol. Quad. Map. GQ–110. Massive, homogeneous, unconsolidated eolian silt. Buff to tan-gray when dry, brown when wet. Contains three white volcanic ash beds ½ inch to 6 inches thick. Thickness ranges from 3 feet on upper hill slopes to maximum of 200 feet on middle slopes and low hill tops.

Named from city of Fairbanks. Widespread on upper slopes and hilltops in northern one-half of Fairbanks (D-2) quadrangle. Excellent exposures in placer excavations in quadrangle, especially on Gold Hill, 8 miles west of Fairbanks, and in center sec. 8, T. 1 S., R. 2 W., 9 miles west of Fairbanks.

Fairbury Trachyte (in Garren Group)

Tertiary: Western Texas.

Hugh Hay-Roe, 1957, Texas Univ. Bur. Econ. Geology Geol. Quad. Map 21. Includes varied sequences of extrusive members in vicinity of Fairbury Draw on Bell ranch. Consists of four members: basal breccia about 140 feet thick; plagioclase trachyte member which varies in thickness from 190 to 390 feet; anorthoclase trachyte member about 100 feet thick; and tuff member (thickness not given). Overlies Pantera trachyte (new); underlies Means trachyte (new).

Composite type section: East face of Garren Mountain for basal breccia; north face of Buck Mountain for plagioclase trachyte member; southeast bank near mouth of Fairbury Draw for anorthoclase trachyte member; east face of Blanquito Hill and west slope of hill east-northeast of Bell's ashpit for tuff member, Culberson County.

Fairfax[1] (coalbearing rocks)

Eocene: Western Washington.

Original reference: W. F. Jones, 1914, Geol. Soc. America Bull., v. 25, p. 122.

Probably named for town of Fairfax, Pierce County.

Fairfax Formation[1]

Pennsylvanian (Conemaugh): Northern West Virginia and western Maryland.

Original reference: N. H. Darton and J. A. Taff, 1896, U.S. Geol. Survey Geol. Atlas, Folio 28.

Exposed around Fairfax, Grant County, W. Va.

Fairfax Limestone[1]

Pennsylvanian: Northern West Virginia.

Original reference: D. B. Reger, 1923, West Virginia Geol. Survey Rept. Tucker County, p. 130, 149, 156.

Visible near summit of Fairfax Knob, Grant County.

Fairfax Schist

Precambrian(?): Northern Vermont.

E. C. Jacobs, 1935, (abs.) Geol. Soc. America Proc. 1934, p. 85. Fine-grained schist. Outcrop belt several miles wide. At eastern margin is in undertermined contact with Mount Mansfield series of schist and gneisses.

Present in Green Mountain area.

†Fairfield coal group (in Mesaverde Group)[1]

Upper Cretaceous: Northwestern Colorado.

Original reference: E. T. Hancock and J. B. Eby, 1930, U.S. Geol. Survey Bull. 812C, p. 206, 208-230.

In Meeker, Axial, and Monument Butte quadrangles. Named for Fairfield mine, Meeker quadrangle.

Fairfield Member (of Canajoharie Formation)

Fairfield Slate[1]

Middle Ordovician (Mohawkian): East-central New York.

Original reference: Lardner Vanuxem, 1842, Geology New York, pt. 3, p. 56–60.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 270–271, pl. 4. Redefined as shale member at top of Canajoharie formation. Includes upper three graptolite zones of the formation; uppermost is Fort Plain zone. At type locality of the Canajoharie, member contains conspicuous set of five metabentonites in lower part. Higher up, beds become interbedded black shales and gray-weathering silty shales; include metabentonites. Composed of silty and sandy beds in Minaville section where upper limit is uncertain. Maximum thickness at least 450 feet. Overlies Minaville member (new) of Canajoharie formation; underlies Utica formation. Extends westward as gradationally overlapping tongue of the formation passing through the Dolgeville interbedded facies into upper Denmark member (new) of Sherman Fall formation. Derivation of name.

Named for Fairfield Township, Herkimer County.

Fairfield Member (of Cuyahoga Formation)[1]

Mississippian (Kinderhook): South-central Ohio.

Original reference: J. E. Hyde, 1915, Jour. Geology, v. 23, p. 656, 657, 671.

F. T. Holden, 1942, Jour. Geology, v. 50, p. 45. Included in Hocking Valley conglomerate facies. Consists of thick coarse- and medium-grained sandstones alternating with shale layers commonly of equal thickness with the sandstones. Thickness of each sandstone may be as much as 65 feet. Overlies Lithopolis sandstone member; underlies Black Hand conglomerate member.

Named from development in Fairfield County.

Fairhaven Diatomaceous Earth Member (of Calvert Formation)

Fairhaven Member (of Calvert Formation)[1]

Miocene, middle: Eastern Maryland.

Original reference: G. B. Shattuck, 1904, Maryland Geol. Survey, Miocene Volume, p. lxxii.

Lincoln Dryden and R. M. Overbeck, 1948, Maryland Dept. Geology, Mines and Water Resources [Repts.] Charles County, p. 53–56. Described in Charles County where it is about 75 feet thick at Popes Creek. Of this total, only one bed, 17 feet thick, contains more than an insignificant proportion of diatoms; it is suggested that term Fairhaven member be used for lower part of Calvert formation and "diatomaceous earth" or "diatomite" be reserved for the one bed containing a high percentage of diatoms.

Named for Fairhaven, Anne Arundel County.

Fairlee Quartz Monzonite

Fairlee Granite Gneiss[1]

Ordovician: East-central Vermont and west-central New Hampshire.

Original reference: E. J. Foyles and C. H. Richardson, 1929, Vermont State Geologist 16th Rept., table facing p. 288.

M. P. Billings, 1937, Geol. Soc. America Bull., v. 48, no. 4, p. 499. Belongs to Highlandcroft magma series.

J. B. Hadley, 1950, Vermont Geol. Survey Bull. 1, p. 22. Described as coarse-grained greenish-gray quartz monzonite with local pink tinges. Generally appears more or less crushed and foliated; converted to phyllonite on margins of the body. Age designated probably Upper Ordovician. Extends into New Hampshire. Type locality given.

Type locality: Strikingly exposed on cliffs known as the Palisades in Fairlee, Orange County, Vt.. Forms several prominent hills in Mount Cube quadrangle in Bradford, Vt., and Piermont, N.H.

Fairmont Shale Member (of Hennessey Shale)[1]

Permian: Central northeastern Oklahoma.

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

Named for exposures near Fairmont, Garfield County.

†Fairmount Gneiss[1]

Precambrian: Southeastern Pennsylvania.

Original reference: T. D. Rand, 1887, Pennsylvania 2d Geol. Survey Ann. Rept. 1886, p. 1601–1603.

Forms hill at Fairmount, in vicinity of Philadelphia.

Fairmount Limestone (in McLeansboro Formation)[1]

Pennsylvanian: Central eastern Ilinois.

Original reference: E. F. Lines, 1912, Illinois Geol. Survey Bull. 17, p. 59, 75.

Crops out over area of less than 2 square miles near Fairmount, Vermilion County.

Fairmount Limestone Member (of Fairview Formation)[1]

Fairmount Formation (in Maysville Group)

Upper Ordovician: Southwestern Ohio, southeastern Indiana, and northern Kentucky.

Original reference: J. M. Nickles, 1902, Cincinnati Soc. Nat. History Jour., v. 20, p. 78.

J. B. Patton, T. G. Perry, and W. J. Wayne, 1953, Indiana Geol. Survey Field Conf. Guidebook 6, pl. 1. Fairmount formation, in Maysville group, shown on generalized stratigraphic column of Ordovician and Silurian rocks exposed in Jefferson and Switzerland Counties. Limestone, blue, thick bedded at top; contains minor amounts of shale. Thickness 30 to 60 feet. Occurs above Mount Hope formation and below Bellevue formation. Cincinnatian.

Named for Fairmount, a part of Cincinnati, Ohio.

†Fairmount Slate[1]

Upper Cambrian: Northwestern Georgia.

Original reference: H. K. Shearer, 1918, Georgia Geol. Survey Bull. 34, map opposite p. 43.

Named for development about Fairmount, Gordon County.

Fairplay Glacial Substage

Pleistocene (Wisconsin): Central Colorado.

Q. D. Singewald, 1950, U.S. Geol. Survey Bull. 955–D, p. 103, 123, 125, 128, pl. 9 [1951]. The times of maximum ice advance and of the two principal ice stands during retreat are called Fairplay, Briscoe, and Alma substages, respectively of Wisconsin stage of glaciation.

In northwestern Park County.

Fairplay Member (of Dunleith Formation)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., p. 33, fig. 3. Shown on columnar section as underlying Mortimer member (new) and overlying Eagle Point member (new).

Occurs in Dixon-Oregon area.

Fairport Chalky Shale Member (of Carlile Shale)[1]

Upper Cretaceous: Western Kansas and southeastern Colorado.

Original reference: W. W. Rubey and N. W. Bass, 1925, Kansas Geol. Survey Bull. 10, p. 16, 40.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 24. Thickness 85 feet in Russell County to 147 feet in Hamilton County. Underlies Blue Hills shale member; overlies Greenhorn limestone.

T. G. McLaughlin, 1954, U.S. Geol. Survey Water-Supply Paper 1256, p. 121. In Baca County, Colo., consists of alternating beds of chalky limestone and tan platy to fissile chalky shale.

Named for exposures a few miles south and west of Fairport, Russell County, Kans.

Fairview Diorite[1]

Tertiary: Central southern Colorado.

Original reference: W. Cross, 1896, U.S. Geol. Survey 17th Ann. Rept., pt. 2, p. 291.

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 dikes cutting earlier andesite, Bald Mountain dacite flows, rhyolite in dikes, eruptive channels and flows, Pringle andesite, trachyte flows, and Bassick agglomerate.

Named for Mount Fairview, Silver Cliff-Rosita Hills region.

Fairview Formation (in Maysville Group)[1]

Fairview Formation (in Covington Group)

Fairview Member (of Martinsburg Formation)

Upper Ordovician: Southwestern Ohio, southeastern Indiana, north-central Kentucky, and Pennsylvania.

Original reference: R. S. Bassler, 1906, U.S. Natl. Mus. Proc., v. 30, p. 10.

R. S. Bassler, 1919, The Cambrian and Ordovician deposits of Maryland: Maryland Geol. Survey, p. 157, 173. Martinsburg shale in southern Pennsylvania and Maryland include a lower Maysville division (Fairview) consisting of fossiliferous gray sandstone with *Orthorhynchula linneyi* beds at top. Thickness 300 feet. Overlies Eden division; underlies upper Maysville division (Oswego sandstone).

Bradford Willard and A. B. Cleaves, 1939, Geol. Soc. America Bull., v. 50, no. 7, p 1175, 1176, 1177, 1183. Upper member of Martinsburg formation in Pennsylvania. Thickness 135 to 246 feet. Overlies beds of Eden and older in lower part of formation. Underlies Bald Eagle member of

Juniata formation, transitional. Massive sandstone at top of Martinsburg in Schuylkill Gap area is herein named Shochary sandstone member. Lithologically, stratigraphically, and faunally, it appears to be correlate of Bassler's Fairview sandstone in south-central section but it is not traceable through.

Wilber Stout, Karl Ver Steeg, and G. F. Lamb, 1943, Ohio Geol. Survey, 4th ser., Bull. 44, chart facing p. 108. Shown on generalized column of Ohio as overlying Latonia formation of Eden group. Thickness 115 feet. Includes (ascending) Mount Hope and Fairmount members.

W. C. Sweet and others, 1959, Jour. Paleontology, v. 33, no. 6, p. 1029–1030. Middle formation of Covington group. Overlies Eden formation; underlies McMillan formation. Fairview and McMillan formations constitute standard for median Cincinnatian Maysville stage.

R. R. Pulse and W. C. Sweet, 1960, Jour. Paleontology, v. 34, no. 2, p. 237–264. Fairview formation (Bassler, 1906) has been divided into two members (ascending) Mount Hope and Fairmount (Nickles, 1902). These units were originally distinguished by their contained bryozoan faunas, the Mount Hope being the "*Amplesopora septosa beds*" and the Fairmount the "*Dekayia aspera* beds." Formation consists of 100 to 120 feet of thin alternating beds of bluish-gray fossiliferous limestone and greenish-gray shale. Individual beds are both laterally and vertically gradational, and a number of different structural types of both limestone and shale occur within formation. In general, shale beds are thicker and limestone beds correspondingly thinner in lower 50 to 60 feet than in upper 60 to 70 feet. As a result, formation can be crudely subdivided into two members of about same thickness, which correspond roughly, at least in type section, to Nickles' (1902) Mount Hope and Fairmount divisions. In present study, more calcareous upper Fairview has been assigned to the Fairmount, and shalier lower Fairview has been regarded as Mount Hope. In sections where this interval is well exposed, the level of first appearance of *Strophomena planoconvexa* was considered to mark boundary between the two members. Overlies Eden formation; underlies McMillan formation. Conodonts described.

Named for Fairview Heights, Cincinnati, Ohio.

†Fairview Shale[1]

Lower Devonian: Colorado.

Original reference: J. M. Hill, 1909, U.S. Geol. Survey Bull. 380, p. 24, 35–36.

J. W. Gabelman, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 8, p. 1584. Term Fairview facies could be applied to lower part of Parting quartzite member of Chaffee formation in northern Sangre de Cristo Range. This part of Parting has been termed Elbert facies but name Fairview facies is more applicable as Lower Devonian Fairview shale is geographically nearer to region discussed.

Named for fact that shale forms hanging wall in Fairview mine located 7½ miles northwest of Pitkin, Gunnison County. Crops out in Quartz Creek district.

Fairview Valley Formation

Permian: Southern California.

O. E. Bowen, Jr., *in* L. A. Wright and others, 1953, California Jour. Mines and Geology, v. 49, pl. 2. Shown on columnar section as unconformably underlying Sidewinder volcanic series (new) and unconformably overlying Oro Grande series. Thickness about 6,075 feet.

O. E. Bowen, Jr., 1954, California Div. Mines Bull. 165, p. 16 (fig. 2), 36–42, pls. 1, 3, 7. Described as tightly folded series of clastic and limy sediments including dark-gray limestone conglomerate, gray-green hornfelsed, silty and sandy limestones, and dense black limestone in thin lenses. Intruded and overlapped by volcanic rocks of Triassic(?) Sidewinder volcanic series (new).

Type section: Fairview Valley, Barstow quadrangle, San Bernardino County. Crops out over area of approximately 3 square miles north and northwest of Southwestern Portland Cement Co.'s Reserve quarry and west of Sidewinder gold mine.

Fais Limestone

Pleistocene or Quaternary (early Holocene): Caroline Islands (Fais).

Risaburo Tayama, 1939, Correlation of the strata of the South Sea Islands: Geol. Soc. Japan Jour., v. 46, no. 549, p. 347. (correlation chart) [English translation in library of U.S. Geol. Survey]; 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 68, table 5 [English translation in library of U.S. Geol. Survey, p. 82–83]. Named on correlation chart. Elevated coral reef limestone. Younger than Caroline limestone. Principally coral limestone; lesser amount of *Halimeda* limestone. Pleistocene.

S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 31. Early Holocene.

Fais (Feys) Island. Constitutes second, third, and fourth terraces on island.

Fajardo Formation

Fajardo Shales[1]

Upper Cretaceous: Puerto Rico.

Original reference: C. P. Berkey, 1915, New York Acad. Sci. Annals, v. 26, p. 61.

C. A. Kaye, 1959, U.S. Geol. Survey Paper 317–A, p. 7 (table 2), 10 (fig. 4), 27–29, pl. 2. Termed Fajardo formation in San Juan area because shale is not prevalent lithology. Consists of light-colored ashy siltstone, siliceous siltstone, and chert, interfingering graywacke, conglomerate, and impure limestone. A little south of Río Guaynabo section, massive to stratified purplish-gray tuff, interbedded in upper part of section, that may be equivalent of Meyerhoff's and Smith's San Diego formation, are included in the Fajardo because it seems that the typical ashy siltstone is only a facies and that formation consists of wide range of rock types forming an interfingering sequence. Maximum thickness, Trujillo Alto Road, estimated 3,000 feet; northwest of Guaynabo, 1,885 feet. Overlies Figuera volcanics; contact conformable in some places, but in others angularity exists. No fossils found. Believed to be Paleocene or Eocene.

H. L. Berryhill, Jr., R. P. Briggs, and Lynn Glover, 3d, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 2, p. 141–143. Fajardo formation of this report includes both Fajardo shales of Berkey and underlying volcanic sandstones that Meyerhoff (1931, New York Acad. Sci., v. 1, pt. 3) apparently called Luquillo formation of Cretaceous age. Formation crops out in northeastern corner of island across nose and along northwestern limb of dissected northeast-trending anticline underlying Luquillo Range and adjacent areas. Base is obscured by faulting, and contact relation with underlying volcanic complex not known. Rocks tentatively correlated with Fajardo formation crop out in central Puerto Rico in faulted blocks that lie across main axis of Puerto Rico anticlinorium. Basal contact with volcanic complex in central Puerto Rico appears to be unconformable. Between these two areas, rocks equivalent to Fajardo appear to have been removed by faulting and subsequent erosion. Thickness of formation and equivalent strata ranges from about 8,000 feet in eastern part of island and 6,500 feet in central Puerto Rico to only a few feet in southernmost outcrops in south-central part of island. Includes Aguas Buenas limestone member at base in central Puerto Rico. Upper Createaceous.

Named for outcrops in vicinity of Fajardo, in northeastern part of island.

Falcon Granite Gneiss

Precambrian: Central northern Colorado.

M. F. Boos, 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1179. Invaded Idaho Springs and younger Precambrian formations, preceding Mt. Evans quartz monzonite.

Denver Mountain Park Area.

Falcon Limestone Member (of Lykins Formation)

Falcon Tongue (of Minnekahta Limestone in Lykins Formation)

Permian: North-central Colorado and southern Wyoming.

L. W. LeRoy, 1946, Colorado School Mines Quart., v. 41, no. 2, p. 31, 33. fig. 7. Impure limestone containing numerous thin, irregular, varvelike laminae of red silt ranging in thickness from paper thin to one-tenth inch. Locally several 2-inch seams of vuggy limestone contain black brittle bituminous material. Unit represented at Ralston Creek by unindurated irregularly interlaminated red and gray calcareous silt. Thickness ranges from 2 to 3½ feet. At type locality, unit lies 46 feet stratigraphically below base of Glennon limestone (new) and 58 feet above Lyons formation. Underlies Bergen shale member (new); overlies Harriman shale member (new).

T. L. Broin, 1958, Dissert. Abs., v. 19, no. 1, p. 114. Designated tongue of Minnekahta limestone in Lykins formation. Underlies Glendo shale member of Lykins. Falcon tongue extends at least from Horse Creek, Wyo., southward to Red Creek Canyon, which is between Colorado Springs and Canyon City, Colo.

Type locality: In west fork of Glennon Canyon, Golden-Morrison area, Jefferson County, Colo. Named from Mount Falcon in southwest part of Morrison quadrangle, sec. 9, T. 5 S., R. 70 W., about 2½ miles southwest of town of Morrison.

Falcon Sandstone Member (of Cook Mountain Formation)

Eocene (Claiborne): Western Texas.

J. M. Patterson, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 2, p. 259 (fig. 2), 263. Proposed for upper 500 feet, approximately, of Cook Mountain formation. Characterized by massive crossbedded fossiliferous marine sandstone beds. Underlies La Perla shale member (new) of Yegua formation; overlies Veleno member (new) of Cook Mountain formation.

Named for town of Falcon, on American bank of Rio Grande, 2 miles north of Starr-Zapata County line.

Falkirk Dolomite[1] (in Bertie Group)

Falkirk Member (of Bertie Formation)

Upper Silurian: Western New York.

Original reference: G. H. Chadwick, 1917, Geol. Soc. America Bull., v. 28, p. 173–174.

L. V. Rickard, 1955, New York State Geol. Assoc. Guidebook 27th Ann. Mtg., p. 7. Member of Bertie formation. Continues eastward into Fiddlers Green dolomite member.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. Formation in Bertie group. Overlies Oatka shale; underlies Scajaquada shale. Field work has not demonstrated lateral continuity of Falkirk and Fiddlers Green as shown on present chart. Thick glacial deposits conceal these units in area where they may merge (north of Seneca Lake). Possibility of facies change should not be overlooked. At present time, distinct names are retained for western and central New York.

Derivation of name not stated. Falkirk is in Erie County.

Fall Creek Conglomerate Lentil (of Chemung Formation)[1]

Upper Devonian: Northeastern Pennsylvania and central southern New York.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. G_5, p. 74–79, 82, 98, 100, 236.

Bradford Willard, 1939, Pennsylvania Geol. Survey Bull. G–19, p. 300. White (1881) thought that Cascade sandstone, which he recognized in lower Chemung in Susquehanna County, might be equal to Fall Creek conglomerate previously described by Sherwood (1878, Pennsylvania 2d Geol. Survey, v. G) from northern Bradford and Tioga Counties. Because Fall Creek is now considered to be at top of Chemung, this correlation seems unlikely, nor is either the Fall Creek or the Cascade to be correlated with Cuba sandstone, because the Cuba is still higher, at base of Conneaut group. White placed Fall Creek below New Milford formation by 200 to 325 feet, an obvious error if the Fall Creek of White was the same as that of Sherwood. Present study would place Fall Creek below the Luthers Mills by about 50 feet. Hence, it should be very near contact between beds of highest Chemung and lowest Canadaway.

Type locality: Falls Creek, Bradford County, Pa.

Falling Run Member (of Sanderson Formation)

Mississippian (Kinderhookian): Southeastern Indiana and northern Kentucky.

Guy Campbell, 1946, Geol. Soc. America Bull., v. 57, no. 9, p. 835, 848–849, 857–858. Consists of phosphatic nodules and is final phase of Sanderson; represents near-shore facies resulting from retreat of sea around Cincinnati dome. Thickness commonly less than 1 foot. Stratigraphic position is beneath Underwood formation (new), but in most of southern Indiana the Underwood is absent, and Falling Run is overlain by Henryville formation (new). Overlain by New Providence shale in Kentucky.

Type section: On Falling Run Creek, at end of Market Street, New Albany, Floyd County, Ind. Traced from Ohio River north to Uniontown, Jackson County, Ind., and south and east through Kentucky to Irvine, Estill County.

Falling Springs Sandstone Member (of New Scotland Formation)

Lower Devonian: Central Pennsylvania.

F. M. Swartz, 1938, (abs.) Geol. Soc. America Bull., v. 49, no. 12, pt. 2, p. 1923; 1939, Pennsylvania Geol. Survey, ser. 4, Bull. G–19, p. 57, 67, 83. Medium-bedded solid calcareous sandstone. Thickness 23 feet at type locality. Underlies Mandata shale and chert (new). Derivation of name given.

Named for Falling Springs, Perry County, where best exposed.

Fallis Sandstone Member (of Wellington Formation)[1]

Permian: Northeastern Oklahoma.

Original reference: J. M. Patterson, 1933, Am. Assoc. Petroleum Geologists Bull., v. 17, no. 3, p. 243, 248.

D. A. Green, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 12, p. 1522 (fig. 2). Included in Minco division of Permian.

H. D. Miser and others, 1954, Geologic Map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped as Fallis sandstone member of Wellington formation.

Named for town of Fallis, sec. 29, T. 15 N., R. 2 E., Lincoln County.

Fall River Formation (in Inyan Kara Group)

Fall River Sandstone Member (of Colorado Shale)

Fall River Formation (in Dakota Group)

Fall River Sandstone (in Inyan Kara Group)[1]

Lower Cretaceous: Western South Dakota and northeastern Wyoming.

Original references: W. L. Russell, 1927, Am. Jour. Sci., 5th, v. 14, p. 402; 1928, Econ. Geology, v. 23, no. 2, p. 135–137.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 15 (fig. 7). Shown on columnar section as basal member of Omadi sandstone (new). Underlies Skull Creek member; overlies Fuson shale.

W. A. Cobban, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 10, p. 2170, 2173–2175, 2197 (fig. 2). Formations in Black Hills that are equivalent to Colorado shale are Fall River sandstone, Skull Creek shale, Newcastle sandstone, Mowry shale, Belle Fourche shale, Greenhorn formation, Carlile shale, and Niobrara formation. Fall River sandstone and equivalent rocks discussed in northern Black Hills, central and northwestern Montana.

K. M. Waagé, 1958, Wyoming Geol. Assoc. Gundebook 13th Ann. Field Conf., p. 71–76. Discussion of regional aspects of Inyan Kara stratigraphy. Fall River sandstone overlies Fuson-Lakota sequence and underlies Skull Creek sandstone.

R. E. Davis and G. A. Izett, 1958, Am. Assoc. Petroleum Geologists Bull. v. 42, no. 11, p. 2745–2756. Formation in northern Black Hills consists of about 120 to 140 feet of well-bedded siltstone, silty claystone, and very fine- to fine-grained sandstone. Subdivided into three and locally four units. Includes Keyhole sandstone member (new) in upper part.

Underlies Skull Creek shale; overlies sequence of lensing and interfingering continental deposits of claystone, siltstone, and sandstone that seem genetically related to underlying Morrison formation and which have been referred to variously as Lakota and Fuson formations undifferentiated, or Lakota formation. Separated from underlying rocks by nearly planar surface of transgressive disconformity.

K. M. Waagé, 1959, U.S. Geol. Survey Bull. 1081–B, p. 58–64, 79–81. Fall River formation (Dakota sandstone of Darton) is redefined so that its basal contact conforms to the transgressive disconformity [see Dakota group] and formation becomes upper part of twofold division of Inyan Kara group as herein redefined. In terms of Russell's (1928) definition of Fall River and Darton's interpretation of the Dakota in Fall River area, the redefinition consists of shift downward in basal contact. In terms of remainder of the Inyan Kara outcrop, redefined Fall River would include, locally, a variable thickness of shale and thin-bedded sandstone, which Darton included in the Fuson. Russell's (1928) definition included "the sandstone and interbedded shales of post-Fuson age lying below the base of the Graneros shales." Russell included Quarry sandstone (Ward, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 2) in these beds. That is, he followed Darton's restriction of the latter's Dakota formation in Fall River Canyon inasmuch as base of Quarry sandstone marked Fuson contact in both classifications. Russell gave type locality "at Evan's Quarry." Actually there are two Evan's quarries both abandoned. The newer quarry shows only face of the massive sandstone and a few of beds above, whereas original Evan's quarry shows the massive sandstone and, in a gully leading from it, all beds beneath it to basal contact of Fall River formation. Good exposures of formation above Quarry sandstone are present a short distance downstream on northeast side of river below falls formed by Quarry sandstone. This general area in vicinity of the falls and the two quarries is here included as part of type locality. Thickness at type locality 158 feet where it overlies Lakota formation and underlies Skull Creek shale. Throughout Black Hills, formation maintains thickness of 110 to 160 feet. Basal contact sharply delimited by transgressive disconformity. Upper contact commonly an abrupt change from sandstone to gray sandy shale, which grades within 5 to 15 feet to black clay shale typical of Skull Creek. Contact, even where relatively sharp is conformable. In southern and eastern Black Hills, formation has threefold subdivision because of tongue of continental beds similar to Lakota formation.

W. A. Pettyjohn, 1960, (abs.) South Dakota Acad. Sci. Proc., v. 38, p. 34–38. Dakota controversy discussed. Suggested that term Dakota group be used to include Lakota, Fuson, Fall River, Skull Creek, and Newcastle formations.

U.S. Geological Survey currently classifies the Fall River as a member of the Colorado Shale in Montana on the basis of a study now in progress.

Type locality: Exposures in bluffs of Fall River in area of the falls and Evan's quarries which lie on opposite sides of river just above the falls. All exposures are in N½ sec. 33, T. 7 S., R. 6 E., Hot Springs quadrangle, Fall River County, S. Dak.

Fall River Sandstone[1]

Pennsylvanian: Southeastern Kansas.

Original reference: Robert Hay, 1887, Kansas Acad. Sci. Trans., v. 10, p. 7, cross section.

Named for Fall River, Greenwood County.

Falls Formation[1]

Lower Ordovician: Central southern Oklahoma.

Original references: E. O. Ulrich, 1928, Manuscript chart exhibited at New York Meeting of Geol. Soc. America; 1930, U.S. Natl. Museum Proc., v. 76, art. 21, p. 73.

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

Named for exposures on Falls Creek, sec. 33, T. 1 S., R. 2 E., Murray County.

Falls City Limestone (in Admire Group)

Falls City Limestone (in Admire Shale)[1]

Falls City Limestone Member (of Chicago Mound Formation)

Permian: Southeastern Nebraska and eastern Kansas.

Original reference: G. E. Condra and N. A. Bengston, 1915, Nebraska Acad. Sci. Pub., v. 9, no. 2, p. 9, 17, 30.

G. E. Condra, 1935, Nebraska Geol. Survey Paper 8, p. 5, 9. Rank raised to formation in Admire group. Includes (ascending) Miles limestone, Reserve shale, and Lehmer limestone member.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 37. Rank reduced to member status in Chicago Mound formation (new). Includes Miles limestone, Reserve shale, and Lehmer limestone as beds. Thickness about 9 feet.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 52. Underlies West Branch shale; overlies Hawxby shale.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2274 (fig. 1). Falls City limestone underlies West Branch shale member of Janesville shale (new); overlies Hawxby shale member of Onaga shale (new). Wolfcamp series.

Type locality: In Lehmer quarry, sec. 32, 2½ miles south and 1½ miles west of Falls City, Richardson County, Nebr.

Falls City Shale[1]

Eocene (Jackson): Southeastern 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. 2631. Replaced by Conquista clay member (new) of McElroy formation. Name Falls City preempted.

Type locality: West of Falls City, in bed of San Antonio River, forming falls of the river, Karnes County.

†Falls Creek Formation[1]

Lower Ordovician (Chazy): Central southern Oklahoma.

Original reference: C. E. Decker and C. A. Merritt, 1931, Oklahoma Geol. Survey Bull. 55, p. 12, 98.

Arbuckle and Wichita Mountains.

Falls Mills Limestone (in Hinton 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. 295, 338.

Type locality: Along Bluestone River slightly northwest of Falls Mills, Tazewell County, Va. Also observed in Summers County, W. Va.

Falls Mills Sandstone (in Hinton Formation[1] or Group)

Falls Mills Sandstone (in Pennington 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. 295, 335.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5, pl. 2, columns 97–99. Shown on correlation chart as sandstone in Pennington formation in southwest Virginia; occurs below Princeton sandstone and above Avis limestone.

Type locality: In edge of Tazewell County, Va., just west of Falls Mills Station; makes falls across Bluestone River.

Falls Mills Shale (in Hinton 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. 295, 336.

Type locality: Along Bluestone River slightly northwest of Falls Mills, Tazewell County, Va. Also observed in Mercer and Summers Counties, W. Va.

Falor Formation

Pliocene: Northwestern California.

G. A. Manning and B. A. Ogle, 1950, California Div. Mines Bull. 148, p. 7, 14 (fig. 2), 22–25, pls. 1, 2. Poorly consolidated marine sandstones, clays, silts, and conglomerates. Thickness 750 to 2,000 feet; upper 200 feet are red beds. In fault contact with Franciscan. Beds strike approximately N. 40° W., and dip homoclinally about 20° NE. Name replaces term Boulder formation as used by authors in unpublished theses.

Type locality: Along Maple Creek near Falor Ranch, Blue Lake quadrangle, Humboldt County.

Fan Mountain Glaciation

Recent: Northern Alaska.

R. L. Detterman, A. L. Bowsher, and J. T. Dutro, Jr., 1958, Arctic, v. 11, no. 1, p. 45, 57, 60 (table 1), figs. 3, 10. Six glacial advances recognized in northern Brooks Range and on Arctic Slope. Fan Mountain represents most recent glacial advance recorded in region. Preceded by Alapah Mountain glaciation (new). Moraines are fresh, bare of tundra, and generally restricted to cirque areas. Kettle lakes present behind a few of the moraines. Small glaciers confined to higher, larger, and mainly north-facing cirques characterized the glaciation.

Named for glacial deposits at thresholds of cirques in vicinity of Fan Mountain, 13 miles south of Shainin Lake. Moraines appear to be present in many cirques in higher parts of Brooks Range, generally above altitude of 4,600 feet in vicinity of Alapah Mountain.

Fannettsburg Member (of Shippensburg Formation)

Middle Ordovician (Bolarian): South-central Pennsylvania and western Maryland.

L. C. Craig, 1959, Geol. Soc. America Bull., v. 60, no. 4, p. 715 (fig. 1), 722–727. Name proposed for middle member of formation. Described at type locality as light- to dark-gray medium-grained to coarsely crystalline limestone in platy to massive beds. Shows two intertonguing facies; dark and fine grained in eastern belts of outcrop, and lighter medium to coarsely crystalline in western belts. Crude vertical zoning also present in western belts; lower part typically medium gray, rather thick-bedded coarse calcarenite with layers of *Solenopora* conglomerate, and upper part dark-gray cross-laminated fine calcarenite in platy beds. Contains four metabentonite beds in eastern outcrops. Maximum thickness 263 feet; 39 feet at type locality. Conformably overlies Pinesburg member (new); conformably underlies Doylesburg member (new) in type section and disconformably underlies Mercersburg formation in eastern belts.

Type section: Exposure on south side of U.S. Route 30, 1 mile southwest of St. Thomas, Franklin County, Pa. Named for the exposure east of Pennsylvania Route 75, 2.6 miles southwest of Fannettsburg in Path Valley.

Fanney Rhyolite[1]

Tertiary: New Mexico.

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

Named for prominent outcrops in vicinity of Fanney mine, on Fanney Hill, Mogollon district.

Fant Meta-Andesite[1] or **Andesite**

Lower Jurassic: Northern California.

Original reference: J. S. Diller, 1908, U.S. Geol. Survey Bull. 353.

E. D. McKee and others, 1956, U.S. Geol. Survey Misc. Geol. Inv. Map. I–175, p. 5 (table 2). Fant andesite overlies Hardgrove sandstone; underlies Thompson limestone. Lower Jurassic.

Named for an unidentified locality near Taylorsville, Plumas County.

Fant Tuff Member (of Catahoula Tuff)[1]

Oligocene or Miocene, lower: Southwestern Texas.

Original reference: T. L. Bailey, 1926, Texas Univ. Bull. 2645, p. 46, 65, 66–80, 178–179.

H. H. Cooper, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 11, p. 1432. Principally volcanic tuff. Thickness 100 feet. Underlies Soledad member; overlies Frio formation.

Named for exposures near Fant City, northern Live Oak County.

Fantastic Lava Beds

Cenozoic: Northern California.

Howel Williams, 1932, California Univ. Pub., Bull. Dept. Geol. Sci., v. 21, no. 8, geol. map. Named on geologic map.

Mapped in Lassen County, northeastern part of Lassen Volcanic National Park.

Farallon Quartz Diorite

[Upper Cretaceous]: Western California.

G. H. Curtis, J. F. Evernden, and J. Lipson, 1958, California Div. Mines Spec. Rept. 54, p. 9. Name applied to quartz diorite exposed on Farallon Islands. These outcrops have been regarded by geologists as the ancient core of a mountain range which once extended along coast of California and which supplied sediments for Franciscan formation and for many of Cretaceous formations. Age determination by potassium-argon method 89.5 million years.

Farallon Islands are off the coast of California near San Francisco Bay.

Faraway Ranch Formation

Faraway Ranch Series

Cenozoic: Southeastern Arizona.

H. E. Enlows, 1951, Tulsa Geol. Soc. Digest, v. 19, p. 106 (fig. 1). Series comprises (ascending) buff pahoehoe biotite dacite—thickness 400 feet; basalt breccia—175 feet; lapilli tuff—200 feet; soft white rhyolite tuff—10 feet; and hard pink rhyolite tuff—10 feet in Rhyolite Canyon section, Chiricahua National Monument. Uncomformably underlies Rhyolite Canyon series (new).

H. E. Enlows, 1955, Geol. Soc. America Bull., v. 66, no. 10, p. 1217, 1221 (table 2). Formation overlies Bonita Park formation (new) in Hands Pass region just east of Chiricahua National Monument. Most of rhyolite deposits of Cenozoic age in Monument, heretofore termed flows, are more correctly classified as welded rhyolite tuff or ignimbrite, the result of many eruptions of nuées ardentes. Thickness at least 800 feet. Underlies Rhyolite Canyon formation. Probably correlative with Blacktail formation (new). Derivation of name given.

F. F. Sabins, 1957, Geol. Soc. America Bull., v. 68, no. 10, p. 1325–1327, pl. 1. In Cochise Head and Vanar quadrangles, all but minor part of formation consists of volcanic flows and agglomerate. Lenses of lacustrine deposits and stream-deposited tuff constitute minor part. Lacustrine deposits comprise a red clastic sequence and a light-colored sequence containing fresh-water limestone. In southeast part of the area, formation overlies Nipper formation (new), but to the north and west it unconformably overlies Bisbee group. Late Cretaceous to late Tertiary.

Named from outcrops near Faraway Ranch on lower Bonita Canyon, a short distance west of Chiricahua National Monument, Cochise County.

Farewell Glaciation

Pleistocene: Central southern Alaska.

A. T. Fernald *in* T. L. Péwé and others, 1953, U.S. Geol. Survey Circ. 289, p. 6–7, 13 (table 1); A. T. Fernald, 1960, U.S. Geol. Survey Bull. 1071–G, p. 222, 225–233. Two major glaciations of western part of Alaska Range recognized in Upper Kuskokwim region. The younger, Farewell, succeeded Selatna glaciation (new). Represented along South Fork of Kuskokwim River by prominent moraines; along Middle Fork by two moraines; and along West Fork by single V-shaped moraine which lies in broad open valley within mountainous area. Twofold division of Farewell glaciation, which is well displayed on piedmont slope along South and Middle Forks, may represent two distinct glaciations.

Along South Fork of Kuskokwim River near Farewell; also along Middle and West Forks. In Upper Kuskokwim region. Named after settlement of Farewell on Sheep Creek, just outside moraines of South Fork.

Fargo Limestone[1]

Pennsylvanian: Southeastern Nebraska and southwestern Iowa.

Original reference: G. E. Condra and N. A. Bengston, 1915, Nebraska Acad. Sci. Pub., v. 9, no. 2, p. 15, 26, 27.

Type locality: Prominent cliff in valley side near Fargo, Richardson County, Nebr. Exposed between Weeping Water Valley and Walnut Creek, from 4 miles northwest of Fargo to near Rulo, and in spur south of Rulo, Richardson County, Nebr.

Fargo Canyon Diorite

Upper Jurassic: Southern California.

W. J. Miller, 1944, California Jour. Mines and Geology, v. 40, no. 1, p. 12, 44, 45, 59–60. Massive to moderately foliated. Cut by granite and pegmatitic granite dikes which are offshoots of White Tank and San Jacinto batholiths. Probably a correlative of Bradley granodiorite (new). In Little San Bernardino Mountains, the Fargo Canyon cuts Chuckwalla complex (new).

Named for exposures in Fargo Canyon, Little San Bernardino Mountains, northeast of Indio, Riverside County.

Farisita Conglomerate

Oligocene(?): Southeastern Colorado.

R. B. Johnson and G. H. Wood, Jr., 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 4, p. 709 (fig. 2), 718. Consists of buff conglomeratic sandstone and siltstone beds. Individually beds are lenticular and highly cross-laminated and show limonite stains on bedding surfaces. Conglomeratic fragments range in size from pebbles to 8-foot boulders and are subangular to rounded and very poorly sorted. Rocks generally poorly cemented. Ranges in thickness from thin edge to about 1,200 feet. Unconformably overlies Huerfano formation and older rocks of Cenozoic, Mesozoic, and Precambrian age. Unconformably underlies Devils Hole formation.

Robert Berner and L. I. Briggs, 1958, (abs.) Geol. Soc. America Bull., v. 69, no. 12, pt. 2, p. 1533. Detailed mapping demonstrated that accurately dated Huerfano formation interfingers with Farisita formation in central part of basin. This dates Farisita as late early Eocene (Wasatchian), middle Eocene (Bridgerian), and probably late Eocene. Uppermost beds of formation may be still younger.

Named from exposures along Turkey Creek north of town of Farisita. No more specific type section reported or described owing to nature of outcrops, which are very scarce and discontinuous. Occurs entirely within Huerfano Park.

Farland[1] (limestone)

Lower Cretaceous: Montana.

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

Farley Limestone Member (of Wyandotte Limestone)

Farley Limestone Bed (in Lansing? Formation)[1]

Farley Limestone Member (of Lane Shale)

Pennsylvanian (Missouri Series): Northwestern Missouri, southwestern Iowa, eastern Kansas, and southeastern Nebraska.

Original reference: H. Hinds and F. C. Greene, 1915, Missouri Bur. Geology and Mines, v. 13, 2d ser., p. 29, 155.

H. S. McQueen and F. C. Greene, 1938, Missouri Geol. Survey and Water Resources, 2d ser., v. 25, pl. 5. Shown on chart as member of Lane shale. Thickness 2 to 10 feet. Underlies Bonner Springs shale member; overlies Island Creek shale member.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2031 (fig. 4), 2033; F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. vi (fig. 2), 14. According to interstate agreement, Farley limestone is classified as uppermost member of Wyandotte limestone. Overlies Island Creek shale member; underlies Bonner Springs shale.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 25, fig. 5. Uppermost member of Wyandotte limestone. Comprises two or three gray argillaceous limestone beds separated by thin shales and varies considerably in thickness. Thickness about 2 feet in Madison County; more than 7 feet in Union County. Overlies Island Creek shale; underlies Bonner Spring shale.

Named for exposures near Farley, Platte County, Mo.

Farm Creek Intraglacial Substage

Pleistocene (Wisconsin): North-central United States.

M. M. Leighton, 1960, Jour. Geology, v. 68 no. 5, p. 549, 550. Name applied to Farmdale-Iowan intraglacial substage. Represented by black soil, wood, and peat that overlie Farmdale silt and underlie Iowan and Tazewell (Peorian) loess. This report also gives consideration to other classifications of the Wisconsin including one proposed by Frye and Willman (1960).

Named for Farm Creek, Tazewell County, Ill.

Farmdale Stade, Loess

Farmdale Drift, Till, Silt

Farmdale Substage, Subage, Glaciation

Farmdalian Substage

Pleistocene (Wisconsin): Mississippi Valley.

M. M. Leighton, 1947, *in* Itinerary State Geologists Conf. on loess deposits-Illinois portion, p. [8]. Names Farmdale(?) and Farmdale loess(?) listed on correlation chart.

M. M. Leighton and H. B. Willman 1950, Jour. Geology, v. 58, no. 6, p. 602–603. Silt deposit which lies on weathered zone and erosional slopes of Illinoian drift and which has very youthful profile of weathering beneath Peorian loess was described by Leighton (1926, Jour. Geology, v. 34) as late Sangamon loess. This is unit named Farmdale (Leighton, 1948, *in* H. L. Wascher, R. P. Humbert, and J. C. Cady, Soil Sci. Soc. America Proc., v. 12, p. 390). Farmdale substage and loess are pro-Wisconsin. Farmdale is older than Iowan. Loess has definite valley relationships to Illinois River valley (ancestral Mississippi), present Mississippi Valley below mouth of Illinois River and Wabash and lower Ohio Valleys. Such a relationship suggests a valley-train source. This, in turn, implies an extension of an ice sheet during Farmdale into drainage basin of ancestral Mississippi prior to Iowan substage but not yet recognized in series of drift sheets because it fell short of subsequent ice lobes.

J. C. Michelson, 1950, Iowa Acad. Sci. Proc., v. 57, p. 268–269. Loess, exposed in sec. 31, Magnolia Township, Harrison County, Iowa, believed to be equivalent to Farmdale loess of Illinois as defined by Leighton. Thickness 4 feet. Overlies Loveland loess; underlies Iowan loess. A section which shows similar succession of loesses is exposed near St. Charles, Mo. These loesses are called Loveland, Farmdale, and Peorian.

P. R. Shaffer, 1954, Science, v. 119, no. 3098, p. 693–694; 1956, Illinois Geol. Survey Rept. Inv. 198, p. 13–24. Part of glacial drift in northern Illinois formerly mapped as Illinoian is Farmdale in age, the earliest substage of Wisconsin stage. Drift sheet consists of till and widespread deposits of water-laid materials in form of kames, eskers, and kame terraces. So far as known, this is first reported occurrence of glacial drift of Farmdale age. This drift is uppermost drift in northern half of Boone County, in all but small areas in southeastern and northwestern Winnebago County, southeastern Stephenson County, northern Ogle County, and small areas in eastern Carroll and northern Whiteside Counties. The loess (Peorian) cover which varies from a few inches to about 5 feet is usually leached. Farmdale drift passes beneath Shelbyville drift.

G. E. Ekblaw and H. B. Willman, 1955, Illinois Acad. Sci. Trans., v. 47, p. 129–138. Farmdale drift described in vicinity of Danville.

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 the Farmdale substage. Intermediate group of ages ranges 14,000 to 17,000. A possible interpretation of radiocarbon dates from Iowa places Iowan substage in older position than Farmdale, rather than younger, as hitherto believed. Farmdale is dated in Iowa at 24,500 years B. P.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 174. Discussion of Wisconsin glaciation in Illinois River valley. Farmdale (sub-age, glaciation) is oldest of five advances. Pinkish-colored Farmdale loess was leached to depth of 7 feet before deposition of overlying Peorian loess in those few places where its thickness was that great. Farmdale subage was followed by Iowan subage.

L. R. Ray, 1957, Jour. Geology, v. 65, no. 5, p. 542–544. Farmdale loess recognized in section at Medora, Ky. Thickness about 5 feet. Overlies Loveland loess; underlies Tazewell loess.

J. C. Frye and H. B. Willman, 1960. Illinois Geol. Survey Circ. 285, p. 1, 2, 3, 6, 11–12. Presentation of revised time-stratigraphic classification of Wisconsinan stage of Lake Michigan lobe. Wisconsinan consists of (ascending) Altonian (new), Farmdalian, Woodfordian (new), Twocreekan, and Valderan substages. Farmdalian substage is based on Farmdale slit exposed in Farm Creek area, Tazewell County. Deposits in this stratigraphic position have been known since the last century and for many years were assigned to late Sangamon. Rock-stratigraphic unit, Farmdale silt, consists of massive silt, noncalcareous, light-brown to pale-purple, that commonly contains wood fragments and is locally replaced by peat. Although some Farmdale silt probably was initially deposited as loess during Farmdalian time, it is believed that much of it was derived by water transport and colluvial action from older Roxana loess (new). Radiocarbon dates from Farmdale silt and peat range from 26,150±600 (W–381) to 22,900±900 (W–68). On the basis of these dates, their positions within Farmdale deposits, and dates from both younger and older deposits, it is herein suggested that the range of radiocarbon years for Farmdalian substage is 28,000 to 22,000. Although till in several areas (Shaffer, 1956; Ekblaw and Willman, 1957 [1955]) has been referred to the Farmdale, present data indicate absence of till of Farmdalian age. It is here concluded that the Farmdalian is the major interval of glacial withdrawal within Wisconsinan as developed in Lake Michigan lobe rather than an episode of glacial advance.

W. D. Thornbury, 1958, Am. Jour. Sci., v. 256, no. 7, p. 457. Possibility exists that some of till that has been considered Tazewell in age in upper Wabash Valley may be Farmdale or Iowan.

M. M. Leighton, 1960, Jour. Geology, v. 68, no. 5, p. 529–540. Presentation of classification of Wisconsin glacial stage of north-central United States. Farmdale glacial substage, oldest in sequence, is separated from Iowan glacial substage by Farm Creek intraglacial substage (new). Author [Leighton] does not agree with classification presented by Frye and Willman (1960); among the reasons cited one (1) C–14 dates of large pulmate land snails in Roxana silts of Frye and Willman are in question; (2) C–14 dates of wood from black soil, peat, and muck, heretofore referred to as Farmdale substage, belong to boreal Farmdale-Iowan intraglacial substage, the overlying loess being Iowan; (3) no deposit of Wisconsin age intervenes between Farmdale materials Sangamon weathered zone; (4) only humus forest bed, peat, and related materials separate Farmdale loess and drift from deposits below from Iowan loess and Iowan drift above; and (5) Iowan substage is not datable by spurious fragments of wood found in its base but is shown by stratigraphic and other geologic evidence to be younger than Farmdale.

Name amended to Farmdale Stade to comply with Stratigraphic Code adopted 1961.

Named from exposure in Farm Creek section near Farmdale, Tazewell County, Ill.

Farmers Siltstone Member (of New Providence Formation)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 77, 125–126, 128, 129, 130. Even-bedded uniform-grained siltstones generally 25 to 35 feet thick. Included in Bluestone facies (new) of the formation. In type area, underlies 15-foot unnamed shale and siltstone unit and overlies Henley shale member of New Providence formation.

Well exposed at quarry of Rowan County Freestone Co. and adjacent hillside, at village of Farmers, about 6 miles southwest of Morehead, Rowan County. Named for village of Farmers.

Farmington Complex

See Farmington Canyon Complex.

Farmington Sandstone Member (of Kirtland Shale)[1]

Upper Cretaceous: Northwestern New Mexico and southwestern Colorado.

Original reference: C. M. Bauer, 1916, U.S. Geol. Survey Prof. Paper 98–K.

Harley Barnes, E. H. Baltz, Jr., and P. T. Hayes, 1954, U.S. Geol. Survey Oil and Gas Inv. Map OM-149. Described in Red Mesa area, La Plata and Montezuma Countries, Colo. Middle member of Kirtland; overlain and underlain by unnamed shale members. Consists of thin- to massive-bedded lenses of sandstone separated by shale and sandy silty shale. Thickness about 345 feet.

Well exposed near Farmington, San Juan County, N. Mex.

Farmington Shale Member (of Modesto Formation)

Farmington Shale (in McLeansboro Formation)[1]

Farmington Shale (in McLeansboro Group)

Pennsylvanian: Western and northern Illinois.

Original reference: T. E. Savage, 1927, Am. Jour. Sci., 5th, v. 14, p. 309.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 116, 189, 190, 191, 193, 194, 195. Shale is gray to olive green; commonly contains gray ironstone concretions as much as 2 inches thick by 1 foot in maximum diameter. Maximum thickness 50 feet. Locally, in Glasford quadrangle, entirely cut out by Gimlet sandstone. Included in Sparland cyclothem. Overlies Sparland (No. 7) coal, which in turn overlies Copperas Creek sandstone. In McLeansboro group. Derivation of name given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 38, 49 (table 1), pl. 1. Reallocated to member status in Modesto formation (new). Underlies Gimlet sandstone member. Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois.

Type locality: Outcrops in Farmington Township, T. 8 N., R. 4 E., Fulton County.

Farmington Canyon Complex

Precambrian: North-central Utah.

A. J. Eardley, 1939, Geol. Soc. America Bull. v. 50, no. 8, p. 1282, pl. 1, Rocks of Farmington Canyon complex crop out in mouth of Little Cottonwood Canyon.

A. J. Eardley and R. A. Hatch, 1940, Jour. Geology, v. 48, no. 1, p. 59 (fig. 3), 61–72. Name given to large group of crystalline rocks in north-central Utah area. Rocks are distinctly stratified throughout region. Contains metamorphosed mafic rocks, injection gneisses, silicic igneous rocks, and metamorphosed sedimentary rocks. Type locality stated.

A. J. Eardley and R. A. Hatch, 1940, Geol. Soc. America Bull., v. 51, no. 6, p. 810 (fig. 3), 815. In Willard Canyon [between Ogden and Brigham City] underlies Tintic quartzite.

A. J. Eardley, 1944, Geol. Soc. America Bull., v. 55, no. 7, p. 823, 827. Thickness about 10,000 feet. Underlies an ancient sequence which is probably Upper Proterozoic and in part Lower Cambrian.

R. E. Cohenour, 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 34–36, 37 (fig. 2). Precambrian rocks of western Uinta Mountains and central and northern Wasatch Mountains are divisible into two main groups. Older group is divisible into two sequences: older, Farmington Canyon complex, and younger, Little Willow series. Most of the description of Farmington Canyon is based on an unpublished thesis by Larsen (1957).

Type locality: Farmington Canyon and Bountiful Peak, Davis County.

Farm Ridge Drift

Pleistocene (Wisconsin): Northern Illinois.

H. B. Willman and others, 1942, Illinois Geol. Survey Bull. 66, p. 145 (fig. 85), 146 (fig. 86), 161–162. Largely till but includes sand and gravel as lenses in the till, in kames, in one large esker, in subglacial channels, and as outwash deposits in front of the moraine and overlying the ground moraine; till is medium to light gray, yellowish, or brownish, silty, clayey. Thickness in Farm Ridge moraine commonly 30 to 40 feet, although in some of higher hills as much as 60 feet; in ground moraine commonly 5 to 15 feet. Overlies Bloomington till. [Report lists six drifts in the Tazewell; for sequence see under Shelbyville.]

Named for Farm Ridge post office at one time located on prominent part of moraine about 5 miles west of Grand Ridge in Farm Ridge Township, Streater quadrangle, La Salle County.

Farragut Limestone

Middle Ordovician: Northeastern Tennessee.

C. E. Prouty, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 7, p. 1156–1157. Proposed for coarsely crystalline variegated limestone, or marble (of Knoxville and surrounding area) which overlies Lenoir limestone (restricted) and underlies Tellico sandstone. Thickness 115 feet. Zone has been referred to stratigraphically as "Holston" marble in this area and represents principal zone quarried for commercial "Tennessee marble"; just east of Knoxville along Holston River, Keith (1895) assigned name "Holston" to lentils of variegated marble occurring within Chickamauga limestone; since term was originally assigned to type of lithology occurring at different horizons, term "Holston" is of no significance as definite formational unit.

Type section: Appalachian Marble Co. quarry, 1.4 miles due east of Lowes Ferry. Named for site of Admiral Farragut homestead at Lowes Ferry on Tennessee River 9.5 miles southwest of Knoxville.

Farrer Formation

Farrer Member or facies (of Price River Formation)

Farrer Noncoal-Bearing Member (of Price River Formation)[1]

Upper Cretaceous: Central eastern Utah and central western Colorado.

Original reference: D. J. Fisher, 1936, U.S. Geol. Survey Bull. 852.

Teng-Chien Yen, 1954, U.S. Geol. Survey Prof. Paper 254–B, p. 59, 60, 62. Listed in fossil collection locality data both as formation and as member of Price formation.

R. G. Young, 1955, Geol. Soc. America Bull., v. 66, no. 2, p. 187, 191–192, figs. 2, 3, pl. 3. Beds of coarse to fine sandstone, shale, and sandy shale. Do not contain appreciable coal although a few thin beds found at various horizons. Lenslike sandstones constitute bulk of rocks and are somewhat darker than sandstones in Neslen facies. Shales mostly gray but in places olive green. Castlegate member included in base of Farrer facies west of Woodside and in top of Neslen facies eastward. Rocks thicken from about 1,200 feet in Price River Canyon, Utah, to about 1,500 feet near Palisade, Colo. Facies comprises whole of formation at Price River Canyon but only upper part of formation near Palisade. Upper boundary coincides with that of formation and underlies North Horn formation with transitional contact in Price River Canyon and disconformably underlies Tuscher formation east of Green River. Montana age.

Named for local mine in Coal Canyon, Utah. In Book Cliffs.

Farrington Sand Member (of Raritan Formation)

Upper Cretaceous: East-central New Jersey.

H. C. Barksdale and others, 1943, The ground-water supplies of Middlesex County, New Jersey: New Jersey State Water Policy Comm. [Spec. Rept. 8], p. 104–140. Medium- to fine-grained sand (No. 1 sand of previous reports) in lower part of Raritan between Woodbridge clay above and Raritan fire clay below. Separated from Sayreville sand member (new) by Woodbridge clay. Lower part, 10 to 20 feet thick, is coarse, arkosic, light-gray, or light-yellow sand commonly containing sprinkling of small pebbles. Arkosic material, as seen in outcrop, is partly kaolinized, the white kernels of the partly decomposed feldspar standing out in contrast to the gray and yellow sand and gravel; occasionally the gravelly beds contain numerous small chunks of red and white clay. Lenses of clay, commonly only a few feet thick, are present, and thin clay seams are fairly common within limits of member. Thickness 80 feet. Most of the discussion deals with relation of unit to ground-water supply. In this report, Woodbridge and Raritan clays are considered informal economic names.

Crops out in band nearly 1 mile wide along southeast edge of Farrington Lake, Middlesex County.

Far Rockaway Gravels[1]

Tertiary: Southeastern New York.

Original reference: J. B. Woodworth, 1901, New York State Mus. Bull. 48, pl. 1, map.

In Oyster Bay and Hempstead quadrangles, Long Island.

Fashing Clay Member (of Whitsett Formation)

Fashing Clays[1]

Eocene, upper: South-central Texas.

Original reference: A. C. Ellisor, 1933, Am. Assoc. Petroleum Geologists Bull., v. 17, no. 11, p. 1302, 1315.

D. H. Eargle, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 11, p. 2624 (fig. 1), 2626 (table 1), 2633–2634. Termed member of Whitsett. At designated type locality, thin fossiliferous sandstone, less than 1 foot thick and containing *Corbula*-type pelecypods, overlies olive-gray bentonitic clay containing coquinas of *Corbula*, *Ostrea*, and other pelecypods, and septarian calcareous concretions. This section, about 20 feet thick, is exposed on western valley wall of small branch on Hierholzer Ranch. Elsewhere banks of oyster shells are found. Overlies Calliham sandstone member; overlain by Olmos sand of Ellisor (1933).

Type locality: About 1.8 miles south of Fashing School, and one-quarter mile south of sharp curve on Farm Road 99 where highway from Fashing to Whitsett bends from a southerly to southwesterly direction. Named for exposures around town of Fashing, Atascosa County.

Faulconer Formation

Faulconer Limestone Member (of Perryville Formation)[1]

Middle Ordovician: Central Kentucky.

Original reference: A. F. Foerste. 1912, Denison Univ. Sci. Lab. Bull. 17, p. 23, 32, 131, 132.

A. C. McFarlan, 1938, Geol. Soc. America Bull., v. 49, no. 6, p. 992. 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 synonym of Benson; name Devils Hollow division of upper Lexington is proposed for post-Woodburn "Perryville" of Frankfort-Versailles area. At its type section, the Devils Hollow includes 15 feet of "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, Faulconer formation is 18½ feet thick; underlies Salvisa formation.

Named for Faulconer, Boyle County.

Fauquier Formation

Precambrian: North-central Virginia.

A. S. Furcron, 1939, Virginia Geol. Survey Bull. 54, p. 1, 37–41, pl. 1. Series of marbles, graphitic slates and graphitic schists, mica schists, and biotite-garnet gneisses. In vicinity of Fauquier White Sulphur Springs and west of Piney Mountain, it is extensively intruded by dikes of greenstone, amphibolite, or metagabbro of Catoctin age. Oldest rocks of sedimentary origin in area [Warrenton quadrangle]. Underlies Precambrian Catoctin volcanic series and locally Warrenton agglomerate member (new) of Catoctin. Rocks of Fauquier were formerly classified with Loudoun formation of Cambrian age.

Named for exposures in vicinity of Fauquier White Sulphur Springs, Fauquier County. Formation enters quadrangle from north where it follows west side of Watery Mountain and extends southwestward through quadrangle.

Favret Formation

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]. Thin-bedded black bituminous limestone and interbedded black shale, generally underlain by massive dark-gray to brown dolomite. Thickness at type locality 800 feet; locally much thinner. Conformably underlies Augusta formation (new); overlies Dixie Valley formation (new), contact gradational.

Type locality: Favret Canyon, west slope of Augusta Mountain.

Faxon Limestone[1]

Precambrian (Grenville): Northern New York.

Original reference: H. L. Alling, 1918, New York State Mus. Bull. 199.

E. M. 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 Dixon schist and below Swede Pond quartzite.

Type locality: Faxon Pond, Warren County.

Fayette Breccia[1]

Middle Devonian: Northeastern Iowa.

Original reference: W. J. McGee, 1884, 10th Census, v. 10, Rept. on Building stones, p. 262–263.

M. A. Stainbrook, 1945, Am. Jour. Sci., v. 243, no. 2, p. 69. It may be interpolated that term "Fayette breccia" as used by Calvin (1898 Iowa Geol. Survey, N. 8) included basal Cedar Valley beds and that, in all cases where "Fayette breccia" lies above Independence shale, it is basal Cedar Valley and not the lithographic Davenport ("Lower Davenport of Norton").

Occurs at Fayette, Fayette County, Quasqueton, Buchanan County, and elsewhere.

Fayette facies (of Flagstaff Formation)

Paleocene, upper: Central Utah.

W. N. Gilliland, 1951, Nebraska Univ. Studies, new ser., no. 8, p. 29, pl. 11. Consists of light-gray to buff extremely dense massive locally fossiliferous limestone. Thickness of nearly 500 feet on north side of Mellor Canyon. Unconformably overlies Price River formation. Exact correlation of Fayette facies with Flagstaff of other areas not known; believed to be roughly correlative with unit B of Valley Mountain facies (new).

Particularly well exposed on north side of Mellor Canyon about 2 miles north-northeast of village of Fayette, Gunnison quadrangle.

†Fayette Sandstone[1]

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, 497.

Named for Fayette Station, Fayette County, W. Va.

†Fayette Sandstone[1] or Formation

Eocene (Jackson): Northwestern Louisiana and eastern and southern Texas.

Original reference: E. T. Dumble and R. A. F. Penrose, Jr., 1890, Texas Geol. Survey 1st Ann. Rept., pl. 3, p. xxxiii, 17, 47, 57, 58, 63.

J. M. Patterson, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 2, p. 259 (fig. 2), 266–270. Fayette formation described in area between Laredo and Rio Grande City, Tex. Classification followed is that of Kane and Gierhart (1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 9) in which names Fayette and Jackson are used synonymously; it is understood that Fayette has been restricted so that some of beds of lower Jackson are not now included in Fayette. Thickness in Starr County about 1,500 feet. Contains three prominent marine sandstone tongues separated by shaly beds of marginal to nonmarine facies. Named units include (ascending) Salineno sandstone tongue, Resendez shale member (new), Roma sandstone tongue. Gorgora shale member (new), Sanchez sandstone tongue, Agua Verde shale member (new), and Villa Nueva sandstone member. Overlies Yegua formation; underlies units termed uppermost Jackson.

D. H. Eargle, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 11, p. 2625–2626. History of usage summarized. On the basis of recent fieldwork, it is believed that the Jackson of west Gulf Coastal Plain should be classified as a group and that name Fayette, of varied usage in the past, be abandoned.

Named for Fayette County, Tex. Section exposed at Lipan Hills, Atascosa County, as described by Dumble (1924) has been regarded as type section.

Fayetteville Shale[1]

Fayetteville Formation

Upper Mississippian: Northern Arkansas, southern Missouri, northeastern, central, and eastern Oklahoma.

Original reference: F. W. Simonds, 1891, Arkansas Geol. Survey Ann. Rept. 1888, v. 4, p. 26, 42–49.

R. A. Brant, 1941, *in* Tulsa Geol. Soc. [Guidebook] Field Trip, Oct. 18. strat. sections. In Tulsa-Choteau-Grand River area, overlies Grand River limestone (new) and underlies Pitkin limestone or rocks of Morrow age.

W. H. Easton, 1942, Arkansas Geol. Survey Bull. 8, p. 17 (table), 19–20; K. C. Jackson, 1959, Fort Smith Geol. Soc. Guidebook 1st Field Conf., p. 56. In Arkansas, includes Mayes limestone member near base.

E. B. Branson, 1944, Missouri Univ. Studies, v. 19, no. 3, p. 267–268. Geographically extended into Missouri where it occurs in outliers of Boston Mountains, Reed Mountain, Lennox Mountain, and Oakleigh Mountain. Consists of black fissile carbonaceous shale and thin lenticular beds of dark-gray limestone; contains discus-shaped concretions of earthy limestone. Overlies Batesville sandstone; underlies Pennsylvanian Hale sandstone.

G. G. Huffman and others, 1958, Oklahoma Geol. Survey Bull. 77, p. 66–71. Described on flanks of Ozark uplift in northeastern Oklahoma. Formation is typically developed on Bragg Mountain escarpment where it is 110 feet thick. Lower 95 feet is largely black fissile shale with thin interbeds of blue-black lithographic limestone; upper part consists of interbedded limestone and shale; grades upward into overlying Pitkin through 6½-foot zone of rubbly nodular-weathering black to gray lithographic limestone; in eastern Adair County 165 feet thick; lower 100 feet consists of black fissile shale with black lithographic septarian concretions; overlying Wedington sandstone member is as much as 25 feet thick. Unconformably overlies Hindsville limestone; where Hindsville is absent, the Fayetteville rests upon "Boone" chert knobs; where the Pitkin is missing Hale formation rests upon the Fayetteville; in northernmost exposures in Craig County, succeeded unconformably by sandstones and shales of Middle Pennsylvanian age.

K. C. Jackson, 1959, Fort Smith Geol. Soc. Guidebook 1st Field Conf., p.-55–56. Fayetteville, in area of this report [southwestern Washington County, Ark.], is divided into four units. Major part of formation is lower black shale member; near base of this unit is a locally developed limestone known as Mayes limestone member. Lower shale member is overlain by Wedington shale member. Upper member is light-colored silty shale. Thickness 100 to 247 feet. Underlies Pitkin formation. Chesterian.

Named for Fayetteville, in valley of West Fork of White River, Washington County, Ark.

Faywood Rhyolite

Tertiary: Southwestern New Mexico.

W. E. Elston, 1957, New Mexico Bur. Mines Mineral Resources Bull. 38, p. 37, pl. 1. Described as two domelike plugs of cream-colored fine-grained flow-layered rhyolite. Also minor flows. Both plugs intrude Rubio Peak flows and Sugarlump tuffs.

One plug forms Mimbres Mountain in secs. 17, 18, 19, 26, T. 20 S., R. 10 W.; other plug located near Faywood Hot Springs, in secs. 15, 16, 21, 22, T. 20 S., R. 11 W., Dwyer quadrangle.

Fearn Springs Sand Member (of Nanafalia Formation or Wilcox Formation)

Fearn Springs Formation

Eocene, lower: Mississippi and Alabama.

F. F. Mellen, 1939, Mississippi Geol. Survey Bull. 38, p. 33–37. In this report [Winston County] four divisions of Wilcox series are recognized: Fearn Springs (new), Ackerman, Holly Springs, and Hatchetigbee. In complete section, Fearn Springs formation lies disconformably on lignite of Betheden formation (new) and is disconformably overlain by grit-bearing arkosic(?) sand of Ackerman formation. Contains ball-type clays, stoneware clays, silty clays, silt, sand, lignite, and siderite. Thickness 0 to more than 50 feet. Fearn Springs is possibly equivalent to Ackerman formation as limited in Alabama by Cooke (1933, Am. Assoc. Petroleum Geologists Bull., v. 17, no. 2) or to Coal Bluff series of Langdon (1895). At time of Cooke's correlation, the Ackerman was defined as all the Wilcox below Holly Springs formation.

W. E. Belt and others, 1945, Geologic map of Mississippi (1:500,000): Mississippi Geol. Survey. Mapped as sand member of Wilcox formation.

G. E. Murray, Jr., and E. P. Thomas, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 1, p. 47 (fig. 1). Correlation chart shows Fearn Springs (sand) member at base of Wilcox group (undifferentiated) in Mississippi.

F. S. MacNeil, 1946, U.S. Geol. Survey Strategic Minerals Inv. Prelim. Rept. 3–195, p. 18–19. Redefined as member of Wilcox formation in Mississippi and member of Nanafalia formation in Alabama. Unit is more of a channel sand in Alabama than in Mississippi. Thickens and thins greatly along strike. Maximum thickness in Alabama 80 feet, in western Butler County. In area of type locality, in addition to fine-grained sands and clay originally assigned to unit by Mellen, it also includes coarse sand (originally considered to be colluvium) exposed farther downhill from type locality but actually forming main part of member. In Mississippi, member varies both in thickness and texture, but in general thickest sections carry coarsest material. Greatest thickness, about 100 feet, and very coarse throughout, is in northern Lauderdale and southern Kemper Countries. Fine-grained sands and clays which commonly mark top of member are lenticular; some lenses pinch out completely within single exposure. Member thins northward, becomes finer textured, and, in northern Mississippi, is indistinguishable from overlying Wilcox.

F. F. Mellen, 1950, Mississippi Geol. Survey Bull. 69, p. 7–20. Discussion of confusion existing in use of term Fearn Springs. Proposed that section of Fearn Springs clays at Flat Rock Church be regarded as alternate locality of formation. At this locality, basal Ackerman gritty sand which caps ridge overlies stoneware clays of Fearn Springs, at top of which is fossil leaf-bearing ironstone. About 300 yards to the west, Betheden kaolin is exposed in stream channel.

F. S. MacNeil, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 5, p. 1062–1073. Report is reply to Mellen's (1950) article. Evidence is presented to show that Mellen's interpretation of type locality was erroneous. From section compiled at Fearn Springs, based in part on auger hole, it is shown that upper part of Fearn Springs member (of Wilcox formation) consists of about 28 feet of laminated to slightly crossbedded fine sandy or silty micaceous clay. Above this lies coarse red sand that Mellen called basal Ackerman sand, Below silty clay is concealed interval of 19 feet, and below this is exposed 27½ feet of coarse crossbedded sand some fine gravel and clay balls. Much of the disagreement between Mellen and writer [MacNeil] hinges on this lower unit of coarse sand, found to have total thickness of 34½ feet. This same sand in nearby exposures can be seen to be the sand Mellen included in most other sections as his basal Ackerman sand. Probably this accounts for Mellen's failure to map the Fearn Springs and Ackerman separately in Winston County. This 34½-foot unit of coarse sand is in turn underlain by 12½-foot interval composed of tough silty clay, coarse sand, clay balls, and sand containing lignitized logs that probably represents Betheden formation as defined by Mellen. There are, therefore, two coarse sands: one below the silty clay phase of the Fearn Springs and another above it. Mellen believes that only one sand exists. This erroneous interpretation led to the following misapplication of names: (1) sand in lower part of type exposure of Fearn Springs, which Mellen believed to be colluvium, is in reality in place; in other exposures, Mellen has termed unit basal Ackrman sand: (2) name Fearn Springs was applied to part of Naheola formation at surface in Lauderdale and Kemper Counties, Miss., (Foster, 1940, Mississippi Geol. Survey Bull. 41) and to entire Naheola formation in subsurface in both Alabama and Mississippi (Mellen, 1950): and (3) Naheola, as used by Mellen (1950) in his subsurface diagrams, includes mainly Matthews Landing marl bed of Smith and Johnson (1887), a zone of fossiliferous greensand and clay that was once regarded as basal part of Naheola formation, but is now designated Matthews Landing marl member of Porters Creek clay. Also suggested that name Fearn Springs be made to include Betheden unit and name Betheden be abandoned.

J. S. Attaya, 1951, Mississippi Geol. Survey Bull. 71. p. 8–10. Fearn Springs formation overlies Porters Creek formation in Lafayette County. Most data from drill holes.

T. W. Luck, 1956, Mississippi Geol. Survey Bull. 80, p. 18–25. Formation described in Benton County where greatest exposed thickness is about 103 feet at Hickory Flat, lower contact not exposed. Underlies Ackerman formation; overlies Betheden formation.

R. J. Hughes, Jr., 1958, Mississippi Geol. Survey Bull. 84, p. 143–165. Described in Kemper County where it is treated as basal member of Nanafalia formation.

P. E. LaMoreaux and L. D. Toulmin, 1959, Alabama Geol. Survey County Rept. 4, p. 98. Sand beds included in Gravel Creek member (new) of Nanafalia have been called Fearn Springs sand member. However, name Fearn Springs is not used in this report for lower member of Nanafalia in Alabama because boundary positions at Fearn Springs type locality are in dispute and stratigraphic relationships with section in Alabama are uncertain.

Type locality: SE¼NE¼ sec. 3, T. 13 N., R. 14 E., one-fourth mile west of Fearn Springs, Winston County, Miss. Alternate locality: At Flat Rock Church (old Hurley School) near center sec. 9, T. 5 S., R. 2 E., Benton County, about one-half mile west of Tippah County line.

Federal Hill Beds (in Patapsco Formation)[1]

Lower Cretaceous: Northeastern Maryland.

Original reference: L. F. Ward, 1905, U.S. Geol. Survey Mon. 48, p. 566–569, 598.

At Federal Hill, in Baltimore.

Felch Formation (in Menominee Group)

Felch Schist[1]

Precambrian (Animikie Series): Northern Michigan.

Original reference: C. R. Van Hise and C. K. Leith, 1911, U.S. Geol. Survey Mon. 52, p. 303, 307.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 30 (table 1), 35. Name Felch formation used in preference to lithologic term schist. In type locality, designated strata occur between Randville dolomite and Vulcan iron-formation; in Menominee district, term Felch formation is applied to distinctive sericitic slate-quartzite sequence which similarly lies above Randville dolomite and below the Vulcan iron-formation and which has been referred to as "Traders quartzite" and "Footwall slate." Forms basal unit of group.

Named for typical development at Felch Mountain, Dickinson County.

†Felch Mountain Iron-Bearing Series[1]

Precambrian (Huronian): Michigan.

Original references: C. R. Van Hise, 1892, U.S. Geol. Survey Bull. 86, p. 195; 1892, U.S. Geol. Survey Mon. 19, p. 473.

Felch Mountain district.

Feldt Ranch Beds (in Ash Hollow Formation)

Pliocene: Southwestern Nebraska.

M. K. Elias, 1942, Geol. Soc. America Spec. Paper 41, p. 141. Name applied to 15 feet of beds of loose crossbedded sand and gravel, cemented grit, and porous limestone that occur in lower part of Ash Hollow formation in type section of the Ogallala.

Type locality: On north side of South Platte Valley, 2 to 2½ miles east and northeast of Ogallala, Keith County. (Also type locality of Ogallala.)

Feliz Granodiorite

Pre-Cretaceous(?): Southern California.

G. J. Neuerburg, 1953, California Div. Mines Spec. Rept. 33, p. 7 (table 1), 12–14, pl. 1. Name applied to fine- to medium-grained granodiorite that occurs in Feliz pluton. Except for microbreccia in western end of Riverside fault block, Feliz granodiorite is confined to Mount Hollywood fault block where it is in intrusive-fault contact with older quartz diorite and with metamorphosed basic igneous rocks. Suggested sequence of intrusion in area is Vermont quartz diorite (new), Lar quartz diorite (new), and Feliz granodiorite.

Exposed in Griffith Park and for short distance south of Los Feliz Blvd., city of Los Angeles.

Fena Beds

Eocene: Mariana Islands (Guam).

Risaburo Tayama, 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 51, table 4 [English translation in library of U.S.

Geol. Survey, p. 61, 62; S. Hanzawa in Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 31–32. Conglomerate with very little liparitic material; pebbles are chiefly andesite and greenish shale, and considered to have originated from underlying Santa Rosa beds. Unconformably underlies Asan limestone. Correlated with Densinyama formation of Saipan.

Type locality: Fena, Guam.

Fence Lake Gravel

Tertiary-Quaternary: Central western New Mexico.

R. J. Marr. 1960, (abs.) Arizona Geol. Soc. Digest, v. 3, p. 181. Incidental mention.

Present on Lynch Ranches, 23 miles east of St. Johns, Ariz. Town of Fence Lake is in Valencia County.

Fencepost limestone[1]

Fencepost limestone bed (in Pfeifer Shale Member of Greenhorn limestone)

Upper Cretaceous: North-central Kansas.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 50.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 111. Bed at top of Pfeifer shale member. Blue gray, weathers to light tan.

Extensively quarried for fence posts near Downs, Osborn County.

Fence River Formation (in Baraga Group)

Precambrian (Animikie Series): Northern Michigan.

J. E. Gair and K. L. Wier, 1956, U.S. Geol. Survey Bull. 1044, p. 14 (table 2), 57–58, pl. 1. Name applied to magnetic rock exposed at Sholdeis exploration where it consists of (ascending) (1) magnetite-specularite-quartz rock, (2) thinly banded rock rich in quartz, magnetite, hornblende, and epidote, and (3) massive garnet-grunerite schist. Estimated thickness probably as much as 250 feet. Conformably overlies eastward-dipping Hemlock formation; underlies biotite-quartz schist that resembles schists of Hemlock formation. If this schist were considered to be part of the Hemlock, the Fence River would be an upper member of the Hemlock; if the schist is considered a basal member of Michigamme slate, the Fence River is a distinct formation between the Hemlock and Michigamme; the latter view is adopted in this report.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 30 (table 1), 36. Assigned to newly defined Baraga group of Animikie series.

Only known exposure is in SE¼NE¼ sec. 21, T. 45 N., R. 31 W., Baraga County. Formation is represented by strong linear north-trending magnetic anomaly crossing northeastern part of area, on east flank of the Amasa oval, extending northward beyond Kiernan quadrangle to the exposure at Sholdeis exploration. Named for Fence River, which crosses magnetic belt 1,100 feet south of the exploration.

Fenner Granite Gneiss

Precambrian: Southern California.

J. C. Hazzard and E. F. Dosch, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 309. Granite gneiss, in part augen. Considered younger than Essex series (new) and older than Kilbeck granite gneiss (new).

Well exposed at Mountain Springs in Piute Mountains, in northern Old Woman Mountains and at Chubbuck, San Bernardino County.

Fentress Formation

Fentress shale division (of Lee Formation)[1]

Pennsylvanian (Pottsville Series) : Eastern Tennessee.

Original reference: L. C. Glenn, 1925, Tennessee Div. Geology Bull. 33–B, p. 276, 384, 385.

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. Glenn used name Fentress shale to include all strata of Pennsylvanian age beneath Rockcastle conglomerate in Fentress County and vicinity, where these beds are primarily shale and where Sewanee conglomerate is too thin to be mapped. Name is here changed to formation because of local occurrences of sandstone. Definition, however, remains the same. Formation includes beds equivalent to parts of two groups: the entire Gizzard group and all of Crab Orchard Mountains group (new) below Rockcastle conglomerate; hence, it is equivalent to Raccoon Mountain formation (new). Warren Point sandstone, Signal Point shale (new), Sewanee conglomerate, Whitwell shale, Newton sandstone, and Vandever formation. In localized areas, some of the constituent formations are recognizable. Name, Fentress formation, is used only where Sewanee conglomerate is not mappable.

Probably named for development in Fentress County.

Ferdig Shale Member (of Marias River Shale)

Upper Cretaceous: Northwestern Montana.

W. A. Cobban and others, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2792 (fig. 3), 2794–2795; 1959 Billings Geol. Soc. [Guidebook] 10th Ann. Field Conf., p. 89 (fig. 1). Inconspicuous disconformities divide member into three units (ascending) : dark-gray shale containing maroon-weathering layers of dark-gray syngenetic ferruginous dolostone and few thin beds of bentonite; micromicaceous silty bentonitic shale characterized by abundant surface litter of small thin flakes of rusty iron-stained shale, which contain gray and yellow-weathering concretionary limestone beds, secondary gypseous concretions, sandy shale, and thin persistent layers of sandstone; and dark-gray shale or sandy siltstone with thin layers of gray limestone concretions. Thin layer of pebbly sandstone present at top of middle unit and persists from type section southward for more than 100 miles. Total thickness of member at type section about 225 feet. Disconformably underlies Kevin shale member (new) ; overlies Cone calcareous member (new) :

Type section: Composite from exposures 3 to 5 miles northwest of Ferdig and from outcrops 8 miles southeast. Name derived from post office of Ferdig at SE cor. sec. 30, T. 35 N., R. 1 W., Sunburst quadrangle, Toole County, which is located over the subcrop of member on east flank of Kevin-Sunburst dome.

Ferdinand Limestone (in Mansfield Group)

Pennsylvanian (Pottsville) : Southwestern Indiana.

D. W. Franklin, 1944, Illinois Acad. Sci. Trans., v. 37, p. 87 (fig. 1), 88, 89. Consists of black shiny opaque chert with casts of productids and dark-blue gray argillaceous dull limestone. Thickness about 2 feet.

Lies about 20 feet below top of group; separated from underlying Fulda limestone (new) by about 15 feet of shale, underclay and coal.

C. L. Cooper, 1946, Illinois Geol. Survey Bull. 70, p. 16 (fig. 2), 19. Included in Ti Valley series (new).

Well exposed northeast of Ferdinand in T. 3 S., R. 4 W., and west of Ferdinand State Forest, Dubois County.

Ferguson Gypsum Member (of Blaine Gypsum)[1]

Permian: Western Oklahoma.

Original reference: C. N. Gould, 1902, Oklahoma Geol. Survey 2d Bienn. Rept., p. 42, 47.

Named for Ferguson, Blaine County.

Ferguson Mountain Formation

Permian (Wolfcampian-Leonardian): Eastern Nevada.

J. S. Berge, Apr. 1960, Brigham Young Univ. Research Studies, Geology Ser., v. 7, no. 5, p. 10 (fig. 2), 18–24, pl. 4, chart (strat. section). (Footnote on chart refers to Steele's article in Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., 1960, p. 91, 106–107. Road logs in guidebook dated Sept. 8–10.). Ferguson Mountain formation is named for thick carbonate sequence overlying Ely limestone at Ferguson Mountain. Steele (1959, unpub. thesis) termed part of this the Ferguson Spring[s] formation, but name and type locality he selected are ill chosen. Therefore Ferguson Spring[s] formation is herein redefined and name Ferguson Mountain formation proposed. This proposal is based on applicability of name to topographic sheet (Elko NK 11–12) of area. The area on topographic sheet is referred to as Ferguson Mountain. not Ferguson Springs Mountains. Type section is in secs. 21 and 22, T. 30 N., R. 69 E., Elko County. Measured section obtained on east side of Ferguson Mountain on spur directly north of principal east-trending canyon on this part of mountain. In adjacent areas surrounding spring area, southeastern side of Ferguson Mountains near U.S. Highway 50, no Ferguson Mountain formation is present. Geology there consists instead, of Guilmette limestone, Ely limestone, Tertiary volcanics, and Quaternary and Recent alluvium. Area is complexly folded, and is fractured by faulting. Seventeen hundred feet to the west in the southern part of the mountain, fault block of Ferguson Mountain formation is juxtaposed against various rock types but cannot be considered type section. Steele (1959) dates this section Upper Lower Missourian to Upper Upper Wolfcampian with total thickness of 3.085 feet, of which 1,111 feet is Pennsylvanian and remaining 1,974 feet is assigned to Lower Permian. He [Steele] also extends lower part of his formation to Mid-Pennsylvanian disconformity with upper limit in contact with Pequop formation of Leonardian age. Ferguson Mountain formation consists predominantly of dark-gray to light-gray limestones. Thickness 1,985½ feet, of which 1,717½ feet is assigned a Wolfcampian age and 268 feet lower Leonardian. Underlies Pequop formation; overlies Ely limestone. On chart (stratigraphic section) Ferguson Mountain is shown above Strathearn formation and below Pequop formation.

H. J. Bissell, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 8, p. 1427 (chart), 1428 (fig. 3). Name appears on chart accompanying preliminary statement on eastern Great Basin Permo-Pennsylvanian strata. Underlies Pequop formation; stratigraphically above Strathearn(?).

Type section: Secs. 21 and 22, T. 30 N., R. 69 E., Elko County. Measured section on east side of Ferguson Mountain.

Ferguson Springs Formation

Pennsylvanian-Permian: Northeastern Nevada and western Utah.

J. S. Berge, Apr. 1960, Brigham Young Univ. Research Studies, Geology Ser., v. 7, no. 5, p. 11 (fig. 3), 18. (Footnote on stratigraphic chart refers to Steele's article in Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf.) Steele (1959, unpub. thesis) named Ferguson Spring[s] formation. His name and type locality were ill chosen and Ferguson Spring[s] formation is herein redefined and renamed Ferguson Mountain formation. Correlation chart (in column credited to Steele) Ferguson Springs formation unconformably overlies Ely limestone and underlies Pequop formation. Pennsylvanian (Missouri-Virgil) and Permian (Wolfcamp).

Grant Steele, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 93 (chart), 101, 104 (pl. 5, fig. 3). (Road logs dated Sept. 8–10). Name applied to those limestones occurring above the middle Pennsylvanian regional unconformity and stratigraphically below Pequop formation of Leonardian age. Light- to medium-gray, crypto- to fine-crystalline, bioclastic, silty, limestone sequence with thin interbeds of bituminous shale. Thickness 3,185 feet at type section. Lower 1,101 feet dated upper Pennsylvanian in age, with lower 592 feet assigned to Missourian, and remaining 519 feet to Virgilian. Upper 1,984 feet dated Wolfcampian. At nearly all known localities, including type area, formation rests disconformably on Ely limestone.

Type section: Sec. 16, T. 30 N., R. 69 E., Elko County, Nev. Named for Ferguson Springs, 1½ miles south of measured section.

†Fernandan system[1]

Precambrian (Llano Series): Central Texas.

Original reference: T. B. Comstock and E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept., pl. 3, p. lvi, 267–276.

Named for San Fernando Creek, Llano County.

Fernando Formation

Fernando Group[1]

Pliocene and Pleistocene: Southern California.

Original reference: G. H. Eldridge and R. Arnold, 1907, U.S. Geol. Survey Bull. 309.

D. L. Durham and R. F Yerkes, 1959, U.S. Geol. Survey Oil and Gas Inv. Map OM–196. Group includes Repetto formation below and unnamed conglomeratic and siltstone sequence above. Overlies Sycamore Canyon member of Puente formation; underlies La Habra formation. Pliocene.

U.S. Geological Survey currently classifies the Fernando as a formation and designates its age as Pliocene and Pleistocene on the basis of a study now in progress.

Named for exposures in San Fernando Valley, Los Angeles County.

Fern Creek Formation (in Chocolay Group)

Precambrian (Animikie Series): Northern Michigan.

F. J. Pettijohn and F. A. Hildebrand, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1927. Named Fern Creek conglomerate; in unfaulted contact with reddish granite gneiss and pegmatite; contains large subrounded boulders derived from subjacent pre-Huronian and truncates, at an angle of 30° or more, the foliation of these basement rocks. Underlies Sturgeon quartzite.

F. J. Pettijohn, 1952, (abs.) Geol. Soc. America Bull., v. 63, no. 12, pt. 2, p. 1289. Formation includes at top a 100-foot thick tillite member, containing 2 to 5 percent of siltstones as much as 6 feet in diameter scattered in fine-grained nonbedded graywacke matrix; tillite is underlain by thinly laminated member characterized by scattered rafted cobbles; this bed grades down into pebbly arkoses and coarse granite-bearing conglomerates which lie unconformably on a granite gneiss basement. Tillite cannot be, by any correlation currently accepted, the correlative of Canadian Cobalt (Gowganda) tillite.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 35. Formation is basal unit in newly defined Chocolay group.

Occurs near Fern Creek, Dickinson County.

Ferndale Sandstone

Pliocene, upper: Northwestern California.

H. D. MacGinitie, 1943, California Div. Mines Bull. 118, pt. 3, p. 633. Fine-grained gray sandstone with thin interbed of clay shale. Thickness about 2,500 feet. Underlies Wildcat formation; overlies Pico formation.

B. A. Ogle, 1953, California Div. Mines Bull. 164, p. 33. Name Ferndale sandstone abandoned. Unit redefined as Scotit Bluffs sandstone.

Occurs in central and southern Humboldt County.

Fern Glen Limestone

Fern Glen Limestone (in Osage Group)[1]

Fern Glen Member (of Chouteau Formation)

Lower Mississippian (Osage Series): Eastern Missouri and southwestern Illinois.

Original reference: S. Weller, 1906, St. Louis Acad. Trans., v. 16, p. 438.

J. M. Weller, 1939, *in* Stuart Weller and J. M. Weller, Illinois Geol. Survey Rept. Inv. 59, p. 8, pl. 1. Formation crops out only on Valmeyer anticline, and exposures occur from Dennis Hollow northward to SW¼ sec. 35, T. 2 S., R. 11 W. Consists chiefly of deep red more or less argillaceous limestone with interbedded shale. Thickness about 50 feet. Underlies Burlington-Keokuk limestone.

E. B. Branson, 1944, Missouri Univ. Studies, v. 19, no. 3, p. 198–199. Interpreted as member of Chouteau formation.

H. A. Lowenstam, 1949, Illinois Geol. Survey Rept. Inv. 145, p. 20. In certain parts of Ozark border area in western St. Clair and Monroe Counties, and possibly in northwestern Jackson County, Fern Glen limestone, of early Osage age, directly overlies Moccasin Springs formation (new) of the Niagaran.

Charles Collinson and D. H. Swann, 1958, Geol. Soc. America Guidebook Field Trip St. Louis Mtg., p. 24 (fig. 3), 50 (fig. 9), 51. Chautauqua, Jersey County, Ill., is northernmost outcrop at which Fern Glen is both characteristically and well exposed. Here it has lost its distinctive red color. Shale grades upward into crinoidal limestone of Burlington; the contact is placed at point where chert nodules lose their greenish color; and the limestone becomes relatively pure. In some areas, consists of light-greenish-gray crinoidal limestone containing greenish-gray chert bands. In vicinity of Jerseyville, the Fern Glen cannot be differentiated from lower Burlington, thus indicating that it is actually a shaly facies of the Burlington. Overlies Sedalia dolomite. Valmeyer series [which includes Osage group]. Thickness about 20 feet.

Named for occurrence near Fern Glen Station, 20 miles west of St. Louis, St. Louis County, Mo.

Fernow Gneiss

Pre-Ordovician(?): North-central Washington.

E. A. Youngberg and T. L. Wilson, 1952, Econ. Geology, v. 47, no. 1, p. 2–4, 12. Name applied to series of quartz-amphibole gneisses, thickness of which is unknown because they extend outside mapped area. Age sequence not clear; it would appear that Fernow units is older than less metamorphosed Buckskin and Martin Ridge schists (both new); this would require that beds be overturned because Fernow gneisses lie stratigraphically above schists.

Named for occurrence in vicinity of Mount Fernow, near Holden, Chelan County.

Fernow Quartz Latite

Fernow 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, pl. 74.

H. T. Morris, 1957, Utah Geol. Soc. Guidebook 12, p. 30–32. Referred to as quartz latite.

U.S. Geological Survey currently considers the Fernow Quartz Latite to be middle Eocene in age.

Named for Fernow Canyon in southern part of Tintic district.

Fern Ridge Tuffs[1]

Miocene or Pliocene, lower and middle: Northwestern Oregon.

Original reference: T. P. Thayer, 1933, Pan-Am. Geologist, v. 59, no. 4, p. 317.

T. P. Thayer, 1939, Oregon Dept. Geology and Mineral Industries Bull. 15, p. 8, fig. 1. Consist of conglomerates, tuffs, and breccia; lower beds are mainly tuffs, sandstones, and fine pebble beds; upper part comprises coarse andesitic conglomerates which contain boulders as much as 18 inches in diameter in tuffaceous matrix. Maximum thickness about 1,500 feet, northeast of Mehama. Conformably overlies Stayton lavas and are probably part of same general sequence. Mehama volcanics (new), Stayton lavas, and Fern Ridge tuffs are traceable as distinct formations to crest of Mehama anticline. Miocene.

W. D. Lowry and E. M. Baldwin, 1952, Geol. Soc. America Bull., v. 63, no. 1, p. 15–16, pl. 2. Overlie Columbia River basalt and underlie lava of Pliocene or younger age. Tuffs can be traced northward into Molalla River drainage where they have been referred to correlative Molalla formation. Age shown on chart as lower and middle Pliocene.

Type locality: Fern Ridge, about 5 miles northeast of Stayton, Marion County.

Fernvale Limestone or **Formation** (in Richmond Group)[1]

Fernvale Formation (in Patterson Ranch Group)

Upper Ordovician: Western Tennessee, northwestern Alabama, northern Arkansas, southwestern Illinois, southeastern Missouri, and central eastern, and northeastern Oklahoma.

Original reference: C. W. Hayes and E. O. Ulrich, 1903, U.S. Geol. Survey Geol. Atlas, Folio 95, p. 2.

W. H. Shideler, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 367–368. The "Fernvale" extending from Glen Park, Mo., and Valmeyer, Ill., to south side of Arbuckles in Oklahoma, is a massive uniformly crystalline limestone with varied fauna of ostracods and trilobites; this differs from typical Fernvale. Name Ada is proposed for the crystalline limestone.

J. M. Weller, 1939, *in* Stuart Weller and J. M. Weller, Illinois Geol. Survey Rept. Inv. 59, p. 7. Exposed in limited area in Kimmswick quadrangle where Ordovician rocks are brought to surface in Mississippi River bluff at crest of Valmeyer anticline. Consists of brownish coarsely crystalline limestone with many fossils. Thickness 6 to 14 inches. Overlies Kimmswick limestone; underlies Maquoketa shale.

C. E. Decker, 1942, Oklahoma Acad. Sci. Proc., v. 22, p. 153, 154 (table 1). Formation included in Patterson Ranch group (new). Overlies Viola; underlies Sylvan.

E. B. Branson, 1944, Missouri Univ. Studies, v. 19, no. 3, p. 92–93. Chiefly limestone with considerable amount of impurities, in some places highly siliceous. Commonly light gray but ranges from nearly white to brown or reddish tints. Lies on various members of Kimmswick; unconformable below Maquoketa formation. Thickness about 4 feet. Lowest Upper Ordovician in Missouri; correlates with part of Arnheim of Kentucky; continuous with Fernvale of Arkansas and Illinois.

A. M. Gutstadt, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 3, pt. 1, p. 524. Templeton and Willman (1953, unpub. ms.) reported name Ada limestone preempted and proposed name Cape limestone for the Missouri "Fernvale".

G. G. Huffman and others, 1958, Oklahoma Geol. Survey Bull. 77, p. 14 (fig. 2), 26–27, pls. 3, 4. Limestone described on south and west flanks of Ozark uplift in northeastern Oklahoma. Massive coarsely crystalline fossiliferous crinoidal limestone. Light gray to pink and weathers lead gray. Maximum thickness 18 feet; average thickness 14 feet. Unconformably overlies Fite limestone and conformably underlies Sylvan shale south and east of Tahlequah; northeast of Tahlequah unconformably underlies Chattanooga black shale. Upper Ordovician, Richmondian.

G. B. Martin, 1960, Gulf Coast Assoc. Geol. Sci. Trans., v. 10, p. 201–205. In Alabama, Fernvale formation consists mainly of gray to blue crystalline thin-bedded fossiliferous limestone. Thickness 12 to 20 feet. Unconformably underlain by Leiper formation or by Hermitage formation. Recommended that in this area name Chickamauga be avoided in favor of more specific Leipers and Fernvale formations.

Named for Fernvale, Williamson County, Tenn.

†Ferriferous Limestone[1]

Ferriferous ironstone member

Pennsylvanian (Allegheny Series) : Pennsylvania, Ohio, and West Virginia.

Original reference: H. D. Rogers, 1858, Geology of Pennsylvania: Philadelhia, J. P. Lippincott & Co., v. 2, pt. 1, p. 491.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 45–46, table 1. Ferriferous ironstone member of Scrubgrass cyclothem in report on Perry County. Name Ferriferous was first applied to limestone which, in present usage, is known as Vanport. In this report, term Ferriferous is restricted to ironstone directly overlying Vanport member. Thickness 6 inches to 1 foot. Underlies Lower Kittanning clay of Lower Kittanning cyclothem. Allegheny series.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 60. Term Ferriferous is one of few descriptive names still used as name for rock units in Pennsylvanian rocks. A useful bed for correlation in a series of beds lacking distinguishable members in Athens County [this report], and without its positive identification, recognition of any members of Scrubgrass cyclothem within county would have been uncertain or impossible.

Ferris Formation[1]

Upper Cretaceous and Paleocene: Central southern Wyoming.

Original reference: C. F. Bowen, 1918, U.S. Geol. Survey Prof. Paper 108, p. 228, 230.

R. W. Brown, 1943, Geol. Soc. America Bull., v. 54, no. 1, p. 81–82. Supposed unconformity between the Medicine Bow and Ferris is now regarded as nonexistent or as marked by a transitional zone indicating erosional irregularity. Basal 1,000 feet of Ferris is a coal-barren conglomeratic zone whose matrix and pebbles are similar to those of Medicine Bow. This zone yields remains of *Triceratops* and a Cretaceous flora not materially different from the lower Medicine Bow and Lance. Typical Paleocene flora has been found in lowest coal-bearing strata just above the latest dinosaur remains of the Ferris, indicating that the Cretaceous-Tertiary boundary is at or near that level. Concluded that Medicine Bow formation encompasses basal dinosaur-bearing part of the Ferris and that the remainder of the Ferris, about 5,500 feet, is Paleocene.

Well exposed on old Ferris Ranch, on North Platte River, Carbon County.

Ferron Sandstone Member (of Mancos Shale)[1]

Upper Cretaceous: Central and southeastern Utah.

Original reference: C. T. Lupton, 1914, U.S. Geol. Survey Bull. 541, p. 128.

E. M. Spieker and J. B. Reeside, Jr., 1925, Geol. Soc. America Bull., v. 36, no. 3, p. 438, 440 (fig. 2). In Wasatch Plateau, Ferron sandstone member overlies unnamed lower shale member that is equivalent to "Tununk shale" of Gilbert's (1877) section in Henry Mountains and underlies unnamed shale member below Emery sandstone member (new).

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 that Ferron sandstone member of Mancos overlies Tununk shale member and underlies Blue Gate shale member. Thickness 150 to 250 feet.

C. B. Hunt, Paul Averitt, and R. L. Miller, 1953, U.S. Geol. Survey Prof. Paper 228, p. 36, 37 (table), 80–83, pl. 1. Underlies Blue Gate shale member; overlies Tununk shale member. Thickness about 800 feet in southern Castle Valley; thins to about 75 feet at northeast end of valley and thinned part becomes increasingly shaly eastward; at Green River represented only by very thin sandy beds. In Henry Mountain region, almost 300 feet thick but thins eastward to about 150 feet; probably did not extend far east of Henry Mountains. In most parts of the region, consists of three lithologic units each having about same thickness: at base is sequence of interbedded sandstone and shale; overlying is massive sandstone; and at top is lenticular carbonaceous and coal-bearing shale and sandstone. Data on type locality. Gilbert (1877) applied name Tununk sandstone to this member.

Type locality: In Castle Valley near town of Ferron, Emery County.

Ferron Point Formation[1] (in Traverse Group)

Middle Devonian: Northeastern Michigan.

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

A. S. Warthin, Jr., and G. A. Cooper, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 5, p. 579 (fig. 3), 581–582, 583. Described in Thunder Bay region where it underlies Genshaw formation (redefined) and overlies Rockport Quarry limestone. Thickness at type section about 18½ feet. Included in Traverse group.

Type section: West wall of Rockport quarry at Rockport, sec. 6, T. 32 N., R. 9 E., Alpena County.

Ferry Lake Anhydrite (in Trinity Group)

Lower Cretaceous (Comanche Series): Subsurface in Louisiana, Arkansas, Mississippi, and Texas.

R. W. Imlay, 1940, Arkansas Geol. Survey Inf. Circ. 12, p. 4, 35–36, cross sections. Consists of about 250 feet of white to gray finely crystalline anhydrite which contains minor amounts of interbedded gray to black shale, dense limestone, and dolomite. Lies conformably between Rodessa below and Mooringsport formation (new) above. Name replaces Glen Rose massive anhydrite. Type section will be described in paper by Shreveport Geological Society.

J. M. Forgotson, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 10, p. 2354–2355. Redefined as formation which occupies stratigraphic interval between base of Rusk formation (new) and top of Rodessa formation as they are recognized in Caddo Lake (Ferry Lake) area of western Caddo Parish, La. Formation thins as anhydrite grades into shale and limestone northward into southern Arkansas where it is represented in outcrop by interval of gypsum within DeQueen limestone. Ferry Lake is regional wedge thickening basinward from southern Arkansas into northern Louisiana and reaching thickness of about 250 feet in type area; extends into Texas where it grades rather abruptly into porous fossiliferous and oolitic limestones; thins to featheredge in central Mississippi. Type well designated.

Type well: Gulf Refining Co.'s Caddo Levee Board "O" Gas Unit Well No. 1, Jeems Bayou field, sec. 10, T. 20 N., R. 16 W., Caddo Parish, La. Top of unit placed at 3,823 and base at 4,072 feet.

Fetzer Tongue (of Arline Formation)

Middle Ordovician (Mohawkian): Eastern Tennessee, northern Georgia, and southwestern Virginia.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 64, chart 1 (facing p. 130). In type section, consists of 6 to 8 feet of nodular crumbly limestone with thin granular interbeds. Has general lithology of Arline formation. Generally more argillaceous than underlying beds of Lenoir limestone; overlies Paperville formation (new). Virtually the same unit as Botetourt limestone member of Edinburg formation of Shenandoah Valley of Virginia. Page 83 mentions Fetzer formation. Name attributed to B. N. Cooper and G. A. Cooper.

Type section: Along U.S. Route 64 about 3 miles southwest of Benton Station, Benton (TVA 126–NW) quadrangle, Polk County, Tenn. Named from Fetzer Creek not far from type section along Ocoee River. Recognized in southeastern belts of Southern Appalachian region from Wytheville, Va., to Georgia.

Fibron Limestone[1]

Fibron Limestone Member (of Hendricks Dolomite)

Middle Silurian (Niagaran): Northern Michigan.

Original reference: R. A. Smith, 1916, Michigan Geol. Survey Pub. 21, p. 153.

G. M. Ehlers and R. V. Kesling, 1957, Michigan Geol. Soc. [Guidebook] Ann. Geol. Excursion, p. 2 (table), 15. Member occupies position near top of formation. Thickness at type section about 30 feet; maximum thickness about 50 feet; thickness in type section of Hendricks 18 feet. Member is thickest high calcium layer in formation.

Type section: Abandoned Fibron quarry, about 3 miles east and 3 miles north of Rexton, Mackinac County.

†Fickett Series[1]

Silurian(?), Devonian, and Mississippian: Northern central Alaska.

Original reference: F. C. Schrader, 1902, Geol. Soc. America Bull., v. 13, p. 242.

Named for river called Fickett River in early reports but now known as John River.

Fidalgo Formation[1]

Triassic(?): Northwestern Washington.

Original reference: R. D. McLellan, 1927, Washington Univ. Pub. Geol., 2, p. 142–146.

Occurs on Fidalgo Head and at several localities in southeastern part of Fidalgo Island. Composes Burrows, Young, Allan, Saddlebag, Dot, and Hat Islands, and Williamson Rocks, and major part of Cypress Island.

Fiddlers Green Dolomite (in Bertie Group)

Fiddlers Green Dolomite Member (of Bertie Formation)

†Fiddlers Green Limestone[1]

Upper Silurian: Central and western New York.

Original reference: T. C. Hopkins, 1914, New York State Mus. Bull. 171, p. 12.

D. W. Fisher and L. V. Rickard, 1953, New York State Mus. Circ. 36, p. 9, fig. 1. Rank reduced to member status at base of Bertie formation. Underlies unnamed middle member. Overlies Camillus. Grades into Brayman shale (redefined).

L. V. Rickard, 1955, New York State Geol. Assoc. Guidebook 27th Ann. Mtg., p. 7, 9. In central New York, dolomite is considered member at base of Bertie formation. Underlies Forge Hollow member (new). Thickness 25 to 30 feet. Not restricted to Syracuse region; may be traced east and west for considerable distances. Continues westward into Falkirk member of Bertie; therefore should not be referred to Camillus shale of Salina group. Upper Silurian.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. Basal formation in Bertie group in central New York. Underlies Forge Hollow shale. Fieldwork has not demonstrated lateral continuity of the Falkirk and Fiddlers Green as indicated on present chart. Thick glacial deposits conceal these units in area where they may merge. Possibility of facies changes should not be overlooked. At present, distinct names are used in western and central New York.

First described in Syracuse quadrangle.

†Fido Sandstone[1]

Upper Mississippian: Southwestern Virginia.

Original reference: Charles Butts, 1927, Virginia Geol. Survey Bull. 27.

R. H. Wilpolt and D. W. Marden, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 38, sheet 1. Abandoned on basis of this report. Equivalent to top beds of Greenbrier and basal beds of Bluefield.

D. B. Reger, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 9, p. 1911. Butts (1927) ignored Reger's 1926 terminology, used names "Cove Creek" limestone and "Fido" sandstone for certain stages of the Mauch Chunk, and assigned everything between the Gasper (Upper Union) and St. Louis ((Hillsdale) to the Ste. Genevieve. This assignment of certain lower rocks to the Ste. Genevieve was merely an avoidance of Pickaway, Taggard, Patton, and Sinks Grove. Continued use of Butts' illogical Ste. Genevieve column has led to confusion. [See Denmar formation.]

Named for exposures in vicinity of Fido, Scott County.

†Fierro Limestone[1]

Mississippian, Pennsylvanian, and Permian: Southwestern New Mexico.

Original reference: S. Paige, 1916, U.S. Geol. Survey Geol. Atlas, Folio 199.

L. R. Laudon and A. L. Bowsher, 1949, Geol. Soc. America Bull., v. 60, no. 1, p. 7. Formation names were assigned to Carboniferous rocks in Silver City, Santa Rita and Fierro mining districts without regard to their stratigraphic relations to previously named formations in other districts of State. Consequently, several synonymous formational names were proposed for Mississippian rocks of this area. Paige (1916) introduced name Fierro for limestone beds resting on Devonian Percha shale and unconformably overlain by Cretaceous Beartooth quartzite. Lower part of the Fierro has been correlated with Lake Valley formation.

Named for Fierro mine in northeastern part Silver City quadrangle.

Fifes Peak Formation

Fifes Peak Andesite

Oligocene or Miocene: South-central Washington.

W. C. Warren, 1940, (abs.) Geol. Soc. America Bull., v. 51, no. 12, pt. 2, p. 2035. Name applied to a unit consisting of basic andesite flows and pyroclastics forming upper part of Keechelus andesitic series in Mount Aix quadrangle. Unconformable on lower part of Keechelus series. Overlapped by marginal flows of Yakima basalt.

W. C. Warren, 1941, Jour. Geology, v. 49, no. 8, p. 800–802. Described as a group of flows, agglomerates, and tuffs. Proportion of flows to agglomerates and tuffs varies from place to place; on the whole, the pyroclastic materials have the greater volume. Flows are black on fresh exposures; they are dense to vitreous, porphyritic, with clear phenocrysts of plagioclase. On weathered surfaces, rock is brownish with chalky phenocrysts. Tuffs are yellow to buff. Agglomerates are variable in color with grays, reds, and purples predominating. Underlies Yakima basalt. Presumably not younger than middle Miocene.

Occurs in Mount Aix quadrangle in vicinity of Fifes Peak, Yakima County.

Figuera Volcanics

Figuera Formation[1]

Paleocene, upper, or Eocene, lower: Pureto Rico.

Original reference: H. A. Meyerhoff and I. F. Smith, 1931, New York Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, v. 2, pt. 3, p. 284.

R. C. Mitchell, 1954, Puerto Rico Univ. Agr. Expt. Sta. Tech. Paper 13, p. 36 (table 2), 60 (table 7), 71. Thickness 500 feet. Underlies Fajardo shale; overlies Trujillo Alto limestone. Upper Cretaceous.

C. A. Kaye, 1959, U.S. Geol. Survey Prof. Paper 317–A, p. 7 (table), 9 (fig. 3), 22–27, pl. 2. Figuera volcanics in San Juan area consist of pyroclastic rocks of variable thickness with lenticular calcareous beds and included blocks of older limestone (Trujillo Alto? limestone) in basal part. Characteristically hornblende andesite of mauve to greenish color. Greatest thickness, about 3,000 feet, south and east of Guaynabo; about 600 feet on Trujillo Alto Road. Meyerhoff and Smith placed the Figuera stratigraphically between Trujillo Alto limestone and Fajardo shales, but noted that no outcrop of Trujillo Alto was seen in vicinity of the Figuera. The absence of common contact with Trujillo Alto at type locality and uncertainty that Fajardo shales of Meyerhoff and Smith at Fajardo and those in San Juan area are stratigraphically identical raise an element of uncertainty as to identity of the two volcanic sequences. Near Pueblo Seco and La Muda, Figuera volcanics conformably overlie Trujillo Alto limestone; between Guaynabo and Rio Piedras, apparently separated from underlying rocks by angular unconformity because north of Guaynabo the Figuera overlies Monacillo limestone (new) whereas to the south it overlies Frailes formation (new). Underlies Fajardo formation. No diagnostic fossils found above Trujillo Alto, but it is proposed that Figuera volcanics correlate with late Paleocene or early Eocene deposits of Loiza, to east, and Corozal, to west.

Two parallel bands occur near Ceiba, one at east coast of Punta Figuera, from which formation has been named; the other extends from Puerto Medio Mundo into interior for undetermined distance.

Filer Sandstone Lentil (of Amherstburg Formation)

Middle Devonian: Michigan (subsurface).

K. K. Landes. 1951, U.S. Geol. Survey Circ. 133, p. 2 (fig. 2), 7, 9, 12. Lies within carbonate rock sequence above Sylvania sandstone member of Amherstburg formation and below Lucas formation. Thickness exceeds 50 feet in Bay and western Manistee Counties, and as much as 100 feet in western Michigan.

Type section: Ruggles and Rademacher well 24, sec. 12, T. 21 N., R. 17 W., Filer Township, Manistee County. Confined for most part to western flank of Michigan Basin.

Fillmore Limestone (in Pogonip Group)

Lower Ordovician (Canadian): West-central Utah and eastern Nevada.

L. F. Hintze, 1951, Utah Geol. and Mineralog. Survey Bull. 39, p. 9 (fig. 2), 13–16, 29 (fig. 4), 37–38, 39–40, 41–43, 45–50. Characteristically a complex of thin-bedded interbeds of intraformational conglomerate, limy siltstone, muddy limestone, and limy shales, with occasional layers of calcilutite; individual beds thin and lens out, or grade into other beds, within short distances. Thickness, composite section, about 1,500 feet; entire thickness not exposed in any one section. Thins eastward from Ibex, Utah; westward in Nevada, thickness changes little, but lithology changes considerably—intraformational conglomerates become less prominent, and quartz detritus less conspicuous in limestone, chert becomes more prominent, and several thick-bedded resistant beds appear. Overlies House limestone (new); underlies Wahwah limestone (new). Pogonip group redefined in this report.

Type localities: Ibex sections D, G, and H, are designated as type localities of various portions as listed in section descriptions. These are, respectively, approximately 2 miles south-southeast of Government Well 108 which is located in sec. 1, T. 22 S., R. 14 W.; NW¼ sec. 8, T. 23 S., R. 14 W.; east slope of lava capped butte approximately at ¼ cor. sec. 5, sec. 6, T. 23 S., R. 14 W. Name derived from Fillmore, Millard County, Utah.

Final shales (in Chuaran series)

Precambrian: Northern Arizona.

Charles Keyes, 1938, Pan-Am. Geologist, v. 70, no. 2, p. 107 (chart), 113. Brown more or less sandy shales. Some thin limestone layers included. Thickness 600 feet. Underlies Oveja formation (new) unconformably; overlies Marble limestone.

Exposed in Chuar Valley under Cape Final, a long tongue reaching down from Kaibab Plateau; Grand Canyon region.

Fina-sisu Formation

Oligocene, upper: Mariana Islands (Saipan).

P. E. Cloud, Jr., R. G. Schmidt, and H. W. Burke, 1956, U.S. Geol. Survey Prof. Paper 280–A, p. 60–62, chart 1, pls. 1, 2. Calcareous marine tuffs and interbedded andesite flow rocks, with distinctive planktonic smaller Foraminifera in some of tuffs. Flows commonly less than 20 feet thick but one is 80 to 100 feet. Maximum exposed thickness about 400 feet in type section; base of formation nowhere exposed. Overlapped by Tagpochau limestone.

Type section: Fina-sisu hills or ridge, south of As Lito village. Section extends eastward from fault at west side of Fina-sisu hills up ravine 300 to 400 feet south of structure section C–C' (pls. 1, 2), and south of As Lito village, to unconformably overlapping *Acropora*-rich facies of Mariana limestone.

Finger Bay Volcanics

Tertiary(?): Southwestern Alaska.

R. R. Coats, 1947, U.S. Geol. Survey Alaskan Volcano Inv. Rept. 2, pt. 5, p. 75–76, pls. 6; pt. 7, p. 101, pl. 8. Sequence of volcanic rocks on Adak Island consisting of black, dark-gray, purplish-gray, greenish-gray and grayish yellow-green basaltic tuff, basalt flows, tuff-breccia, agglomerate, and dikes with a few small rhyolitic flows and dikes. Some rocks conspicuously porphyritic. In general, rocks are intensely altered and locally recrystallized. Thickness at least 2,000 feet and possibly as much as 15,000 feet. Intruded by Zeto Point basalt porphyry (new). Tentatively assigned to the Mesozoic.

F. S. Simons and D. E. Mathewson, 1947, U.S. Geol. Survey Alaskan Volcano Inv. Rept. 2, pt. 4, p. 57, 60–61, pls. 4, 5. Oldest rocks exposed on Great Sitkin Island. Predominantly andesitic and basaltic greenstone, and include coarse- to fine-grained porphyritic flows, amygdaloidal flows, coarse flow-breccia, pillow lava, and dense fine-grained rocks that are probably flows, and also coarse- to fine-grained tuff. Unconformably underlies Sand Bay volcanics (new). Chain of islands between Great Sitkin and Adak seem to be composed largely if not entirely of Finger Bay volcanics. Source of volcanics not known.

F. S. Simons and D. E. Mathewson, 1955, U.S. Geol. Survey Bull. 1028–B, p. 27–28, pl. 5. Age not definitely known but believed to be late Paleozoic. Mapped as Pennsylvanian(?) or Permian(?).

R. R. Coats, 1956, U.S. Geol. Survey Bull. 1028–C, p. 48–49. Described on northern Adak Island. Leaf impressions, identified as *Annularia stellata* (Schlotheim) Wood, of Pennsylvanian or Permian age, have been collected from sandstone in northernmost outcrops, isolation of sequence in which fossil was found from type area about Finger Bay and Sweeper Cove introduces the possibility that rocks of more than one age are included in the mapped unit. At present, Finger Bay volcanics are regarded as Paleozoic(?).

G. D. Fraser and G. L. Snyder, 1959, U.S. Geol. Survey Bull. 1028–M, p. 377–384. Coats (1956) included a body of fossiliferous yellow sandstone of volcanic composition, basaltic flows, and sills that crop out between Clam Lagoon and Andrew Lake in northern Adak Island in his Finger Bay volcanics as mapped. The rocks are Pennsylvanian or Permian as indicated by impressions of fossil leaves. Relations of these fossiliferous rocks to rocks of Finger Bay volcanics, which are continuous with those mapped as Finger Bay volcanics in southern Adak Island (and identical with those of Kagalaska Island) are uncertain. Volcanic sandstone beds of northern Adak Island are doubtless terrestrial beds, whereas Finger Bay volcanics of this report is interpreted as marine Tertiary(?) age believed more probable than Paleozoic(?) for Finger Bay volcanics.

Underlies southern part of northern Adak Island; well exposed in Finger Bay from which it takes its name. Also on chain of islands extending eastward to Great Sitkin Island and beyond; in central part of Aleutian Islands.

Finger Lakes Group

Finger Lakes Stages

Upper Devonian (Senecan): North America.

G. A. Cooper and others, 1942. Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1734, chart 4. Devonian is subdivided into 10 stages of which the Finger Lakes is seventh in sequence (ascending). [For complete sequence see Helderberg stage this reference.] Preceded by Taghanic stage (new). Includes strata from top of Geneseo shale to base of Chemung stage (Cayuta shale and sandstone and Grimes sandstone). Sequence includes Genesee and Naples groups.

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 Finger Lakes group. Includes Portage and Catskill formations. Overlies Taughannock group; underlies Chemung group.

Type section (stage): In Finger Lakes country of New York where these rocks are exposed on all the larger lakes.

Finis Formation (in Caddo Creek Group)

Finis Shale Member (of Graham Formation)[1]

Pennsylvanian (Canyon Series): Central northern Texas.

Original reference: F. B. Plummer and R. C. Moore, 1922, Jour. Geology, v. 30, p. 24, 31; Texas Univ. Bull. 2132, p. 127–128.

B. F. Howell, Wagner Free Inst. Sci., v. 28, no. 1, p. 4. Referred to as Finis formation in Caddo Creek group, Canyon series.

Named for Finis, Jack County.

Finlay Limestone

Finlay Limestone (in Fredericksburg Group)[1]

Finlay Limestone (in Sixshooter Group)

Lower Cretaceous (Comanche Series): Western Texas.

Original reference: G. B. Richardson, 1904, Texas Univ. Min. Survey Bull. 9, p. 47.

R. M. Huffington, 1943, Geol. Soc. America Bull., v. 54, no. 7, p. 992 (fig. 2), 1004. In vicinity of northern Quitman Mountains, overlies Cox sandstone; underlies Kiamichi formation. Thickness about 100 feet. Basal formation of Fredericksburg group.

R. M. Huffington, 1947, Harvard Univ. Summ. of Theses, 1943–1945, p. 196. In Quitman Mountains, overlies Cox formation; underlies Tarantula formation (new).

Elliot Gillerman, 1953, U.S. Geol. Survey Bull. 987, p. 22–24, pls. 1, 10. Described in Eagle Mountains, Hudspeth County. Thickness 198½ feet. Overlies Cox sandstone; underlies Kiamichi formation. Map bracket shows the Finlay as basal formation in Fredericksburg group.

Hugh Hay-Roe, 1957, Texas Univ. Bur. Econ. Geology Geol. Quad. Map 21. Described in Wylie Mountains and vicinity where it is basal formation of Sixshooter group (new). Underlies Boracho formation (new); overlies Cox sandstone. Thickness 110 to 170 feet.

J. P. Brand and R. K. DeFord, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 2, p. 374 (fig. 2), 378–379. Described in Kent quadrangle. Basal member of Sixshooter group. Underlies Levinson limestone member (new) of Boracho limestone. Unconformably overlies Cox sandstone. Thickness 40 feet.

Named for Finlay Mountains, El Paso County.

†Finley Limestone[1]

Lower Ordovician (Beekmantown): Southwestern Missouri.

Original reference: E. M. Shepard, 1904, Bradley Geol. Field Sta. Drury Coll. Bull. 1, pt. 1, p. 42.

Finley Creek, Christian County.

Finley Knob Shale Member (of Carwood Formation)[1]

Lower Mississippian: Southern Indiana.

Original reference: P. B. Stockdale, 1931, Indiana Dept. Conserv., Div. Geology Pub. 98, p. 77, 100, 111, 116, 148, 151, 152, 154, 158, 162–163.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 75. Finley Knob shale member included in Bennettsville facies of Carwood.

Name derived from Finley Knob, on Knobstone Escarpment, NW¼ sec. 5, T. 2 N., R. 6 E., 6 miles west of Vienna, Scott County.

Finney Greenschist

Age not stated: Northern Washington.

R. W. Jones, 1959, Dissert, Abs., v. 20, no. 3, p. 994. Consists of actinolite-, tremolite-, glaucophane-, and crossite schists with interlayered quartz-albite schists. Forms core of synclinorium. Gold Mountain phyllite (new) forms adjacent anticlinorium.

Report discusses geology of Finney Peak area, northern Cascades.

Finnie Sandstone Member (of Abbott Formation)

Finnie Sandstone (in Tradewater Formation)[1]

Pennsylvanian: Western Kentucky, southern Illinois, and southern Indiana.

Original reference: L. C. Glenn, 1912, Kentucky Geol. Survey Bull. 17, p. 13, 14, 23, 24.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 34, 83. Massive sandstone in lower part of Tradewater formation between Ice House above and Bell coals; locally attains maximum thickness of 60 to 80 feet. Recognized in Indiana.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 31, 44 (table 1), 62. Reallocated to member status in Abbott formation (new). Replaces name Delwood sandstone so that term Delwood may be retained for the coal. Overlies Willis coal member (new); underlies Delwood coal member (new). Thickness about 60 feet at type section of Abbott. Type locality stated. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type locality: Along road for less than 2 miles north of Mulfordtown [Milfordtown], near Caseyville, Union County, Ky. Named for Finnie Bluff, on road north of Milfordtown.

Fire Clay Hill Bentonitic Shale (in Chinle Formation)

Upper Triassic: Southwestern Utah.

P. D. Proctor, 1953, Utah Geol. and Mineralog. Survey Bull. 44, p. 19–22, pl. 2. Fluffy soil indicative of bentonite with gentle to steep scarps, characterizes weathered outcrop of these gray to purplish beds. Towards the base, calcareous concretions and geodes as much as 6 inches in diameter occur sporadically and in places are associated with concretions of iron-oxide and copper-bearing concretions. Agate beds banded with red, orange, green, yellow, and white occurs at base of shales, ranges in thickness from fraction of an inch to almost a foot, and is remarkably persistent total. Thickness changes a little from East Reef to West Reefs; average is 10–13 feet. Underlies Trail Hill sandstone (new); overlies Hartley shale and sandstone (new).

Best exposures of shales on East Reef 1,000 feet north of Duffin mine. Best exposures of agate bed at base of Fire Clay Hill south of old town of Silver Reef, Silver Reef (Harrisburg) Mining District, Washington County.

Fire Creek Underclay (in New River 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. Medium gray clay, about 4 feet thick, in lower part of New River group; about 900 feet below base of Kanawha group. Commonly occurs immediately below Fire Creek coal, but locally is separated from it by a foot of carbonaceous shale.

Present in Webster County.

Firemoon Limestone Member (of Piper Formation)

Middle Jurassic: Central and eastern Montana (subsurface and surface) and western North Dakota (subsurface).

J. W. Nordquist, 1955, Billings Geol. Soc. Guidebook 6th Ann. Field Conf., p. 97, 101–102. Consists of 69 feet of buff to brown, dense to earthy limestone in type section, which is typical of member throughout much of northern and eastern Montana. Locally becomes sandy and oolitic. In some wells, member is dolomitic and cherty, especially on east flank of Sweetgrass arch. In south-central Montana, unit is thinly bedded with much varicolored claystone and locally some gypsum. Pebbly oolitic and coquinoid limestones common. Very uniform in thickness. In outcrop sections, member appears transitional with underlying Tampico shale member (new) and overlying Bowes member (new), but in subsurface of northern Montana stratigraphic boundaries generally sharp. West and south of Bearpaw Mountains, it overlaps Tampico member and unconformably rests on Madison limestone. Occasionally in contact with Amsden formation on Big Snowy platform. Unit is correlative to middle limestone member of Piper as described by Imlay and others (1948).

Type section: Interval from 4,618 to 4,687 feet in Murphy Corp. No. 1 Firemoon well, center SE¼SE¼ sec. 12, T. 30 N., R. 41 E., Valley County, Mont.

First 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), 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 First Street proposed for terrace deposit that is younger than and lies about 18 feet below Beaumont (Sixth Street) terrace. Composed of dark weathering silt overlying limestone gravel.

Named for occurrence at corner of First and Chicon Streets, Austin, Travis County. Extends much of length of First Street east of Congress Avenue.

Fish Creek Argillite[1]

Paleozoic(?): Northeastern Washington.

Original reference: C. E. Weaver, 1920, Washington Geol. Survey Bull. 20, p. 80, map.

Occurs along Fish Creek, Stevens County.

†Fish Creek Beds[1]

Upper Cretaceous: Central southern Montana.

Original reference: E. Douglass, 1902, Am. Philos. Soc. Proc., v. 41, p. 207–221.

In area east of Crazy Mountains and south of Big Snowy Mountains, in basin of Musselshell River. Well exposed between Fish and Mud Creeks, a few miles from where the latter empties into Musselshell River Sweetgrass County.

Fish Creek Gypsum

Miocene: Southern California.

T. W. Dibblee, Jr., 1954, California Div. Mines Bull. 170, chap. 2, p. 22, pl. 2. Playa deposit of white bedded gypsum and anhydrite. Ranges in thickness from knife edge to about 100 feet. Rests on Split Mountain conglomerate and is overlain by Imperial formation in western Fish Creek Mountains.

Occurs in Fish Creek Mountains in southwestern Imperial Valley.

Fish Creek Sandstone Member (of Greene Formation)[1]

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

Original reference: J. J. Stevenson, 1876, Pennsylvania 2d Geol. Survey Rept. K, p. 42.

R. L. Nace and P. P. Bieber, 1958, West Virginia Geol. Survey Bull. 14, p. 17. Fish Creek sandstone listed in summary of stratigraphic sections of Dunkard group in Harrison County. Thickness about 30 feet. Occurs above Fish Creek coal and below unnamed shale below Hostetter coal and (or) fire clay.

Thomas Arkle, Jr., 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 118 (table 1). Fish Creek sandstone listed in Greene series. Occurs above Fish Creek coal and below Hostetter coal.

Named for exposures on Fish Creek, southwestern Greene County, Pa.

Fish Creek Shale (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. 183.

Named for association with Fish Creek coal.

†Fish Creek shale (in Medinan Group)

Lower Silurian: Western New York, and southern Ontario, Canada.

D. W. Fisher, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 9, p. 1987–1988. Name proposed for medium-dark-gray argillaceous rock with minor amounts of angular quartz silt, secondary silicia, and secondary calcite. Thin beds of calcareous sandstone occur near base. Includes Rumsy Ridge sandstone member (new) 6 feet above base in Niagara Gorge. Maximum thickness 24 feet. Underlies Manitoulin dolomite; overlies Whirlpool sandstone with transitional contact. Unit corresponds to lower part of Power Glen formation of Ontario, and abandonment of latter name suggested.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. Name preoccupied; replaced by Rumsy Ridge shale herein given formational status.

Type locality: In Niagara Gorge. Best sections include those near old tunnel for abandoned New York Central Railroad, 0.9 mile south of center of village of Lewiston and 0.2 mile south of American end of Lewiston suspension bridge, Niagara County, N.Y. Also well exposed where Fish Creek cascades down east wall of Niagara Gorge, 500 feet south of Lewiston Bridge.

Fisher Formation[1]

Eocene, upper, and Oligocene: Northwestern Oregon.

Original reference: H. G. Schenck, 1927, California Univ. Pub. Dept. Geol. Sci. Bull., v. 16, no. 12, p. 451, 459.

H. E. Vokes, P. D. Snavely, Jr., and D. A. Myers, 1951, U.S. Geol. Survey Oil and Gas Inv. Map OM–110. Continental Fisher formation consists of approximately 7,000 feet of clastic material, largely andesitic lapilli tuffs and breccias, but includes also large amounts of basaltic and some rhyolitic fragmental debris; in lower part of formation are lenses of coarse water-laid conglomerate that may be as much as 50 feet thick and contain boulders predominantly of andesitic composition, as much as 4 feet in diameter. At all exposures mapped, Eugene formation rests on tuffs of the Fisher, the contact being marked by soft friable arkosic and quartzose sandstone that contains much fossil wood. Evidence indicates Fisher and Eugene formations are contemporaneous. Overlies Spencer formation (redefined). Upper Eocene and Oligocene.

Typically exposed in vicinity of Coyote Creek sec. 12, T. 18 S., R. 5 W., about 8 miles west of Eugene, and near Fisher Butte, one-quarter mile west of Oak Hill, Lane County.

Fisher Quartz Latite

Fisher Latite-Andesite[1]

Tertiary, middle or upper: Southwestern Colorado.

Original reference: E. S. Larsen, 1917, Colorado Geol. Survey Bull. 13, p. 20, 23–33.

E. S. Larsen, Jr., and Whitman Cross, 1956, U.S. Geol. Survey Prof. Paper 258, p. 13, 172–185, pl. 1. Termed Fisher quartz latite. Characteristically a chaotic aggregate of flows and breccias. Outcrops are mostly light gray to brownish and somewhat darker than those of rhyolites of Potosi volcanic series. Maximum thickness about 1,000 feet. Overlies different formations of Potosi volcanic series from Conejos quartz latite to Piedra rhyolite; also locally overlies older rocks and Creede formation. In most places, not overlain by younger formations but locally overlain by Hinsdale formation.

T. A. Steven and J. C. Ratté, 1960, U.S. Geol. Survey Prof. Paper 343, p. 13–28, pls. 1, 2. Fisher quartz latite, in Summitville district, differentiated into two members separated by an unconformity. Lower member consists of rhyo-dacite and quartz latitic flows, volcanic domes, and pyroclastic rocks (tuff and volcanic breccia) that were erupted onto irregular surface cut across earlier volcanic rocks of San Juan Mountains. Resulting pile of volcanic rocks was faulted, locally altered by hydrothermal activity, and deeply eroded before renewed eruptions poured out quartz latitic lava flows to form upper member of formation. Unconformable above Conejos formation. Middle or upper Tertiary.

Named for exposures in vicinity of Fisher Mountain, Creede quadrangle.

Fish Haven Dolomite[1]

Upper Ordovician: Southern Idaho and northeastern and western Utah.

Original reference: G. B. Richardson, 1913, Am. Jour. Sci., 4th, v. 36, p. 407, 409.

L. L. Sloss, 1954, Geol. Soc. America Bull., v. 65, no. 4, p. 365, 366, 367 (fig. 1). In Lemhi arch, Idaho, overlies Kinnikinic quartzite and underlies Laketown and(or) Jefferson dolomite. Thickness 41 to 700 feet.

R. W. Rush, 1956, Utah Geol. and Mineralog. Survey Bull. 53, p. 12 (fig. 3), 16 (fig. 4), 18–19, measured sections. In western Millard County, Utah, is predominantly dolomite with chert; subdivided into five unnamed members. Thickness 505 to 590 feet. Conformably underlies Roberts Mountain[s] formation; overlies Eureka quartzite.

P. D. Proctor and others, 1956, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–45. Mapped in Allens Ranch quadrangle where it is 280 feet thick. Overlies Opohonga limestone and underlies unit referred to as Bluebell and Fish Haven undifferentiated.

H. T. Morris, 1957, Utah Geol. Soc. Guidebook 12, p. 10, 11 (fig. 3). In East Tintic Mountains, underlies Bluebell dolomite and overlies Opohonga limestone. Thickness 275 to 350 feet. As used in this area, includes lower third of Bluebell dolomite of Loughlin (1919); thus, it includes Eagle dolomite plus lower half or so of Beecher dolomite.

J. K. Rigby, 1958, Utah Geol. Soc. Guidebook 13, p. 28 (fig. 4), 31–33. In Stansbury Mountains is as much as 260 feet thick, underlies Laketown dolomite and overlies Kanosh shale. In northern areas, where Kanosh is missing, overlies Garden City formation.

H. J. Bissell, 1959, Utah Geol. Soc. Guidebook 14, p. 137–140. In Fivemile Pass-North Boulter Mountain area consists essentially of dark-gray and medium gray-blue aphanitic to coarse-crystalline dolomite in thin- to massive-bedded layers, with some gray chert. Thickens gradually through Boulter Mountains to about 70 feet in Rattlesnake spur area. Disconformably underlies Laketown dolomite; overlies Opohonga limestone.

M. H. Staatz and F. W. Osterwald, 1959, U.S. Geol. Survey Bull. 1069, p. 17–21, pl. 1. Described in Thomas Range, Juab County, Utah, where it is 280 to 303 feet thick; overlies Swan Peak formation and underlies Floride dolomite (new).

Named for exposures on Fish Haven Creek, Bear Lake County, Idaho.

†Fish House Beds[1]

Pleistocene: Southern New Jersey.

Original reference: L. Woolman, 1897, New Jersey Geol. Survey Ann. Rept. State Geologist 1896, p. 201.

At Fish House, on Delaware River, about 5 miles north of Camden, Camden County.

Fish House Clay[1]

Pleistocene: Southern New Jersey.

Original reference: R. D. Salisbury, 1895, New Jersey Geol. Survey Ann. Rept. State Geologist 1894.

At Fish House, on Delaware River, about 5 miles north of Camden, Camden County.

Fishkill Limestone[1]

Cambrian and Ordovician: Southeastern New York.

Original reference: J. M. Clarke, 1909, New York State Mus. Bull. 133, p. 12–18.

D. W. Fisher, 1956, Internat. Geol. Cong., 20th, Mexico, Cambrian Symposium, pt. 2, p. 329, 343. Name rejected. Stockbridge has priority.

Crops out in town of Fishkill, northwest of road from Fishkill Village to Matteawan, Dutchess County.

Fishpot cyclothem

Pennsylvanian (Monongahela Series) : Southeastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 158 (table 13), 168 (map 21), 170–172. Embraces interval between Redstone cyclothem (new) below and Lower Sewickley cyclothem (new) above. Normal sequence includes six members (ascending): Pomeroy sandstone, Fishpot redbed, Fishpot limestone, Fishpot underclay, Fishpot coal, and Fishpot roof shale. Thickness varies from 15 to 50 feet; average 44 feet; variability is attributed to thickening and thinning of Pomeroy sandstone. 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.

Fishpot Limestone Member (of Monongahela Formation)[1]

Fishpot Limestone (in Monongahela Group)

Fishpot limestone and shale member

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

Original reference: J. J. Stevenson, 1876, Pennsylvania 2d Geol. Survey Rept. K.

M. N. Shaffner, 1952, Pennsylvania Geol. Survey, 4th ser., Prog. Rept. 141. Shown on columnar section below Sewickley sandstone and above Redstone coal in Monongahela group.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 10 (fig. 3), 71–72, geol. map. Fishpot limestone and shale member (Monongahela series) occupies interval between Pomeroy sandstone (below) and Fishpot clay members. In Morgan County, consists of an alternation of limestone and calcareous shale layers which vary rapidly in thickness and lateral extent. Thickness 15 to 33 feet. Basal contact is uncertain where the sandstone and shale development extends upward in thick section; summit boundary indefinite where Fishpot coal and clay members are absent and where overlying Lower Sewickley sandstone is shaly; locally the Fishpot extends to or near base of Meigs Creek (No. 9) coal. In three localities; Pomeroy sandstone occupies entire interval of Fishpot limestone.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 159 (table 13), 171. Member of Fishpot cyclothem in report on Athens County. Thickness as much as 34 feet. Monongahela series.

Probably named for occurrence at mouth of Fishpot Run in southern Washington County, Pa.

Fishpot roof shale member

See Fishpot cyclothem.

Fishpot Sandstone (in Monongahela Formation)[1]

Upper Pennsylvanian: Eastern Ohio.

Original reference: R. E. Lamborn, 1930, Ohio Geol. Survey, 4th ser., Bull. 35, p. 29, 32, 181, 234, 235–236.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 10 (fig. 3), 71. Term Fishpot sandstone, as defined by Lamborn (1930), was applied to a sandstone occurring between the Fishpot and Sewickley (Meigs Creek) coals. Probable correlation with Lower Sewickley sandstone of West Virginia was recognized by Lamborn; thus, the term Fishpot as applied by Lamborn is stratigraphically higher than the Pomeroy sandstone of Lovejoy. On "Generalized Section of Rocks of Ohio," published by Ohio Geological Survey (Stout, 1939 and 1947), the sandstone above the Redstone (Pomeroy) (No. 8–A) coal is designated as the Fishpot or Pomeroy sandstone. However, the Ohio Geological Survey no longer considers the Fishpot sandstone correlative with the Pomeroy sandstone, and term Fishpot is abandoned.

Type locality and derivation of name not stated.

Fishpot underclay member

See Fishpot cyclothem.

Fisk Formation (in Admiral Group)

Permian (Wolfcamp Series): North-central Texas.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, p. 66 (fig. 1), 95–96. Proposed for the limestones and underlying shales and sandstones ("Indian Creek bed" of Drake, 1893 [Indian Creek shale member of Admiral formation]) that occur above the Hords Creek formation (redefined) and below the disconformity at the base of the newly defined Jim Ned shale.

M. G. Cheney, 1948, Abilene Geol. Soc. [Guidebook] Spring Field Trip June 11–12, p. 15. Wildcat Creek shale and Overall limestone members of Admiral formation are names being introduced by R. C. Moore to replace "Indian Creek" shale and "Coleman" limestone of earlier reports. These two members are equivalent to the Fisk formation.

Name derived from village of Fisk about 12 miles southwest of Coleman, Coleman County. Fisk is located on upper part of the formation.

Fiske Creek Formation

Upper Jurassic[?] or Cretaceous[?]: Northern California.

Klaus Küpper, 1956, Cushman Foundation Foram Research Contr., v. 7, pt. 2, no. 152, p. 40–47. Description of Upper Cretaceous pelagic Foraminifera from "Antelope shale" of Taliaferro (1954). Kirby (1943, California Div. Mines Bull. 118) referred to these strata as Horsetown formation of Shasta group. J. Lawton (unpub. thesis) has proposed term Fiske Creeke formation for this unit. In present report, term "Antelope shale" is used as most suitable published name, although it is a junior homonym of "Antelope formation" (Miocene) subsurface, Kern County, Calif., described by Noble (1940, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 3).

J. E. Lawton, 1956, Dissert. Abs., v. 16, no. 10, p. 1885. Uppermost of six formations in area studied. Overlies Brophy Canyon formation (new). Upper Jurassic and Cretaceous section, about 40,000 feet thick, consists of sequences of shale and silty shale which alternate with sequences of sandstone.

Occurs in Morgan-Wilbur area in Lake, Yolo, and Colusa Counties.

Fiss Fanglomerate (in Tropico Group)

Miocene(?): Southern California.

T. W. Dibblee, Jr., 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 1, p. 137 (fig. 1), 138, 141. Composed of ill-sorted cobbles and boulders of pinkish-brown rhyolitic volcanic and granitic rocks; crudely bedded; nonfossiliferous. Thickness at type section about 500 feet; 1 mile northwest 900 feet; at Antelope Buttes about 1,700 feet. Overlies Gem Hill formation (new), in places unconformably; top is eroded, and, north of Rosamond, fanglomerate is unconformably overlain by gravel of probable Pleistocene age.

Type locality: Fiss Hill, in west-central part sec. 1, T. 9 N., R. 13 W., San Bernardino base and meridian, 1½ miles north-northeast of Tropico mine, 4½ miles northwest of Rosamond, Rosamond quadrangle, Kern County. Crops out discontinuously about 8 miles along southwestern margin of Rosamond Hills from the west end 6 miles northwest of Rosamond to Red Hill.

Fitch Formation[1]

Middle Silurian: West-central New Hampshire.

Original references: M. P. Billings and A. B. Cleaves, 1933, Geol. Soc. America Bull., v. 44, no. 1, p. 196; 1933, Am. Jour. Sci., 5th ser., v. 25, no. 146, p. 149.

M. P. Billings, 1956, Geology of New Hampshire, pt. 2, bedrock geology: Concord, New Hampshire State Plan. Devel. Comm., p. 24–27. Formation is in chlorite metamorphic zone northwest of the Ammonoosuc River. Interbedded rocks in that area include bluish-gray limestone, white marble, buff dolomite slate, gray calcareous slate and gray slate; less common are white calcareous sandstone, gray arenaceous limestone, white arkose and light-gray quartz conglomerate. In other areas, formation is represented in staurolite metamorphic zone by white to buff marble, greenish-gray diopside-actinolite granulite, greenish-gray actinolite marble, purplish-brown actinolite-biotite schist, purplish-brown biotite-calcite schist, light-gray arenaceous marble, white quartzite, and light-gray mica schist. Also includes amphibolites in area west of Newport. Overlies Clough formation: underlies Littleton formation. Distribution discontinuous; hence, not everywhere present between Clough and Littleton formations.

Named for [G. E.] Fitch Farm, 2 miles northwest of Littleton, Grafton County.

Fitchburg Granite[1]

Upper Carboniferous or post-Carboniferous: Central Massachusetts and south-central New Hampshire.

Original reference: B. K. Emerson, 1917, U.S. Geol. Survey Bull. 597, p. 231–233, map.

M. P. Billings, 1956, Geology of New Hampshire, pt. 2, Bedrock geology: Concord, New Hampshire State Plan. Devel. Comm., p. 67. Represented mostly by granodiorite in the Fitchburg pluton in New Hampshire. Granodiorite was mapped with the granite by Emerson (1917).

Outcrop area extends through Fitchburg, Mass.

Fitch Hill Arkose[1]

Silurian (Niagaran): Northwestern New Hampshire.

Original reference: F. H. Lahee, 1913, Am. Jour. Sci., 4th, v. 36, p. 231–250.

Forms Fitch Hill, northwest of town of Lisbon, Grafton County.

Fitch Hill Granite Gneiss[1]

Silurian(?): Northwestern New Hampshire.

Original reference: F. H. Lahee, 1913, Am. Jour. Sci., 4th, v. 36, p. 231–250, map.

Probably named for proximity to Fitch Hill, northwest of town of Lisbon, Grafton County.

Fitchville Formation

Lower Mississippian: Central Utah.

M. D. Crittenden, Jr., 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 63, 65, 69 (fig. 3). Basal beds in Provo area are characterized by yellowish-weathering unit ranging from 1 to 10 feet thick and varying in composition from limy siltstone to well-cemented quartzite; bulk of formation is dolomite, commonly with two distinct and roughly equal units—a lower one of light-gray medium-grained dolomite and an upper one of coarser grained dark-gray dolomite—separated by a few feet of yellowish limy siltstone much like that at base. Thickness 170 to 265 feet. In some places overlies limestone member of Ophir shale, and in others overlies about 200 feet of Maxfield limestone; underlies Gardison limestone (new). Unit formerly presumed to be Devonian and called Jefferson(?) dolomite (Calkins and Butler, 1943, U.S. Geol. Survey Prof. Paper 201). Name credited to Morris and Lovering.

Named for exposures on Fitchville Ridge, East Tintic Mountains.

Fite Limestone[1]

Ordovician: Central eastern Oklahoma.

Original reference: I. H. Cramm, 1930, Oklahoma Geol. Survey Bull. 40-QQ, p. 20–22.

G. G. Huffman and others, 1958, Oklahoma Geol. Survey Bull. 77, p. 14 (fig. 2), 24–26, pls. 3, 4. Described on southwestern flank of Ozark uplift as a predominantly light-gray dense lithographic limestone characterized by specks and streaks of clear calcite; near base is a 3-foot bed of buff sandy dolomite underlain by 2 feet of gray lithographic limestone; upper beds are massive when fresh but weather into layers 4 to 20 inches thick. Thickness about 8 feet. Unconformably underlies Fernvale limestone; believed to conformably overlie Tyner formation; alternating ledges of Tyner and Fite lithologies in basal parts are thought to represent transition from dominantly dolomite facies of Tyner to lithographic limestone of Fite.

Named from exposures on estate of Dr. Fite in sec. 11, T. 17 N., R. 22 E., northeast of Tahlequah, Cherokee County.

Fittstown Member (of Bois d'Arc Formation)

Silurian and Devonian: South-central Oklahoma.

T. W. Amsden, 1957, Oklahoma Geol. Survey Circ. 44, p. 6 (fig. 3), 45–47, fig. 4. Name proposed for upper member of formation. Described as fossiliferous calcarenite with relatively low silt-clay content; beds 6 or 8 inches thick; locally contains nodules and lenses of chert. Thickness difficult to determine due to gradational nature of lower boundary; maximum thickness 75 feet (on Haragan Creek); on Lawrence uplift, thickness ranges from 25 to 60 feet. Overlies Cravatt member; underlies Frisco formation.

Type locality: Along Chimneyhill Creek, SE¼ and NE¼ sec. 4, T. 2 N., R. 6 E., Pontotoc County. Named from town of Fittstown.

Fitzwilliam Granite[1]

Upper Carboniferous or post-Carboniferous: Southwestern New Hampshire and central northern Massachusetts.

Original reference: C. H. Hitchcock, 1873, Am. Assoc. Adv. Sci. Proc., v 21, p. 134–135.

Named from Fitzwilliam, Cheshire County, N.H.

Fivemile 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. 295–296, 338–340.

Type locality: Fivemile Creek, along Princeton-Narrows Road, 4.5 miles southeast of Princeton, Mercer County, W. Va.

Five Oaks Limestone (in Cliffield Group)

Five Oaks Limestone (in Lurich Formation or Group)

Five Oaks Limestone Member (of Cliffield Formation)

Middle Ordovician: Northeastern Tennessee and southwestern Virginia.

B. N. Cooper and C. E. Prouty, 1943, Geol. Soc. America Bull., v. 54, no. 6, p. 826, 863, 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 29 zones (ascending). Name Five Oaks limestone member of Cliffield formation is applied to zone 4, described as the first calcilutite, the lowest of four zones of fine-grained high-calcium limestone. Thickness at type locality 50 feet; average thickness about 25 feet. Overlies Blackford member (new); underlies Ward Cove member (new). Five Oaks member is Butts' Mosheim in Burkes Garden, Thompson Valley, and in median and northwestern belts west of Tazewell but does not correspond to the Mosheim of the Yellow Branch section in Lee County.

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 57–58. In area between Brushy and Walker Mountains, the Five Oaks is considered a formation in Cliffield group.

B. N. Cooper, 1945, Virginia Geol. Survey Bull. 66, p. 17 (fig. 3), 44–46. Overlies Elway limestone (new).

C. E. Prouty, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 7, p. 1148–1150. Widely distributed and represented in all belts in southwestern Virginia and northeastern Tennessee. In local absence of the Blackford, the Five Oaks rests directly on Beekmantown dolomites. Thickness at Rye Cove, Va., 90 feet.

R. L. Miller and W. P. Brosgé, 1954, U.S. Geol. Survey Bull. 990, p. 33–34, 41–43. Probably correlates with Rob Camp limestone of Jonesville district. Discussion of problems of correlation and summary of nomenclature of Middle Ordovician formations in Lee and Tazewell Counties.

Marshall Kay, 1956, Geol. Soc. America Bull., v. 67, no. 1, p. 69, 72. Included in Lurich formation or group (new).

L. D. Harris and R. L. Miller, 1958, U.S. Geol. Survey Quad. Map GQ–111. In Duffield quadrangle, the upper 15 feet of the Elway may be equivalent to the Five Oaks limestone as used by Cooper (1945) in Scott County.

Type locality: In lime quarry at Five Oaks village, about 4 miles northeast of Tazewell, Tazewell County, Va.

Five Point Limestone Member (of Janesville Shale)

Five Point Limestone (in Admire Shale)[1]

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 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 Hamlin shale member; overlies West Branch shale member. Wolfcamp series.

Type locality: Five Point Creek, near Five Point School, sec. 25, T. 1 N., R. 15 E., 2 miles south and 4½ miles west of Falls City, Richardson County, Nebr.

Fizzle Flat Lentil (in Terlingua Formation)

Cretaceous (Gulf Series): Western Texas.

C. G. Moon, 1953, Geol. Soc. America Bull., v. 64, no. 2, p. 151, 159 (fig. 2), 160, 164. Name applied to a 50-foot rock unit that occurs about the middle of the Bouquillas-Terlingua sequence and is considered as the base of the Boquillas-Terlingua unit. The lentil, termed a transition zone, is predominantly a creamy-yellow platy impure limestone.

Occurs in Agua Fria quadrangle, in southwestern part of Brewster County, in Big Bend region.

Flades Clay[1]

Silurian (Niagaran) : East-central Kentucky.

Original references: A. F. Foerste, 1905, Kentucky Geol. Survey Bull. 6, p. 145; 1906, Bull. 7, p. 10, 18, 60.

Named for Flades Creek, east of Crab Orchard, Lincoln County.

Flag Pond Granite Group

Precambrian: North Carolina and Tennessee.

Ebraham Shekarchi, 1959, Dissert. Abs., v. 20, no. 4, p. 1323. Crystalline complex is divided into two groups, Flag Pond granite and unakite granite. Both groups contain mylonite, pegmatite, diorite bodies, basic dikes, and various types of granite. Flag Pond granite group is a medium- to fine-grained granite with units of sheared biotite granite.

Report discusses geology of Flag Pond quadrangle, Tennessee-North Carolina.

Flag Rock Formation

Precambrian: Southwestern South Dakota.

T. A. Dodge, 1942, Geol. Soc. America Bull., v. 53, no. 4, p. 563. Graphitic, sandy, or pyritic schists: some quartzite. Thickness 5,000 feet. Unconformably overlies Northwestern formation; underlies Grizzly formation (new).

J. A. Noble and J. O. Harder, 1948, Geol. Soc. America Bull., v. 59, no. 9, p. 944, 949–952, pl. 1. Heterogeneous. Most abundant material is light-gray sericitic phyllite or schist. Special feature of formation is the Iron Dike that forms conspicuous outcrops on hilltop to east and northeast of Lead. This consists of dense siliceous jaspery material, for the most part without visible bedding. Thickness 5,000 feet, but there may be some duplication by faulting. Overlies Northwestern formation; underlies Grizzly formation.

In Lead district.

Flag Spring Limestone (in Conemaugh Formation)[1]

Pennsylvanian: Ohio.

Original reference: E. Orton, 1878, Ohio Geol. Survey, v. 3, p. 889–890.

Named for well-known locality in Walnut Township, Gallia County.

Flag Spring Trachyte[1]

Tertiary, middle or upper: Northwestern Arizona.

Original reference: F. L. Ransome, 1923, U.S. Geol. Survey Bull. 743.

Well exposed in cliffs along Cottonwood Canyon. Named for Flag Spring, in the canyon, Oatman district.

Flagstaff Limestone[1]

Flagstaff Formation

Paleocene, upper, and Eocene, lower(?) : Central eastern Utah.

Original reference: E. M. Spieker and J. B. Reeside, Jr., 1925, Geol. Soc. America Bull., v. 36, p. 150–151, 488.

E. M. Spieker, 1946, U.S. Geol. Survey Prof. Paper 205–D, p. 122, 135–136. Limestone, gray shale, gray sandstone, some oil shale. Thickness 300 to 1,500 feet. Overlies North Horn formation with local unconformity; underlies Colton formation. Age uncertain, more likely Paleocene than lower Eocene.

W. N. Gilliland, 1951, Nebraska Univ. Studies, new ser., No. 8, p. 25–33, pl. 2. Formation described in Gunnison quadrangle; term limestone considered inappropriate in area west of Sevier Valley where unit contains large amounts of sandstone and conglomerate. Four more or less distinct facies in area: Valley Mountain, yellow, gray, and red dense massive limestone with some shale; red limestone, arenaceous, in part, interbedded with considerable amounts of sandstone and conglomerate; Fayette facies, massive gray dense limestone; and Willow Creek, conglomerate and limestone. Throughout extent, lacustrine Flagstaff strata are gradational with fluviatile sediments of underlying North Horn formation and overlying Colton formation. Fauna indicates early Tertiary no younger than Eocene, and, in view of other date, late Paleocene age seems acceptable.

S. L. Schoff, 1951, Geol. Soc. America Bull., v. 62, no. 6, p. 622 (table 2), 631–632. Described in Cedar Hills area where it is 750 feet thick; overlies North Horn formation and underlies Colton formation. Upper Paleocene and lower Eocene.

Aurèle La Rocque, 1960, Geol. Soc. America Mem. 78, 100 p. Formation divided into three units: lowest, Paleocene; middle, Paleocene or Eocene; and upper, Eocene. This determination made on basis of study of molluscan faunas. Unconformably overlies North Horn formation; underlies and interfingers with Colton formation; where Colton is absent, underlies Green River formation. Type section noted.

U.S. Geological Survey currently designates the age of the Flagstaff Limestone as upper late Paleocene and lower Eocene(?) on basis of a study now in progress.

Type section: On slopes of Flagstaff Peak, T. 20 S., R. 5 E., San Pete County.

Flambeau Quartzite[1]

Precambrian (Huronian): Northwestern Wisconsin.

Original reference: W. O. Hotchkiss and others, 1915, Wisconsin Geol. Nat. History Survey Bull. 44, econ. ser. 19, p. 50.

Probably named for exposures at Flambeau or on Flambeau River, Rusk County.

†Flaming Gorge Group[1]

Upper Jurassic: Northeastern Utah and northwestern Colorado.

Original reference: J. W. Powell, 1876, Geology of eastern portion of Uinta Mountains, p. 41, 51, 146, 151.

Named for Flaming Gorge, on south side of Green River, at mouth of Henrys Fork, Uintah County, Utah.

†Flanagan Limestone[1]

Middle Ordovician: Central Kentucky.

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

Term Flanagan Limestone abandoned. Woodburn and Brannon Limestones, formerly classified as members of the Flanagan are now classified as members of Cynthiana Formation.

Named for exposures at Flanagan Station, Clark County.

Flannigan Coal Member (of Bond Formation)

Pennsylvanian: Southeastern and eastern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 39, 50 (table 1), pl. 1. Assigned member status in Bond formation (new). Occurs above Mount Carmel sandstone member and below Reel limestone member. Coal named by Newton and Weller (1937, Illinois Geol. Survey Rept. Inv. 45). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: Flannigan Township, T. 6 S., R. 5 E., Hamilton County.

Flannigan cyclothem (in Bond Formation)

Flannigan cyclothem (in McLeansboro Group)

Pennsylvanian: Southeastern Illinois.

W. A. Newton and J. M. Weller, 1937, Illinois Geol. Survey Rept. Inv. 45, p. 9, 10; J. M. Weller, 1942, Illinois Acad. Sci. Trans., v. 35, no. 2, p. 145 (table 1). In sequence, occurs below Macoupin cyclothem and above Shoal Creek cyclothem. Thickness about 26 feet.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 52 (table 2), pl. 1. In Bond Formation (new). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification independent of rock-stratigraphic classification.

Named from exposures in Flannigan Township, Hamilton County.

Flat Creek 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), 72, pl. 1. Name applied to coal member stratigraphically above Bunje limestone member (new) and below Witt coal member (new). Thickness about 1 foot. Name credited to J. A. Simon (unpub. ms.). Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification is retained but is entirely independent of rock-stratigraphic classification.

Type locality: NE¼SE¼ sec. 24, T. 6 N., R. 5 W., Bond County. Named for exposures along Flat Creek.

Flat Creek cyclothem (in Bond Formation)

Flat Creek 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 below an unnamed cyclothem below the Millersville cyclothem and above 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. A persistent cyclic succession intervenes between the Flat Creek and Millersville; term Reel limestone has been used for the limestone in this succession. Type locality given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 43, 52 (table 2), pl. 1. In Bond formation (new). Below Witt cyclothem (new). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type locality: Center E½ sec. 24, T. 6 N., R. 5 W., Bond County.

Flat Gap Limestone Member (of Olive Hill Formation)[1]

Flat Gap Formation

Lower Devonian: Western and central Tennessee.

Original reference: C. O. Dunbar, 1918, Am. Jour. Sci., 4th, v. 46, p. 738.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 302–306, figs. 2, 88. Rank raised to formation. Overlies various units of Ross formation (new)—Ross limestone member, Bear Branch facies, Birdsong shale member; unconformably underlies Harriman formation which truncates it northward. Maximum thickness 55 feet at type exposure herein stated.

Type exposure: On Flat Gap Creek, northeast of Olivehill, Hardin County.

†Flathead Formation[1] or Shales[1]

Middle Cambrian: Montana and northwestern Wyoming.

Original reference: A. C. Peale, 1893, U.S. Geol. Survey Bull. 110.

Named for exposures in Flathead Pass, in northeast corner of Threeforks quadrangle, Montana.

Flathead Quartzite[1] or Sandstone

Flathead Sandstone Member (of DePass Formation)

Middle Cambrian: Montana and northwestern Wyoming.

Original references: A. C. Peale (Flathead formation with Flathead quartzite, 125 feet at base, and Flathead shales, 290 feet above), 1893, U.S. Geol. Survey Bull. 110, p. 20–22, pl. 4; W. H. Weed, 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. 1271–1272, 1288, 1289 (fig. 5), 1317 (fig. 9), 1326–1328. Presentation of revision of type Cambrian formations and sections of Montana and Yellowstone National Park. Publications dealing with problem of Cambrian nomenclature in area are discussed. Peale's original Flathead and Gallatin formations are not valid because latter included both Middle and Upper Cambrian rocks. Although Weed and others used Peale's names, the Flathead and Gallatin formations, meanings of these names were never redefined and given official status. Because of error by Walcott, formational name Gallatin was dropped, but name Flathead was retained to include only strata equivalent to Flathead quartzite member of Peale's Flathead formation. In present report, names given by Weed (1900) for Little Belt Mountains are retained to designate type Cambrian formations of central and southern Montana and Yellowstone National Park. These names, Flathead, Wolsey, Meagher, Park, Pilgrim, and Dry Creek, are chosen for types because they were correctly used by Weed (1900); they have been widely used by later writers, and they are taken from carefully measured and located sections. These formational names were correctly taken from geographic features. However, the location of these geographic features were not and are not the type localities or sections of either the original or emended formations. This fact must be clearly understood by future workers. Weed's (1900) definition of Flathead sandstone quoted. Flathead sandstone (herein emended) is basal formation of Cambrian system and everywhere in Montana and Yellowstone Park rests upon Precambrian rocks. Underlies Wolsey shale (emended). Within region, maximum thickness of Flathead is 276 feet in Beaver Creek area; least thickness, 93 feet on Crowfoot Ridge; 243 feet at emended type section; thins northward to average of 90 feet in northwestern Montana. Consists of crossbedded, thin- and thick-bedded sandstones, which have been indurated locally into quartzites. Most diagnostic characteristic is presence of tan and white pure quartz pebbles, which range from less than one-fourth inch to more than 3 inches in diameter, are well rounded, and are largely concentrated into thin lenses. Most exposures exhibit purple-maroon and buff banding, particularly in lower half of formation; upper half commonly thinner bedded, more sandy, and contains intercalated, micaceous, sandy, thin beds of shale. Oolitic hematite or hematitic sandstone, as much as 2 feet thick, commonly marks top of formation. Emended type section is on Belt Creek; formation is better exposed, more complete, and less metamorphosed on Crowfoot Ridge in Yellowstone National Park, Checkerboard Creek in Castle Mountains, and on Beaver Creek in northern part of Big Belt Mountains. Weed took name Flathead for his formation in Little Belt Mountains from Peale's (1893) Three Forks section. By using name Flathead, Weed created confusion in nomenclature, but not in the stratigraphy, because he neither stated nor implied that type section of Peale's Flathead quartzite member was type of Flathead sandstone (formation) in Little Belt Mountains. Weed gave his Belt Creek section as part of his definition of the formation and thereby indicated it as type of his Flathead sandstone. Comparison of the original and emended Belt Creek section shows a sill at top instead of near bottom of latter section and a thickness of 243 feet instead of 168 feet (sills excluded in both cases). In this section, Flathead sandstone is incompletely exposed, and contact with Wolsey shale is covered. It is however, the best known section of basal Cambrian formation in Little Belt Mountains. Because Weed indicated Belt Creek section as the type, the emended one is retained in that capacity for Flathead sandstone.

B. M. Miller, 1936, Jour. Geology, v. 44, no. 2, p. 118–119. Formation described in northwestern Wyoming where it averages about 175 feet in thickness and consists of quartz sandstones and quartzites which unconformably overlie Precambrian rocks and conformably underlie Gros Ventre formation.

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1083, 1088–1089, 1098–1100, 1101 (fig. 3), 1103. Deiss (1933, Montana Bur. Mines and Geology Mem. 6) divided Cambrian rocks in northwestern Montana into 11 formations—Flathead quartzite at base overlain by Wolsey shale. Sequence is herein revised—Flathead sandstone is overlain by Gordon shale. In Wind River Canyon area, Wyoming, Flathead sandstone is considered member of DePass formation. Underlies Gros Ventre member; overlies pre-Beltian granite. Thickness in type section of Depass 280 feet.

Charles Deiss, 1939, Geol. Soc. America Spec. Paper 18, p. 34, 35–37. In Dearborn River-Monitor Mountain section, Lewis and Clark Range, Mont., Flathead sandstone is 102 feet thick and conformably overlies Miller Peak formation.

E. N. Goddard, 1940, U.S. Geol. Survey Bull. 922–G, p. 163, 165 (table). In Phillipsburg area, Montana, Flathead quartzite is 135 feet thick, underlies Silver Hill formation; overlies Spokane formation.

Charles Deiss, 1943, Geol. Soc. America Bull., v. 54, no. 2, p. 213 (table 1), 219. In Saypo quadrangle, Montana, Flathead sandstone is 50 to 100 feet thick; underlies Gordon shale and unconformably overlies Precambrian Ahorn quartzite (new).

Adolph Knopf, 1950, Am. Mineralogist, v. 35, nos. 9–10, p. 839. On Greenhorn Mountain, overlies Greenhorn Mountain quartzite (new). In extant geologic maps, Greenhorn Mountain quartzite has been included with "undifferentiated Devonian and Cambrian" strata, with the result that the Flathead, which averages 100 feet in thickness with little deviation from this thickness over scores of miles, is implied to have thickness of several thousand feet on Greenhorn Mountain.

A. M. Hanson, 1952, Montana Bur. Mines and Geology Mem. 33, p. 20, 27, 29, 34. Unconformably overlies two major rock types. North of line connecting Melrose, Whitehall, Three Forks, and Livingston, overlies Belt series; south of this line, overlies Precambrian metamorphics including Cherry Creek series, Pony series, and other unnamed units.

A. B. Shaw and P. O. McGrew, 1954, Wyoming Geol. Assoc. Guidebook 9th Ann. Field Conf., chart 2. In Wind River basin, underlies Buck Spring formation (new).

R. K. Hose, 1955, U.S. Geol. Survey Bull. 1027–B, p. 44. In Johnson County, Wyo., Flathead sandstone unconformably overlies Precambrian granite and underlies Gallatin limestone and Gros Ventre formation, undivided. Consists of about 260 feet of tan to light-brown medium- to coarse-grained quartz sandstone.

M. M. Knechtel, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 8, p. 1994–1995. In Little Rocky Mountains, Mont., underlies Emerson formation (new).

M. R. Klepper, R. A. Weeks, and E. T. Ruppel, 1957, U.S. Geol. Survey Prof. Paper 292, p. 7–8, pls. 1, 2, 3. Five lowest natural map units of Cambrian 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), and these formational names have been adopted. Flathead quartzite is 100 to 119 feet thick; overlies Belt series (Spokane shale) and underlies Wolsey shale.

W. J. Mapel, 1959, U.S. Geol. Survey Bull. 1078, p. 10, 11. Flathead sandstone is oldest sedimentary formation in Buffalo-Lake De Smet area. Together with overlying undifferentiated Gros Ventre and Gallatin formations, it crops out in narrow belt marked by valleys and saddles between Precambrian granite and metamorphic rocks to the west and high ridges of Bighorn dolomite to the east. Thickness 344 feet at Johnson Creek where it consists mainly of yellowish-gray fine- to coarse-grained crossbedded sandstone with some interbedded green micaceous siltstone and shale. Middle Cambrian.

Type section (emended): On Belt Creek, Little Belt Mountains, Cascade County. Incomplete section of Flathead measured from Archean contact, 40 to 50 feet above railroad track on spur one-half mile north of mouth of Hoover Creek and 5¼ miles S. 35° E. of Monarch, in Belt Creek valley in NE¼ sec. 14, SW¼ sec. 13, N½ sec. 24, and SE¼ sec. 25, T. 15 N., R. 7 E., near north edge of Little Belt Mountains. Weed gave locality of his Monarch (Belt Creek) section as "Section of beds exposed north of Belt Creek, 8 miles south of Monarch." Only Archean rocks, as indicated correctly on Weed's geological map, are present from 5½ to 8 miles south of Monarch along Belt Creek. Named for exposures in Flathead Pass, northeastern corner Three Forks quadrangle, Montana.

Flatiron Andesites[1]

Cenozoic: Northern California.

Original reference: H. Williams, 1932, California Univ. Pub., Bull. Dept. Geol. Sci., v. 21, no. 8, p. 214–367, map.

Cenozoic: O. P. Jenkins, 1943, California Div. Mines Bull. 118, pt. 4, p. 676.

J. A. S. Adams, 1955, Geochim. et Cosmochim. Acta., v. 8, p. 77 (table 2), 80 (table 4). Listed on tables and mentioned in text in report on uranium geochemistry of Lassen volcanic rocks.

Flatiron Ridge is in Shasta County in southern part of Lassen Volcanic National Park.

Flatiron Coquinite Member (of Riceville Formation)

Upper Devonian: Northwestern Pennsylvania.

Bradford Willard, 1939, *in* Bradford Willard, F. M. Swartz, and A. B. Cleaves, Pennsylvania Geol. Survey, ser. 4, Bull. G–19, p. 14 (footnote), 278 (footnote). Caster (1934) credited with renaming Roystone coquinite as Flatiron; Roystone here considered to be in good standing. Footnote (with initials of G. H. Ashley) states that "bed here named 'Flat-iron' (Roystone) coquinite is same as Marvin Creek limestone of Ashburner" (1880).

Occurs in McKean and western Potter Counties. Probably named for Flat Iron Station near Olean, Rock City, Cattaraugus County, N.Y.

Flat Lick Sandstone (in Pottsville Group)[1]

Pennsylvanian: Southeastern Kentucky.

Original reference: W. R. Jillson and J. M. Hodge, 1919, Kentucky Dept. Geology and Forestry, ser. 5, Bull. 3, p. 1, 2, 3, 9–10, 34.

Well exposed in cliffs along river near Artemus and forms base of Flat Lick Plateau. Named because it is well exposed by the doming at Flat Lick, Knox County.

Flat Ridge Formation (in Mount Rogers Volcanic Group)

Precambrian: Southwestern Virginia.

A. J. Stose and G. W. Stose, 1957, Virginia Div. Mineral Resources Bull. 72, p. 48, 49–52, pls. 1, 60. Volcanic agglomerate and conglomerate, arkose, tuffaceous slate, and basalt. Cornett basalt member (new) generally at base of formation. Volcanic agglomerate, flow breccia, and thin basalt flows near base form Cinnamon Ridge member (new). In Mount Rogers volcanic series. Main part of formation composed of purplish-red feldspathic tuff, purplish-red shale, and purple arkose. In places, tuffaceous layers conglomeratic; at some localities, thin layers of tuff replaced by apple-green pinite; in others, tuff is buff sericitic slate. Purple-banded quartzite, with layers of red jasper and interbedded purplish-red shale in many places. Conglomerate of granite boulders as much as 10 inches in diameter and of smaller fragments in dark-colored arkosic matrix forms base of formation just west of Cinnamon Ridge. Estimated thickness on hill 1 mile north of Union Church 150 feet. On Comers Rock Branch, north of Comers Rock village, thickness estimated to be 250 feet. Overlies older Precambrian rocks in vicinity of Comers Rock village.

Named from village of Flat Ridge located in Grayson County 5 miles west of Gossan Lead district (as mapped). Mapped in the district.

Flat Rock Dolomite Member (of Lucas Formation)

Flat Rock Dolomite Member (of Detroit River Dolomite)[1]

Middle Devonian: Southeastern Michigan, and western Ontario, Canada.

Original reference: W. H. Sherzer and A. W. Grabau, 1909, Geol. Soc. America Bull., v. 19, p. 541.

G. M. Ehlers, 1950, (abs.) Geol. Soc. America Bull., v. 61, no. 12, pt. 2, p. 1455–1456. Detroit River group revised. Flat Rock dolomite of Sherzer and Grabau cannot be distinguished in outcrop or in well borings as distinct formation. There is little doubt that strata of this dolomite are part of Amherstburg dolomite. Name Flat Rock should be dropped from nomenclature.

K. K. Landes, 1951, U.S. Geol. Survey Circ. 133, p. 1. Term Flat Rock does not merit formation status. At type locality in town of Flat Rock, a bed of carbonate rock 2 or 3 feet thick is poorly exposed in channel of Huron River. This section has not been identified with certainty anywhere else. It is the opinion of the writer [Landes] that these strata actually belong in Lucas formation.

Named for exposures at Flat Rock, Wayne County.

Flat Rock Formation

Precambrian: Southwestern South Dakota.

T. A. Dodge, 1942, Geol. Soc. America Bull., v. 53, no. 4, p. 563. Name appears on list of Precambrian rocks of area. Consists of sandy or pyritic schists about 5,000 feet thick.

J. A. Noble and J. A. Harder, 1948, Geol. Soc. America Bull., v. 59, no. 9, p. 944 (fig. 1), 949–952. Examples of varied lithology: abundant light-gray sericitic phyllite or schist; soft sooty black phyllite or schists with pyrite; quartzites in bands that range in thickness from about 2 feet to about 20 feet; features known as Iron Dike, a dense siliceous jaspery material without visible bedding. Unconformable above Northwestern formation. Underlies Grizzly formation; unconformably overlies Northwestern formation.

Occurs at Homestake mine in vicinity of Lead, Lawrence County.

Flat Rock Creek Granite

Age not stated: Central southern Virginia.

J. P. Meador, 1949, (abs.) Virginia Acad. Sci. Proc. 1948–1949, p. 137. Varies in texture from medium grained to coarse grained and in structure from granulose to gneissose. Lies between Virgilina greenstone and the injected gneisses.

Area discussed is in eastern half of Lunenburg County. Granite covers approximately one-fourth of mapped area.

Flat Top Granite

Precambrian: Southwestern Oklahoma.

C. A. Merritt, 1958, Oklahoma Geol. Survey Bull. 76, p. 33–34. Named by Thomas Polk (1948, unpub. thesis). In present study, name Flat Top granite is not used because in many areas the Flat Top could not be distinguished from the Reformatory granite.

Named for occurrence on Flat Top Mountain, Altus Lake area.

Flat-top limestone[1]

Devonian or Mississippian(?): Western Colorado.

Original reference: C. R. Keyes, 1924, Pan-Am. Geologist, v. 41, p. 281, 292.

Named for Flat-top Mountain, north of Glenwood Springs, Garfield County.

Flat-top Sandstone[1]

Pennsylvanian: Southeastern Oklahoma.

Original reference: H. M. Chance, 1890, Am. Inst. Min. Engrs. Trans., v. 18, p. 653–661.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 101. Abandoned by Oklahoma Geological Survey. Name preoccupied.

Flattop Schist[1]

Precambrian: Western North Carolina.

Original reference: A. Keith, 1903, U.S. Geol. Survey Geol. Atlas, Folio 90, p. 4.

J. L. Stuckey and S. G. Conrad, 1958, North Carolina Div. Mineral Resources Bull. 71, p. 30; J. L. Stuckey, 1958, Geologic map of North Carolina (1:500,000): North Carolina Div. Mineral Resources. Occurs in association with Linville metadiabase, Montezuma schist, and metarhyolite.

Named for Flattop Mountain, Cranberry quadrangle, Watauga County.

Flat Top Mountain Sandstone (in Pottsville Group)[1]

Pennsylvanian: Northeastern Kentucky.

Original reference: J. B. Hoeing, 1913, Kentucky Geol. Survey, 4th ser., v. 1, pt. 1, p. 81.

Upper Big Sandy Valley and headwaters of North Fork of Kentucky River.

Flattop Mountain Sandstone Member (of Pocahontas Formation)

Flattop Mountain Sandstone (in Lee Formation)

Flattop Mountain Sandstone (in Pocahontas Group)

Flattop Mountain Sandstone (in Pottsville Group)[1]

Lower Pennsylvanian: Southwestern Virginia and southern West Virginia.

Original reference: I. C. White, 1908, West Virginia Geol. Survey, v. 2A, p. 13.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey, Greenbrier County, p. 242–243. At top of Pocahontas group in southern West Virginia. Generally hard, medium grained, micaceous, and bluish gray to brown. Thickness 10 to 40 feet. In vicinity of Duo, apparently coalesces with Pierpont sandstone, cutting out beds that normally occcur between the two sandstones.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 19). Shown on correlation chart as sandstone in Lee formation in Virginia.

U.S. Geological Survey currently classifies the Flattop Mountain Sandstone as a member of Pocahontas Formation on the basis of a study now in progress.

Named for Flattop Mountain, 2 miles northwest of Pocahontas, Va.

Flattop Mountain suite

Tertiary: Southwestern Utah.

E. F. Cook, 1960, Utah Geol. and Mineralog. Survey Bull. 70, p. 18 (fig. 1), 39, 43 (map 2). Complex of flows and small intrusive masses that represent a period of eruptive activity in a restricted center. Rocks range from highly siliceous rhyolite to rhyodacite. Colors range from white through bluish purple to almost black. Strong flow layering present in some units and is locally distorted. Thickness exceeds 1.000 feet. Name credited to H. R. Blank (unpub. thesis).

Occurs in vicinity of Flattop Mountain, Washington County.

†Flatwoods Clay[1]

Eocene, lower: Southwestern Alabama, northeastern Mississippi, and western Tennessee.

Original reference: E. W. Hilgard, 1860, Mississippi Geol. and Agr. Rept., p. 110–111, 275.

Named for low, flat land covering several counties in northeast Mississippi, resembling broad river and generally known as the "Flatwoods country."

†Flatwoods Group[1]

Eocene: Western Tennessee.

Original reference: J. B. Killebrew and J. M. Safford, 1874, Resources of Tennessee, p. 44.

Occurs on Porter's Creek.

†Flatwoods Shale[1]

Middle and Upper Cambrian: Eastern Alabama.

Original reference: E. A. Smith, 1890, Alabama Geol. Survey Rept. on Cahaba coal fields, p. 148, map, and structure sec. opposite p. 162.

Named for level, badly drained lands in valley region of eastern Alabama, which are generally known as "Flatwoods."

Flaxman Formation[1]

Pleistocene (Wisconsin): Northern Alaska.

Original reference: E. D. Leffingwell, 1919, U.S. Geol. Survey Prof. Paper 109, p. 103, 142, map.

Well exposed on Flaxman Island, Canning River region.

Flaxville Formation

Flaxville Gravel[1]

Miocene, upper, or Pliocene: Northern Montana and western North Dakota, and Alberta and Saskatchewan, Canada.

Original reference: A. J. Collier, 1917, Washington Acad. Sci. Jour., v. 7, p. 194–195.

R. B. Colton, 1955, U.S. Geol. Survey Geol. Quad. Map [GQ–67]. Flaxville gravel described in Wolf Point quadrangle, Montana. Unconformably overlies Fort Union strata and is unconformably overlain by glacial deposits. In some areas, underlies preglacial Wiota gravels (new). Average thickness about 40 feet. Very late Miocene or early Pliocene.

E. G. Meldahl, 1956, North Dakota Geol. Survey Rept. Inv. 26. Mapped in Grassy Butte area, McKenzie County. Stratigraphically above Golden Valley formation.

I. J. Witkind, 1959, U.S. Geol. Survey Bull. 1073, p. 10 (table), 13, pl. 1. Discussion of Smoke Creek-Medicine Lake-Grenora area, Montana and North Dakota. Flaxville gravel above Fort Union formation, crops out along west edge of area. Thickness 10 to 20 feet. Miocene or Pliocene.

A. D. Howard, 1960, U.S. Geol. Survey Prof. Paper 326, p. 16 (table 2), 17, pl. 1. Average thickness 30 feet. In eastern Montana, stratigraphically above Rimroad gravel. One probable occurrence reported in North Dakota. Miocene or Pliocene.

Named for Flaxville, Daniels County, Mont.

Fleanor Formation

Middle Ordovician (Mohawkian): Northeastern Tennessee.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 65, chart 1 (facing p. 130). Name proposed for about 200 feet of maroon and red shale, thin gray limestones, siltstone, and calcarenite. Underlies Rockdell formation; overlies Elway formation. Name attributed to B. N. Cooper and G. A. Cooper.

Named from exposures on a farm lane along Foster Branch near Fleanor Mill, 2 miles northeast of Heiskell, Powell Station (T.V.A. 137–SE) quadrangle.

Fleener facies[1] (of Carwood Formation)

Lower Mississippian: Southern Indiana.

Original reference: P. B. Stockdale, 1931, Indiana Dept. Conserv., Div. Geology Pub. 98, p. 77, 184–186.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 127–128, pl. 1. Mississippian facies nomenclature discussed. Correlation chart lists Fleener facies of Carwood formation.

Named for exposures in vicinity of old village and post office of Fleener, NE¼SW¼ sec. 22, T. 10 N., R. 1 E., Monroe County.

†Fleming Clay[1] or Group[1]

Fleming Formation (in Grand Gulf Group)

Miocene: Eastern Texas and Western Louisiana.

Original reference: W. Kennedy, 1892, Texas Geol Survey 3d Ann. Rept., p. 45, 62.

H. N. Fisk, 1940, Louisiana Geol. Survey Bull. 18, p. 150–173. Formation, in surface exposures in Rapides Parish, divided into (ascending) Lena, Carnahan Bayou, Dough Hills, Williamson Creek, Castor Creek, and Blounts Creek members (all new). Overlies Catahoula formation; underlies Pleistocene. Grand Gulf group.

H. B. Stenzel, F. E. Turner, and C. J. Hesse. 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 7, p. 977–1011. In light of new age determinations, it is believed that term Fleming formation is applicable to clay beds near Burkeville, Tex., and that term Lagarto, formerly used, is not.

A. W. Weeks, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, p. 1721–1726. In this report, Fleming is considered a group name including both Oakville and Cuero (new) formations. Unconformably overlies Catahoula formation; unconformably underlies Goliad formation.

J. J. Quinn, 1952, Texas Univ. Bur. Econ. Geology Rept. Inv. 14, p. 5–6. New faunal evidence leads to conclusion that the Fleming is middle Miocene in age.

P. H. Jones, 1954, Louisiana Geol. Survey Bull. 30, p. 52 (table 2), 55–56. Formation in subsurface in southwestern Louisiana, underlies Foley formation (new).

Named for Fleming, Tyler County, Tex.

Fleming Formation (in Cabaniss Group)

Fleming 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, 195. Cherokee group is divided into 15 cyclic formational units. The Fleming, 10th in the sequence (ascending), overlies the Mineral and underlies the Coalvale. Average thickness 24 feet. Contains coal bed ranging from 12 to 20 inches in thickness. [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 Fleming formation in Cabaniss group. Underlies Croweburg formation; overlies Robinson Branch formation (new).

C. C. Branson, 1954, Oklahoma Geol. Survey Guide Book 2, p. 5. Listed as a coal cycle in Senora formation, Cabaniss group, in Oklahoma.

W. V. Searight, 1955, Missouri Geol. Survey and Water Resources Rept. Inv. 20, p. 25 (fig. 14). Fleming, as exposed in highwall of Ellis mine in SW¼SW¼ sec. 18, T. 34 N., R. 32 W., Vernon County, Mo., underlies Croweburg formation and overlies Mineral formation. Consists of (ascending) limestone, black shale, sandstone, underclay, and coal. Thickness more than 15 feet. Cabaniss group.

W. B. Howe, 1956, Kansas Geol. Survey Bull. 123, p. 22 (fig. 5), 62–63, 66–68. Formation in Cabaniss subgroup of Cherokee group. Where complete succession is present, formation includes (ascending) calcareous shale and thin beds of limestone, dark shale, sandstone, underclay, and Fleming coal. Over most of outcrop in Kansas consists of Fleming coal and its underclay, lying on underclay or dark shale properly included in Robinson Branch formation.

Type locality and derivation of name not given.

Fletcher Anhydrite Member (of Salado Formation)

Permian (Ochoa): Southeastern New Mexico (subsurface).

W. B. Lang, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 1, p. 63, 69, 75–78. Massive dense fine crystalline to granular crystalline anhydrite of pale-maltese-gray, clear, or pale-bluish color. Contains minor amounts of gray dolomitic silt. Practically free from insoluble grit. Thickness ranges from 50 to 100 feet or more; 69 feet in Fletcher No. 1 well. Unconformably overlies Carlsbad limestone.

Name taken from Fletcher No. 1 well, in lot 4, sec. 1, T. 21 S., R. 28 E., Eddy County, in which this core test was made.

Fleury 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. 824 (fig. 3), 825 (fig. 4), 826 (fig. 5), 827–829, geol. sections. [At type section] consists of 115 feet of light-gray fossiliferous calcarenite in medium to heavy cross-laminated beds. Biohermal masses, principally of *Lamottia heroensis* Raymond, are in a zone 44 to 51 feet from base, and similar structures of *Stromatocerium* and bryozoans are about 20 feet from top. Reef masses not present in northern Champlain Valley. On Valcour Island, thickness reaches 220 feet, the upper 65 feet being calcisiltite distinguished poorly from that of succeeding Crown Point limestone, and 35 feet is similarly transitional near South Hero. Overlies Wait member (new).

Type section: The Head, southern Isle La Motte, Vt. Name derived from Fleury Bay.

†Flint Creek Beds[1]

Miocene, upper: Central western Montana.

Original reference: E. Douglass, 1906, Carnegie Mus. Annals, v. 2, p. 153–154.

P. E. Vanzolini, 1952, Jour. Paleontology, v. 26, no. 3, p. 453. Beds assigned to upper Miocene.

Typically exposed in a line of bluffs, 100 to 150 or more feet, high on west side of valley of Flint Creek, beginning about 1 mile north of village of New Chicago and extending southward several miles; Philipsburg region.

Flint Hill Sandstone (in Little Osage Member of Fort Scott Formation)

Pennsylvanian (Des Moines Series): Central Missouri.

F. C. Greene, and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 6, fig. 1. Channel type sandstone and siltstone that occurs above Blackwater Creek shale in Little Osage member and below Higginsville limestone member. Name credited to A. G. Unklesbay.

A. G. Unklesbay, 1952, Missouri Geol. Survey and Water Resources [Rept.] 2d ser., v. 33, p. 96, 97. At type section, consists of gray to yellowish-brown fine- to medium-grained massive resistant friable calcareous sandstone; locally contains brownish-red and purple streaks. Thickness 5⅔ feet.

Type section: W½SW¼ sec. 11, T. 50 N., R. 13 W., Boone County. Name derived from Flint Hill near Flint Hill School. [1949 reference states type section as NW¼SE¼ sec. 11.]

†Flint Hills division[1]

Permian: Central Kansas.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 3, 6–9.

Named for Flint Hills, Cowley and Butler Counties.

Flint Ridge Clay (in Pottsville Formation)[1]

Pennsylvanian (Pottsville Series): Southern Ohio.

[Original reference]: Wilber Stout, 1927, Ohio Geol. Survey Bull. 31, p. 108–112.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 31, table 1. Included in Flint Ridge cyclothem. Dominantly gray and plastic, locally gray and very sandy; contains siderite nodules. Thickness 6 inches to 8 feet. Overlies Flint Ridge shale and (or) sandstone; underlies Flint Ridge coal.

Extends across State from Mahoning County to Scioto County. Underlies Flint Ridge coal which was named for occurrence on Flint Ridge in Licking County.

Flint Ridge cyclothem

Pennsylvanian (Pottsville Series): Southeastern Ohio.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 31–32, 137, table 1, geol. map. Includes (ascending) Flint Ridge shale and (or) sandstone, 13 feet; Flint Ridge clay, 4 to 8 feet; Flint Ridge coal. Occurs below Middle Mercer cyclothem and above Lower Mercer cyclothem. In area of this report, the Pottsville series is described on a cyclothemic basis; 10 cyclothems are named. [For sequence see Anthony cyclothem.]

Exposed in western and northern Perry County.

Flint Ridge Flint[1]

Flint Ridge Flint (in Breathitt Formation)

Pennsylvanian: Eastern Kentucky.

Original reference: W. C. Morse, 1931, Kentucky Geol. Survey, ser. 6, v. 36, p. 296, 305.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 22). Shown on correlation chart as occurring in upper part of Breathitt formation.

Exposed below top of Flint Ridge at head of Leatherwood Branch of South Quicksand Creek, Troublesome quadrangle, Breathitt County.

Flint Ridge Flint (in Allegheny Formation)[1]

Pennsylvanian: Central Ohio.

Original reference: E. B. Andrews, 1871, Ohio Geol. Survey Rept. Prog. 1870, pl. opposite p. 242.

Named for Flint Ridge, 2½ miles southeast of Newark, Licking County.

Flint Ridge Limestone (in Allegheny? Formation)[1]

Pennsylvanian: Central Ohio.

Original references: E. B. Andrews, 1870, Ohio Geol. Survey Rept. Prog. 1869, p. 86, 91–93; 1871, Ohio Geol. Survey Rept. Prog. 1870, p. 89, 94–95.

Named for Flint Ridge, Licking County.

Flint Ridge Shale (in Pottsville Formation)[1]

Pennsylvanian (Pottsville Series): Central and southeastern Ohio.

Original reference: C. L. Herrick, 1887, Denison Univ. Sci. Lab., v. 2, pt. 1, p. 10–12.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 31, table 1. Flint Ridge shale and or sandstone included in Flint Ridge cyclothem in Perry County. Thickness about 13 feet thick; underlies Flint Ridge clay; overlies Boggs member of the Pottsville.

Named for Flint Ridge, Licking County.

Flint River Formation

Flint River Formation (in Vicksburg Group)[1]

Oligocene, upper: Southern Georgia, southeastern Alabama, northwestern Florida, and southwestern South Carolina.

Original reference: C. W. Cooke, 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 8, p. 1170–1171.

C. W. Cooke and A. C. Munyan, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 7, p. 792. Flint River formation, formerly supposed to be facies of Glendon limestone, has proved to be somewhat younger. Tentatively correlated with Chickasawhay member of Byram of Mississippi. Formation overlaps Eocene formations as far as the Clayton. East of Oconee River, it is overlapped by Hawthorn formation but reappears in Savannah drainage basin. Report is about the coast plain of Georgia.

F. S. MacNeil, 1944, Southeastern Geol. Soc. [Guidebook] 2d Field Trip, p. 35–37. Recent mapping in southwestern Alabama has shown that Flint River is not a single unit of deposition but a mixture of argillaceous and siliceous residuum of Oligocene limestones and disarranged beds of Miocene formations. It appears, therefore, that except at its northward extremity, where Tampa and Hawthorn beds have been eroded away or were never deposited, the Flint River contains materials of Oligocene, if the residuum of the Ocala is excluded from it, Miocene, and possibly of more recent age. If the formation is to be dated from time that it assumed its present form, it is probably largely Pleistocene or Recent.

F. S. MacNeil, 1946, Southeastern Geol. Soc. [Guidebook] 4th Field Trip, p. 64. Suggested that name Flint River be abandoned and that the heterogeneous beds to which name was applied be designated as residuum of Jackson, Oligocene, and Miocene, undifferentiated.

C. W. Cooke, 1959, U.S. Geol. Survey Prof. Paper 321, p. 2 (table 1). In discussion of Cenozoic echinoids, age of Flint River formation (Georgia) is given as late Oligocene.

Named from exposures on Flint River between Red Bluff, 7 miles above Bainbridge, to Hales Landing, 7 miles below Bainbridge, Decatur County, Ga.

Flood Member (of Blackleaf Formation)

Lower Cretaceous: Northwestern Montana.

W. A. Cobban and others, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2787–2790, 2792 (fig. 3); 1959, Billings Geol. Soc. [Guidebook] 10th Ann. Field Conf., p. 89 (fig. 1), 90. At type section, consists of three parts having combined thickness of 138 feet; lower part is light-brown ledge-making sandstone; middle is poorly exposed dark-gray fissile shale with thin interbeds of flaggy sandstone and concretions of dark-brown ironstone or iron-stained limestone; upper part is massive light-brown cliff-forming sandstone that contains large dark-brown-weathering concretions of calcareous sandstone. Basal member of formation; underlies Taft Hill glauconitic member (new).

Type section: On south side of Sun River valley 4½ miles west of city of Great Falls, in SW¼NW¼ and NE¼ sec. 7, T. 20 N., R. 3 E., Cascade County, about 5 miles northwest of Flood Siding. Named for exposures along bluffs on west side of Missouri River in vicinity of Flood Siding on Great Northern Railway in NW¼ sec. 34, T. 20 N., R. 3 E.

Florena Shale Member (of Beattie Limestone)

Florena Shale Member (of Garrison Shale)[1]

Permian: Eastern Kansas and southeastern Nebraska.

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

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 47. Middle member of Beattie limestone. Underlies Morrill limestone member; overlies Cottonwood limestone member. Consists of highly fossiliferous gray shale containing thin limestone beds in southern Kansas. Thickness 3 to 18 feet. Wolfcamp series.

Named for exposures in quarries near Florena, Marshall County, Kans.

Florence Dolomite

Cambrian: West-central Vermont.

G. W. Bain, 1938, New England Intercollegiate Geol. Assoc. [Guidebook] 34th Ann. Field Mtg., p. 8. Described as mainly well-bedded buff-weathering sandy dolomite with some graywacke and micaceous slate. Characterized by ripple marks, corrasion channels, solifluction structures, and interformational breccias. Thickness 1,000 feet. Underlies Pittsford Valley dolomite (new); overlies Clarendon dolomite (new).

Occurrence: Central Vermont marble belt, Rutland County.

Florence Gravel[1]

Pleistocene: Northwestern Illinois.

Original reference: O. H. Hershey, 1895, Am. Geologist, v. 15, p. 7–12.

Typically exposed in banks of Yellow and Crane's Creeks, a few miles west and south of Freeport. Named for Florence Township, Stephenson County.

†Florence Limestone (in Chase Group)[1]

Permian: Central Kansas.

Original reference: C. S. Prosser. 1895, Jour. Geology, v. 3, p. 771–786, 798.

Named for Florence, Marion County.

Florence Limestone Member (of Barneston Formation)

Florence Flint (in Chase Group)[1]

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

Original reference: C. S. Prosser, 1895, Jour. Geology, v. 3, p. 771–786, 798.

G. E. Condra and J. E. Upp, 1931, Nebraska Geol. Survey Bull. 6, 2d ser., p. 41. Florence flint member of Barneston formation (new).

R. C. Moore, 1936, Kansas Geol. Soc. 10th Ann. Field Conf. Guidebook, p. 12. Florence limestone member of Barneston limestone.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 45. Limestone, an abundance of flint, and a minor amount of shale; limestone is commonly lighter in color than the included nodules and layers of gray flint; shale partings common locally. Thickness between 35 and 45 feet. Underlies Oketo shale member; overlies Blue Springs shale member of Matfield shale. Wolfcamp series.

Named for exposures near Florence, Marion County, Kans. Because of large amount of flint or chert it contains, the limestone has been known generally as the Florence flint.

Florencia Formation[1]

Pleistocene: Northwestern Illinois.

Original reference: O. H. Hershey, 1897, Am. Jour. Sci., 4th, v. 4, p. 90–98.

Name derived from Florence Township, Stephenson County.

Flores Limestone

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. 63–67. Dark- to light-gray pure limestone occurring in beds 5 to 10 feet thick. Present as allochthonous blocks in Ildefonso formation (new) emplaced by faulting or possibly by sliding.

Type locality: Quarry about 0.25 kilometer to northeast of intersection of Routes 154 and 153, Coamo quadrangle. Named from village of Las Flores.

Florida Gravel[1]

Pleistocene: Southwestern Colorado and northwestern New Mexico.

Original reference: W. W. Atwood and K. F. Mather, 1932, U.S. Geol. Survey Prof. Paper 166.

V. C. Kelley, 1949, New Mexico Univ. Pubs. in Geology 2, chart facing p. 22. Shown on correlation chart of New Mexico formations as present in San Juan County.

Named for fact it caps Florida Mesa in southwestern Colorado.

Floride Dolomite

Upper Ordovician or Silurian: Northwestern Utah.

F. W. Osterwald, 1953, U.S. Geol. Survey Trace Elements Inv. Rept. TEI–330, p. 105; M. H. Staatz and F. W. Osterwald, 1959, U.S. Geol. Survey Bull. 1069, p. 19 (fig. 2), 21–22, pl. 1. Predominantly fine grained and light to medium gray. Thickness 100 to 135 feet. Overlies Fish Haven dolomite; underlies Bell Hill dolomite (new). Formation may be wholly Ordovician, wholly Silurian, or both.

Type section: Half a mile north of Floride mine in NE¼NE¼ sec. 3, T. 13 S., R. 12 W., Juab County. Named for occurrence at Floride mine. Crops out chiefly along east side of Spor Mountain in southern half of range.

†Floridian Group[1] or Series[1]

Pliocene, lower: Southwestern Florida.

Original reference: A. Heilprin, 1887, Wagner Free Inst. Sci. Trans., v. 1, p. 28–32, 64A–64B, May, 1887.

Named for development on west coast of Florida.

Florissant Lake Beds[1]

Oligocene: Central Colorado.

Original reference: W. Cross, 1894, U.S. Geol. Survey Geol. Atlas, Folio 7.

H. E. Woods 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 19–20. Oligocene, probably Orellan. Paleontological evidence as to age is both uncertain and conflicting. Only mammal, *Peratherium*, is known only from the Oligocene and the John Day. Paleobotanical evidence has usually been interpreted in favor of a much more recent age. Comprise determination as Oligocene and perhaps Orellan represents return to opinions of Cope, Lesquereux, and Scudder.

Named for Florissant, Teller County.

Flour Bluff Sand

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 the *Discorbis*. Name Pierce Estate also suggested for this unit.

Named for well No. 38 (Hurlbutt and Still, Phillips No. 1), in west section of Nueces County.

Flour Sack Member (of Bright Angel Shale)

Lower and (or) Middle Cambrian: Northwestern Arizona.

E. D. McKee, 1945, Carnegie Inst. Washington Pub. 563, p. 14 (fig. 1), 29, 82–83. Facies changes within member are striking. At Diamond Creek, Quartermaster Canyon, and Columbine Falls, consists almost entirely of thin fissile micaceous green and purple shale. West of these localities, at Rampart Cave and Diamond Bar Ranch, thin platy limestone replaces much of shale. Farther west, at mouth of Grand Canyon, shale forms only lower 30 feet of section. Thickness averages about 100 feet. Underlies Rampart Cave member (new) of Muav formation; overlies Meriwitica tongue (new).

Named from former rapids of that name 8 miles east of Grand Wash Cliffs, western Grand Canyon.

Floweree Member (of Marias River Shale)

Upper Cretaceous: Northwestern Montana.

W. A. Cobban and others, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2792 (fig. 3), 2793–2794; 1959, Billings Geol. Soc. [Guidebook] 10th Ann. Field Conf., p. 89 (fig. 1), 91. Chiefly dark-gray noncalcareous shale, medium-gray siltstone, and lentils of sandy siltstone and fine sandstone that locally contains scattered granules of dark-gray chert. Limestone concretions present on east side of Sweetgrass arch and on Kevin-Sunburst dome. A few marine fossils present. About 63 feet thick at type section; regionally shows seemingly unsystematic variation in thickness from 13 to 150 feet. Basal member of Marias River shale (new) underlies Cone calcareous member (new); overlies Bootlegger member (new) of Blackleaf formation.

Type section: Two miles northeast of Floweree on north side of Black Coulee in S½NE¼ sec. 17, and SW¼NW¼ sec. 16, T. 23 N., R. 6 E., Chouteau County. Named for station of Floweree on Great Northern Railway in E½SE¼ sec. 24, T. 23 N., R. 5 E, and contiguous part of sec. 19, T. 23 N., R. 6 E., Chouteau County.

Flowerpot Shale (in El Reno, Nippewalla, or Peace River Group)

Flower-pot Shale (in Cimarron Group)[1]

Permian: Central southern Kansas, western Oklahoma, and Texas.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 3, 24–27.

G. H. Norton, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 12, p. 1782, 1791–1792. Included in Nippewalla group (new).

H. C. Fountain, 1939, *in* Am. Assoc. Petroleum Geologists Bull., v. 23, no. 5, p. 764; Robert Roth, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 8, p. 1412. Included in Pease River group (new).

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Shown on correlation chart as formation in El Reno (San Andres) group.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 158; R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 39. Red soft gypsiferous shale. Average thickness 180 feet. In Nippewalla group below Blaine formation and above Cedar Hills sandstone. Leonardian.

Robert Roth, 1945, Geol. Soc. America Bull., v. 56, no. 10, p. 902–904. At type locality of Pease River group, underlies Blaine formation and overlies San Angelo formation. Thickness 274 feet. Includes Chaney gypsum and anhydrite and Kiser gypsum and anhydrite.

G. L. Scott, Jr., and W. E. Ham, 1957, Oklahoma Geol. Survey Circ. 42, p. 11 (fig. 2), 15–16 (fig. 3), pl. 1. Described in Carter area, Oklahoma, where it conformably overlies Duncan sandstone and conformably underlies Blaine formation. Includes Chaney gypsum and Kiser gypsum members. Thickness 165 feet. El Reno group, Guadalupe series.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. Shown on correlation chart in Nippewalla group. Guadalupian.

Named for Flowerpot [Flower-pot] Mound, Barber County, Kans.

Floyd Limestone[1]

Upper Devonian: Central northern Iowa.

Original reference: A. O. Thomas, 1912, Science, new ser., v. 36, p. 569–570.

In Floyd County.

Floyd Shale[1]

Upper Mississippian: Northwestern Georgia, northern central Alabama, and southern Tennessee.

Original reference: C. W. Hayes, 1891, Geol. Soc. America Bull., v. 2, p. 143.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (column 90). Age shown on correlation chart as Chesterian.

Charles Butts, 1948, Georgia Geol. Survey Bull. 54, p. 49–52. In northwestern Georgia, predominantly gray to black fissile shale but includes beds of limestone like those of the "Bangor" and, at one place, a thick bed of sandstone; some beds of limestone have been mapped as "Bangor," but in such places the amount of limestone falls far short of the real "Bangor," and these beds are regarded as part of the Floyd in this report. Estimated thickness at least 1,500 feet. Occurs above Pennington shale. Distribution noted.

Named for development in Floyd County, Ga. Occurs only east of White Oak Mountain and Taylor Ridge where it occupies several large and more or less detached areas.

Floyds Knob Formation (in Borden Group)[1]

Floyds Knob Member (of Edwardsville Formation)

Lower Mississippian: Southeastern Indiana and northern Kentucky.

Original reference: P. B. Stockdale. 1929, Ohio Jour. Sci., v. 29, no. 4, p. 170.

P. B. Stockdale, 1931, Indiana Div. Geology Pub. 98, p. 76, 193–200. Includes the following facies: Goss Mill limestone, Fordyce Knob sandstone, and Cisco Branch.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 192–200, 228. Geographically extended into northern Kentucky where it extends across the Kentucky outcrop belt to Ohio boundary. Thickness seldom over 5 feet; commonly only 1 or 2. Overlies Brodhead formation (new); underlies Muldraugh formation (new).

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 799. Rank reduced to member of Edwardsville formation.

Named for Floyds Knob three-fourths mile east of post office of same name, 3 miles northwest of New Albany, Clark County, Ind.

Fly Sandstone

Pennsylvanian (Monongahela Series): Eastern Ohio.

A. T. Cross, W. H. Smith, and Thomas Arkle, Jr., 1950, Field guide for the special conference on the stratigraphy, sedimentation, and nomenclature of the Upper Pennsylvanian and Lower Permian strata (Monongahela, Washington, and Greene series) in the northern portion of the Dunkard Basin of Ohio, West Virginia, and Pennsylvania: West Virginia Geol. and Econ. Survey, Sec. 26 (upper part). Fly sandstone shown on profile of strata from upper part of Benwood limestone to about the Washington coal horizon along Pennsylvania Highway 88. Description reads: upper Benwood sandstone (Fly sandstone of Ohio, Arnoldsburg of some reports).

Fly Creek Limestone[1]

Upper Cretaceous: Central southern Montana.

Original reference: J. F. Kemp and P. Billingsly, 1921, Geol. Soc. America Bull., v. 32, p. 474 (chart).

Flying W Formation

Precambrian: East-central Arizona.

Gordon Gastil, 1958, Geol. Soc. America Bull., v. 69, no. 12, pt. 1, p. 1498 (table 1), 1500–1501. pl. 1. Volcanic members of formation are: green, amygdaloidal basaltic pillow lavas containing sparse iron ore; a 150-foot-thick black, porphyritic keratophyre which extends 3½ miles from Colcord to Houden Mesa; and a conglomerate composed of well-rounded gravel, cobbles, and boulders of volcanic rock. Thickness 375–3,200 feet. Unconformably underlies Houden formation (new); overlies Alder formation on south slope of Colcord Mesa with gradational contact, but elsewhere basal member of Flying W formation is either a conformable cobble conglomerate or a pillow lava.

Type section: On lowest tributary to Walnut Creek; base of section approximately 4,450 feet elevation 1 mile north-northwest of Flying W ranchhouse. Good exposures also occur west of Spring Creek three-quarters mile northwest of ranchhouse. Named from Flying W Ranch on Spring Creek, 12 miles west of Young, Ariz., Diamond Butte quadrangle.

Fodderstack 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. Thickness at least 12 feet in Cross Mountain section; about 5 feet in Petros section. Separated from underlying Caryville sandstone (new) by shale interval that ranges in thickness from 50 to 150 feet and contains the Sharp coal; separated from overlying Silvey Gap sandstone (new) by shale interval that ranges from 45 to 110 feet in thickness and contains the Red Ash and Walnut Mountain coal.

Named from Little Fodderstack Mountain, Petros quadrangle, where it forms a bench on which a trail encircles the mountain.

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. 56–61. Sequence of fine- to medium-grained sands interbedded with soft to moderately hard gray-green to brown laminated clays penetrated by a number of water wells in vicinity of Oakdale. Thickness at Oakdale about 1,500 feet; at Mamou, 18 miles down dip, thickness is about 2,500 feet. Includes Mamou member above and Steep Gully member (both new). Underlies Williana formation; overlies Fleming formation.

Named for town of Foley, central Allen Parish. Name Oakdale has been used for other deposits.

†Folley Limestone[1]

Lower Ordovician (Chazy): Central eastern Missouri.

Original reference: C. R. Keyes, 1898, Iowa Acad. Sci. Proc., v. 5, p. 59, 61.

Named for Foley, Lincoln County.

Folsom Vent Basalt

Late Cenozoic: Northeastern New Mexico.

Brewster Baldwin and W. R. Muehlberger, 1959, New Mexico Bur. Mines Mineral Resources Bull. 63, p. 127, 155 (fig. 28). Name applied to basalt that issued from Folsom Vent. Folsolm Vent basalt rests on 5 feet of alluvial sands and gravels, which in turn rest directly on sediments of Cretaceous Niobrara group.

Folsom Vents, two cinder cones and associated basalt, cover less than one-half square mile near mouth of Hereford Park, 1 mile west of Union County line on New Mexico State Highway 72.

Fonda 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), 89–90. Name proposed for youngest most fossiliferous member of formation in Mohawk Valley. Silty, sandy phosphatic calcarenites and dolomitic calcilutite predominate; rest of unit consists of pebble conglomerates, calcitic dolomite, steel-gray dolomisiltite and oolitic dolomitic limestone. Contains ripple marks, cross-laminations, and mud cracks filled with glauconite. Maximum thickness 22 feet; has variable thickness and spotty distribution. Overlies Wolf Hollow member (new); unconformably underlies Chuctanunda Creek dolomite (new).

Type locality: Abandoned quarry 0.5 mile east of Stone Ridge, Montgomery County.

Fond du Lac Beds

Fond du Lac Sandstone[1] (in Lake Superior Series or Keweenawan Group)

Precambrian: Northeastern Minnesota.

Original reference: N. H. Winchell, 1899, Minnesota Geol. Nat. History Survey Final Rept., v. 4, p. 567.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 10, 12–15. Fond du Lac beds are lower formation in Lake Superior series. Occur below Hinckley sandstone. Contact with Hinckley not exposed in east-central part of southeastern Minnesota. Thickness 235 feet at Fond du Lac. Base not exposed.

F. F. Grout and others, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 1058–1061. Included in upper part of Keweenawan group. Thickness several hundred to more than 2,000 feet.

Named for exposures on both banks of St. Louis River from Fond du Lac, Carlton County, westward.

Fontana Shale[1] Member (of Cherryvale 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). Member of Cherryvale formation; underlies Block limestone member; overlies Winterset limestone member of Dennis formation. This is classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 38. Considered formation in Nebraska; overlies Dennis formation; underlies Sarpy formation (new). Thickness 15 feet at type locality; 5 feet at Kansas City, 2 to 7 feet in Missouri; 6½ feet in Sarpy County, Nebr., and near Wimberton, Iowa.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 27, fig. 5. Lowermost member of Cherryvale. Consists of gray calcareous silty micaceous shale. Thickness 10 feet. Underlies Block limestone member; overlies Winterset member of Dennis limestone.

Type exposures: In roadcuts at NE cor. sec. 11, T. 18 S., R. 23 E., and at middle of west side of NW¼ sec. 36, T. 18 S., R. 23 E., near Fontana, Miami County, Kans.

Fontenelle Tongue (of Green River Formation)

Fontenelle Member (of Green River Formation)

Eocene: Southwestern Wyoming.

J. H. Donavan, 1950, Wyoming Geol. Assoc. Guidebook 5th Ann. Field Conf., p. 60, 62, 63–64. Proposed to designate sequence of alternating buff-brown sandstones and green and gray mudstones, which conformably overlie Knight member of Wasatch; underlies marginal facies of Laney shale member of Green River. Thickness as much as 300 feet. East of Big Piney, interfingers laterally with New Fork tongue (new) of Wasatch. Middle Eocene.

W. H. Bradley, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 5, p. 1072. Rank reduced to tongue of Green River. This change is based on inference that unit merges with rest of Green River formation some distance downdip below outcrop belt. Eocene.

Type locality: Sec. 13, T. 24 N., R. 114[115] W., about one-half mile south of Fontenelle Creek, Lincoln County.

Fool Creek Conglomerate

Oligocene(?): West-central Utah.

F. W. Christiansen, 1951, Utah Geol. Soc. Guidebook 6, p. 9, (fig. 2), 10–11; 1952, Geol. Soc. America Bull., v. 63, no. 7, p. 727–728, pl. 1. Thickness 0 to 1,800 feet. Unconformably overlies North Horn(?) formation; unconformably underlies Bonneville and pre-Bonneville sediments.

Well exposed in Dry Fork of Fool Creek and in long spur projecting westward from Canyon Range in area immediately south of small farming community of Fool Creek.

Foraker Limestone (in Council Grove Group)

Foraker Limestone (in Wabaunsee Group)[1]

Foraker Limestone Member (of Sand Creek Formation)

Permian: Central northern and central Oklahoma, southern Kansas, northwestern Missouri, and southeastern Nebraska.

Original refence: K. C. Heald, 1916, U.S. Geol. Survey Bull. 641, p. 21, 25.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2273. Overlies Janesville shale (new) of Admire group.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 78–85, pl. 1. Described in Pawnee County, Okla., where it is between 60 and 70 feet thick. Includes (ascending) Americus limestone, Hughes Creek shale, and Long Creek limestone members. Members are traceable southward from Nebraska across Kansas and into Lincoln County, Okla. Basal formation of Council Grove group; underlies Johnson shale; overlies Admire formation. Wolfcamp series.

M. R. Mudge and R. H. Burton, 1959, U.S. Geol. Survey Bull. 1068, p. 14 (table 2), 53–58. Described in Wabaunsee County, Kans., where it averages about 47 feet in thickness. Comprises (ascending) Americus limestone, Hughes Creek shale, and Long Creek limestone members. Underlies Johnson shale; overlies Hamlin shale member of Janesville shale.

Named for Foraker, Osage County, Okla.

Forbes Formation

Upper Cretaceous (Chico Series): Northern California.

Listed as uppermost formation in Chico series; overlies Guinda formation (new). J. M. Kirby, 1942, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 26, no. 5, p. 899.

J. M. Kirby, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 3, p. 282–283, 291, 293. Described as chiefly shale and siltstone with minor thin sandstones. Thickness 1,875 to 3,000 feet. Underlies upper Pliocene Tehama gravels; conformably overlies Guinda formation. Type locality designated.

Type locality: On crest and east flank of Rumsey Hills, Tps. 12 and 13 N., R. 3 W., Yolo County.

†Forbes limestone (in Shawnee Formation)[1]

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

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

Exposed in top of bluffs of Missouri and Nodaway Rivers, near town of Forbes, Holt County, Mo.

Forbush Creek facies (of New Providence Formation)

Lower Mississippian: Southern Kentucky.

H. J. Klepser, 1937, Ohio State Univ. Abs. Doctors' Dissert. 24, p. 182–183. Name applied to unit that represents featheredge of New Providence formation.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 77. Includes Beaver Creek member of New Providence formation.

Occurrences are in Clinton, Cumberland, Monroe, Pulaski, Russell, and Wayne Counties.

Ford Sandstone[1]

Pennsylvanian: Central southern Iowa.

Original reference: H. Hinds, 1909, Iowa Geol. Survey, v. 19, p. 99, 131, 178.

Probably named for Ford, Warren County.

Fordham Gneiss[1]

Fordham Gneiss (in New York City Group)

Precambrian: Southeastern New York and western Connecticut.

Original reference: F. J. H. Merrill, 1890, Am. Jour. Sci., 3d, v. 39, p. 388–389.

D. M. Scotford, 1956, Geol. Soc. America Bull., v. 67, no. 9, p. 1158, 1159 (table 1), 1170–1173, pl. 1. Assigned to New York City group (new).

J. J. Prucha, 1956, Am. Jour. Sci., v. 254, p. 672–684. Basal formation of New York City group. Conformable to overlying Inwood marble, and Manhattan formation. Traced almost continuously from New York City northeast and east to vicinity of Danbury, Conn. Cannot be considered equivalent of Precambrian gneiss of Hudson Highlands. Interlayering of Fordham, Inwood, and Manhattan type lithologies within formation belts reflects original alternation in type of sediments laid down. Such alternation in lithologic types is most pronounced near the contacts between principal formation belts. So-called Lowerre quartzite, formerly considered basal member of New York City group, is no valid formation but a highly sheared phase of Fordham gneiss. Nonexistence of "Lowerre quartzite" invalidates any correlation based upon presumed similarities in stratigraphic sequences between New York City group and Cambro-Ordovician series north of Hudson Highlands. New York City group may be lower Paleozoic.

T. W. Fluhr, 1957, Geol. Soc. America Eng. Geology Case Histories 1, p. 2, 6 (fig. 1). Fordham is a series of metamorphosed sediments and forms base of Fordham-Inwood-Manhattan group. There is disagreement as to age of formations; some geologists believe they are Precambrian; they are here considered to be early Paleozoic.

J. W. Clark, 1958, Connecticut Geol. and Nat. History Survey Quad. Rept. 7, p. 15–18, geol. map. Mapped in Danbury quadrangle. Stratigraphically below Inwood marble. In Bethel quadrangle to the south, the Inwood is absent and the Fordham lies against Manhattan formation.

Named for fact it forms anticlinal ridge of Fordham Heights, which borders eastern shore of Harlem River, N.Y.

Ford River Granite

Precambrian (Huronian) : Michigan.

R. M. Dickey, 1938, Jour. Geology, v. 46, no. 3, p. 321–335. Granite porphyry which comprises most of the southern complex of the Upper Peninsula of Michigan. It has been considered post-Huronian and named Republic granite by Lamey (1933, Jour. Geology, v. 41).

Type locality and derivation of name not given. Ford River is in Delta County.

Fordyce Knob sandstone facies[1] (of Floyds Knob Formation)

Lower Mississippian: Southern Indiana.

Original reference: P. B. Stockdale, 1931, Indiana Dept. Conserv., Div. Geology Pub. 98, p. 76, 208–210.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 127–128, pl. 1. Mississippian facies nomenclature discussed. Correlation chart lists Fordyce Knob sandstone as facies of Floyds Knob formation.

Name derived from Fordyce Knob, SE¼NE¼ sec. 9, T. 1 S., R. 5 E., 2 miles southwest of Borden, Clark County.

Forelle Limestone[1]

Forelle Limestone Member (of Goose Egg Formation)

Forelle Limestone (in Phosphoria Group)

Forelle Limestone Member (of Lykins Formation)

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, 1950, Nebraska Geol. Survey Bull. 13–A, p. 2 (fig. 2), 6, 9. Formation in Phosphoria group. Overlies Glendo shale (new); underlies Freezeout shale.

T. L. Broin, 1958, Dissert. Abs., v. 19, no. 1, p. 114. Reallocated to member status in Lykins formation. Underlies Livermore shale member (new); overlies Glendo shale member.

U.S. Geological Survey classifies the Forelle Limestone as a member of the Goose Egg Formation on the basis of study now in progress.

Named for railroad station a few miles south of Laramie, Wyo.

Foreman Argillite[1]

Upper Jurassic: Northern California.

Original references: C. H. Crickmay, 1933, Geol. Soc. America Bull., v. 44, no. 1, p. 81; no. 5, p. 895.

Occurs at Taylor's Diggins, in south fork of Forman [Foreman] Ravine, Mount Jura.

Foreman Formation[1]

Upper Jurassic: Northern California.

Original reference: J. S. Diller, 1892, Geol. Soc. America Bull., v. 3, p. 370–394.

E. D. McKee and others, 1956, U.S. Geol. Survey Misc. Geol. Inv. Map I–175, table 2. Shown on paleotectonic map as underlying Combe sandstone and overlying Hinchman sandstone.

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 Triassic and (or) Jurassic metavolcanic rocks.

Named for exposures at Foreman and in Foreman's Ravine, northeast of Taylorsville, Plumas County.

Forest 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).

Probably named for occurrence in old Forest mine, Ontonagon County.

Forest Conglomerate[1] (in Bohemian Range Group)

Precambrian: Northern Michigan.

Original reference: S. H. Broughton, 1863, Remarks on mining interest and details of geology of Ontonagon County; pamph. of 24 pages and map, Philadelphia, 1863, map, p. 19.

Exposed 500 feet north of old Forest mine, Ontonagon County.

Forest 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.

Forest City Limestone (in Shawnee Formation)[1]

Pennsylvanian: Northwestern Missouri.

Original reference: J. A. Gallaher, 1898, Missouri Bur. Geology and Mines Bienn. Rept., p. 55, 57.

Named for Forest City, Holt County.

Forest City sand rock (in Shawnee Formation)[1]

Pennsylvanian: Northwestern Missouri.

Original reference: J. A. Gallaher, 1898, Missouri Bur. Geology and Mines Bienn. Rept., p. 55, 57.

Named for Forest City, Holt County.

Forestdale Marble[1]

Forestdale Member (of Mendon Formation)

Precambrian: West-central Vermont.

Original reference: Arthur Keith, 1932, Washington Acad. Sci. Jour., v. 22, p. 362, 394.

P. H. Osberg, 1952, Vermont Geol. Survey Bull. 5, p. 21 (table 1), 28, 30, 33, 35, geol. map. Rank reduced to middle member of Mendon formation. This is unit termed "pebbly, crystalline limestone" member of Mendon series (Whittle, 1894). Member is buff to rusty-weathering; white to gray dolomite marble. Thickness featheredge to 115 feet. Occurs about 600 feet above base of formation; absent in some areas. Lower Cambrian.

P. H. Osberg, 1959, New England Intercollegiate Geol. Assoc. Guidebook 51st Ann. Mtg., p. 45, 46. In Coxe Mountain area, Vermont, Forestdale dolomite overlies Pinnacle formation. Precambrian(?). Names Mendon and Nickwacket have been used for rocks included in Pinnacle of this report.

Excellent section at Forestdale, Rutland County.

Forest Grove Formation[1]

Mississippian (Chester): Northeastern Mississippi.

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. Upper shale of Green Hill member of Pride Mountain formation (both new) is equivalent to lower part of Morse's Forest Grove formation.

Named for school located on formation near old Mingo village and Southward Bridge, Tishomingo County.

Forest Hill Sand[1]

Forest Hill Formation (in Vicksburg Group)

Forest Hill Member (of Jackson Formation)

Oligocene, lower: Southern Mississippi and southwestern Alabama.

Original reference: C. W. Cooke, 1918, Washington Acad. Sci. Jour., v. 8, p. 187, 191–193.

F. E. Mellen, 1940, Mississippi Geol. Survey Bull. 39, p. 12 (table), 23. Reallocated to member status in Jackson formation. In Yazoo County, consists of argillaceous lignitic silt, thin argillaceous allocthonous lignite; lignitic leaf-bearing montmorillonitic clays; and fine-grained crossbedded sand. Thickness 60 to 80 feet. Overlies Yazoo member; underlies Mint Springs facies of Glendon member of Vicksburg formation. Eocene.

F. S. MacNeil, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 9, p. 1314 (fig. 1), 1318–1324. Cooke originally regarded Forest Hill sand as contemporaneous with Red Bluff clay but later accepted view of group of Gulf Coast geologists that the Red Bluff comes in from the east as a 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 Forest Hill overlies Yazoo clay of Jackson group and underlies Mint Spring marl member of Marianna limestone. Oligocene.

H. A. Tourtelot, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 6. Forest Hill sand and Red Bluff clay mapped together in Choctaw County, Ala.

H. N. Fisk, 1944, [U.S.] Mississippi River Comm., p. 13 (table 2), 15. Table shows Forest Hill formation at base of Vicksburg group. Oligocene.

G. E. Murray, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 10, p. 1838 (fig. 6), 1839 (footnote). Forest Hill sand overlies Shubuta (clay) member (new) of Yazoo formation.

W. J. Hendy, 1948, Mississippi Geol. Soc. [Guidebook] 6th Field Trip, p. 27–28. As used in this report, formation includes Red Bluff member.

W. H. Monroe, 1954, U.S. Geol. Survey Bull. 986, p. 62–74, pls. 2, 3. Forest Hill sand crops out in belt across Mississippi from Yazoo County on the west through Hinds, Rankin, Scott, and Smith Counties, in which area it is interposed between belts of outcrops of Yazoo clay and Mint Spring marl member of Marianna limestone; from eastern Smith County to Alabama line through Jasper, Clarke, and Wayne Counties, it is underlain by and may interfinger with Red Bluff clay. Thickness 68½ feet at type locality (herein stated); thickness generally 100 feet.

Type locality: On Jackson-Raymond Road, one-half mile northeast of Forest Hill School in NE¼ sec. 22, and NW¼ sec. 23, T. 5 N., R. 1 W., Hinds County, Miss.

Forestville Member (of Canadaway Formation)

Upper Devonian (Senecan): Southwestern New York.

I. H. Tesmer, 1954, Dissert. Abs., v. 14, no. 12, p. 2317, 2318. Name given to unit formerly known as Gowanda member of Canadaway formation. Underlies Laona member; overlies South Wales member. Different type locality designated.

[Probably named for Forestville, Chautauqua County.]

Forestville Shale[1]

Mississippian: Michigan.

Original reference: C. H. Gordon, 1900, Michigan Geol. Survey, v. 7, pt. 3, p. 23.

Probably named for exposures at Forestville, Sanilac County.

Forge Hollow Dolomite (in Bertie Group)

Forge Hollow Member (of Bertie Formation)

Upper Silurian: Central New York.

L. V. Rickard, 1955, New York Geol. Assoc. Guidebook 27th Ann. Mtg., p. 7, 9 (strat. column). Gypsiferous shales, 25 to 40 feet thick. Overlies Fiddlers Green member; underlies Williamsville member.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. Rank raised to formation in Bertie group. Overlies Fiddlers Green dolomite; underlies Oxbow dolomite (new). Fieldwork has not demonstrated lateral continuity of Forge Hollow and Scajaquada as indicated on present chart. Thick glacial deposits conceal these units in area where they may merge. Possibility of facies changes—for example, Falkirk to Forge Hollow—should not be overlooked. For the present, distinct names are retained for western and central New York.

Occurs in Clockville and Munnsville areas.

Forked Deer Limestone[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. 49. Kingsport limestone (new) replaces Jefferson City formation (Oder, 1934) and Forked Deer formation (Hall and Amick, 1934).

Named for Forked Deer Creek in valley in which U.S. Highway 25 is located, Morristown quadrangle, Hamblen County.

†Fork Mountain Slate[1]

Pennsylvanian: Southwestern Arkansas.

Original references: A. H. Purdue, 1909, Slates of Arkansas: Arkansas Geol. Survey, p. 30, 40; 1914, U.S. Geol. Survey Bull. 586.

Named for Fork Mountain, Polk County.

Fork Ridge Sandstone Member (of Mingo 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, 39, 40.

H. R. Wanless, 1946, Geol. Soc. America Mem. 13, p. 82, 83, 89, 140. In Mingo formation about 40 feet below Mingo coal.

Named for Fork Ridge, Bell County, Ky.

Forlorn Hope Shale

Lower Cambrian: Southeastern Nevada.

J. F. Mason *in* A. W. Grabau, 1936, Paleozoic formations in the light of the pulsation theory, v. 1, Lower and Middle Cambrian pulsation: 2d ed., Peiping, China, University Press, Natl. Univ. Peking, p. 275–276. Green argillaceous shale with *Olcnopsis*. Thickness 115 feet. Overlies Pioche formation (restricted); underlies Comet shale (new). Pioche shale of Walcott (1908), and Westgate and Knopf (1927) includes Comet shale, Forlorn Hope shale, and Pioche shale as used here. Lower to Middle Cambrian boundary was placed at top of Forlorn Hope shale in order to cause *Olenopsis* to fall at summit of Lower Cambrian.

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1149, 1159. Mason (1936) did not define term Forlorn Hope and did not indicate type locality. Term Forlorn Hope not used in this report [Highland Range area, Nevada].

Type locality and derivation of name not given.

†Forman Volcanics

Miocene, upper: Western Nevada.

V. P. Gianella, 1934, Mining and Metallurgy, v. 15, no. 331, p. 299. Interbedded with Sutro tuffs (new); older than Mount Kate volcanics (new).

V. P. Gianella, 1936, Nevada Univ. Bull., v. 30, no. 9, p. 53. Similar name is used for a formation in California; therefore, renamed Alta andesite series.

Forms hanging wall of the Comstock lode throughout most of its length and entirely encloses the Silver City system of veins, Silver City district.

Forrest Shale[1]

Lower Cretaceous: Southeastern Arizona.

Original reference: C. R. Keyes, 1935, Pan-Am. Geologist, v. 64, no. 2, p. 129, 138, 139.

Named for Forrest Ranch, a few miles east of Bisbee.

Forreston 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, 15C. Shown on columnar section as underlying Eldena member (new) of Nachusa formation (new) and overlying Victory member (new) of Grand Detour formation (new). Thickness 4 to 17 feet.

Occurs in Dixon-Oregon area.

Fort Adams Member (of Pascagoula Formation)

Miocene: Southwestern Mississippi.

G. F. Brown and W. F. Guyton, 1943, Mississippi Geol. Survey Bull. 56, p. 22, 23 (table), 47–50, pl. 3. Calcareous green clay, indurated blue claystone, compact sand, and light coarse sand. Overlies Homochitto member (new). Thickness 135 to 235 feet (data based on test well). Derivation of name given.

This may or may not be unit referred to as Fort Adams or Ellisville phase of Grand Gulf Group.

Named for exposures along bluff above Fort Adams, southwestern Wilkinson County. Supposedly can be followed in northeasterly direction from Fort Adams across Wilkinson County into Franklin County.

†Fort Adams[1] or Ellisville phase[1]

Oligocene(?) or Miocene: Southern Mississippi and southern Louisiana.

Original reference: L. C. Johnson, 1893, Science, v. 21, p. 90–91.

Named for Fort Adams, Wilkinson County, Miss., and Ellisville, Jones County, Miss.

Fort Ancient division (in Richmond Group)[1]

Fort Ancient Member (of Waynesville Formation)

Upper Ordovician: Southwestern Ohio.

Original reference: A. F. Foerste, 1909, Denison Univ. Sci. Lab. Bull. 14, p. 292.

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 basal member of Waynesville formation. Underlies Clarksville member; overlies Oregonia member of Arnheim formation.

Named for Fort Ancient, Warren County.

Fort Ann Limestone (in Great Meadows Formation)

Fort Ann Limestone Member (of Tribes Hill Formation)

Lower Ordovician: East-central New York.

R. R. Wheeler, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1938–1939. Named as member of Tribes Hill formation.

R. R. Wheeler, 1942, Am. Jour. Sci., v. 240, no. 7, p. 518, 522. Limestone is middle member of Tribes Hill in Champlain and Hudson Valleys. Underlies Benson dolomite member; overlies Norton member. Represents division C 3 of Brainerd's and Seely's "Calciferous" (1890, Geol. Soc. America Bull., v. 1, p. 501–516).

John Rodgers, 1952, *in* M. P. Billings, John Rodgers, and J. B. Thompson, Jr., Geol. Soc. America Guidebook for Field Trips in New England, p. 35 (table 2). Described as persistent limestone layer at top of Great Meadows formation (new). Refers to R. H. Flower (unpub. ms.).

D. W. Fisher, 1954, Geol. Soc. America Bull., v. 65, no. 1, p. 74. Subdivisions of Tribes Hill of Champlain Valley are poorly defined and can not be used in Mohawk Valley.

Probably named for occurrence at Fort Ann, Washington County.

Fort Apache Limestone Member (of Supai Formation)[1]

Permian: Southeastern Arizona.

Original reference: A. A. Stoyanow, 1936, Geol. Soc. America Bull., v. 47, no. 4, p. 533–536.

R. L. Jackson, 1951, Plateau, v. 24, no. 2, p. 86, 88, fig. 2. Underlies Corduroy member (new); overlies Big "A" sand facies.

Described in Fort Apache Indian Reservation.

Fort Atkinson Limestone Member (of Maquoketa Shale)

Fort Atkinson Limestone (in Maquoketa Group)[1]

Upper Ordovician: Northeastern Iowa and western Wisconsin.

Original reference: S. Calvin, 1906, Iowa Geol. Survey, v. 16, p. 60, 98.

W. H. Twenhofel, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2 (column 50). Shown on correlation chart as limestone member of Maquoketa formation. Underlies Brainard limestone member; overlies Clermont shale member.

Named for exposures in quarry west of old fort at town of Fort Atkinson, Winneshiek County, Iowa.

†Fort Benton Group[1]

Upper Cretaceous: Southeastern Montana, Colorado, Kansas, southern Minnesota, Nebraska, northern New Mexico, South Dakota, and eastern Wyoming.

Original reference: F. B. Meek and F. V. Hayden, 1862, Philadelphia Acad. Nat. Sci. Proc., v. 13, p. 419, 421.

Occurs along Missouri River from 10 miles above James River to Big Sioux River, along eastern slope of Rocky Mountains, and at Black Hills. Named for Fort Benton, on Missouri River, about 40 miles below Great Falls, Mont.

Fort Buchanan Formation (in Sonoita Group)

Upper Cretaceous: Southeastern Arizona.

A. A. Stoyanow, 1949, Geol. Soc. America Mem. 38, p. 59. Consists of a basal conglomerate about 400 feet thick overlain by a series of alternating hard gray sandstones and soft maroon shales approximately 1,500 feet thick. The lower division of Sonoita group; underlies Fort Crittenden formation (new). Rests on andesitic flows.

In Casa Blanca Canyon, Patagonia Mountains. Name adopted from the nearby ruins of an old fort.

Fort Cassin Formation[1]

Lower Ordovician: Northwestern Vermont and eastern New York.

Original reference: R. P. Whitfield, 1890, Am. Mus. Nat. History Bull., v. 3, p. 25–28.

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. 35 (table 2). Described in Fort Ann 15-minute quadrangle, New York, as consisting of interbedded limestone and dolomite with a basal sandstone. Thickness 150 feet. Underlies Providence Island dolomite; overlies Smith Basin formation.

Named for Fort Cassin, Addison County, Vt.

Fort Covington Glaciation

Fort Covington Till

Pleistocene: Northwestern New York.

Paul MacClintock, 1958, Glacial geology of the St. Lawrence seaway and power project: New York State Mus. and Sci. Service, p. 6–25. Younger of two episodes of glaciation in area. Advance followed Malone glaciation (new) and came from the northwest. Till forms morainal ridges, mantles the northeast-southwest drift hills, and lies on varved sediments in St. Lawrence seaway excavations.

Named for Fort Covington, Franklin County, in vicinity of which till forms strong morainal ridges.

Fort Crittenden Formation (in Sonoita Group)

Upper Cretaceous: Southeastern Arizona.

A. A. Stoyanow, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 27 (table). Named on table. Soft red and yellow clay and sandstone. Early Tertiary.

A. A. Stoyanow, 1949, Geol. Soc. America Mem. 38, p. 59. Consists of (ascending) alternating yellow thin-bedded shales and hard sandstones, 600 feet thick; yellow, red, and black shale alternating with hard yellow and pink sandstone, 200 feet thick; light-colored conglomerate, 350 feet thick; thin-bedded sandstone, 80 feet thick; soft light-colored shale and gray and buff sandstone and shale; conglomerate composed of large boulders, probably over 1,000 feet thick; and south of the Greaterville fault, terminates in a thick series of scarlet-red strata. Upper division of Sonoita group; overlies Fort Buchanan formation (new). Geographical area given. Late Cretaceous.

In Casa Blanca Canyon, Patagonia Mountains. Name adopted from the nearby ruins of an old fort.

Fort Denaud Member (of Caloosahatchee Marl)

Pleistocene: Southern Florida.

J. R. DuBar, 1957, Illinois Acad. Sci. Trans., v. 50, p. 192, (table 1). Table shows Fort Denaud as lowermost member of Caloosahatchee. Underlies Bee Branch limestone member (new); overlies Tamiami formation.

J. R. DuBar, 1958, Gulf Coast Assoc. Geol. Soc. Trans., v. 8, p. 136, (fig. 4), 139–143. Typically strata are light colored, with cream, white, and light gray predominating, although some units are mottled yellow brown. Composed of sandy and silty marls, soft and relatively unconsolidated; near Ortona Locks in Hendry County, a thin hard calcareous sandstone almost barren of fossils forms slight ledge at or below water level. Several units (faunizones) and numerous facies are recognized; includes (ascending) *Cyrtopleura costata* faunizone, basal oyster biostrome, and a brackish-water bed characterized by *Rangia nasuta*. Exposed thickness rarely exceeds 5 feet and commonly is less, although locally may be as much as 8 feet. Base of lower beds observed only where Caloosahatchee marl laps onto erosional remnants of Tamiami formation. Underlies Bee Branch member; where erosion has been intense, member is unconformable below Fort Thompson or Pamlico formation.

Named for exposures along stretch of Caloosahatchee River extending between point ½ mile and 3½ miles upstream from Fort Denaud in Hendry County.

Fort Dodge Gypsum[1]

Permian(?): Central northern Iowa.

Original reference: W. J. McGee, 1884, Rept. 10th Census, v. 10, Rept. on building stones, p. 257, 258.

Occurs in vicinity of Fort Dodge, Webster County.

Fort Ellis Beds[1]

Pliocene(?): Central southern Montana.

Original reference: W. H. Dall and G. D. Harris, 1892, U.S. Geol. Survey Bull. 84, p. 287.

In vicinity of Fort Ellis, near Bozeman, Threeforks quadrangle.

†Fort Gaines[1]

Eocene, lower: Western Georgia and southern Alabama.

Original reference: E. A. Smith, 1888, Geographic map of Alabama: Alabama Geol. Survey Rept. Prog. 1884–1888.

Probably named for Fort Gaines, Clay County, Ga.

Fort Hall Formation (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, pl. 1. Mapped in Ammon and Paradise Valley quadrangles where thickness is about 1,000 feet.

Bernard Kummel, 1954, U.S. Geol. Survey Prof. Paper 254–H, p. 172. Mansfield (1916, Washington Acad. Sci. Jour., v. 6) raised Thaynes to rank of group and subdivided it into (ascending) Ross Fork limestone (called Ross limestone in Mansfield's 1916 paper), Fort Hall formation, and Portneuf limestone. In area between Fort Hall Indian Reservation and Gray's Range, these three divisions of Thaynes are distinctive. Eastward toward Salt River Range and southward toward Bear Lake Valley, the Ross Fork and Fort Hall formations lose their identity. The Portneuf is a much more distinctive unit, and parts of it can be traced from Fort Hall, Idaho, to Cumberland, Wyo. Name Portneuf is retained, but in present paper names Ross Fork and Fort Hall are not used.

Named for old Fort Hall, the site of which is in valley of Lincoln Creek, which appears on some maps as Fort Hall Creek. Formation occupies a prominent ridge along north side of valley.

†Fort Hays division or Group[1]

Upper Cretaceous: Western Kansas.

Original reference: B. F. Mudge, 1876, U.S. Geol. and Geog. Survey Terr. Bull. 2, p. 218–221.

Named for old Fort Hays, Ellis County.

Fort Hays Limestone Member (of Niobrara Formation)[1]

Upper Cretaceous: Western Kansas, eastern Colorado, northeastern New Mexico, and southeastern South Dakota.

Original reference: S. W. Williston, 1893, Kansas Acad. Sci. Trans., v. 13, p. 108–109.

R. L. Griggs, 1948, New Mexico Bur. Mines Mineral Resources Ground-Water Rept. 1, p. 30–31. Described in Colfax County, N. Mex., where it underlies Smoky Hill marl member and overlies Carlile shale. Consists of seven or eight limestone beds that are separated by beds of calcareous shale. Thickness 15 to 20 feet. Believed to be equivalent to part of Timpas limestone of previous usage.

E. J. Bolin, 1952, South Dakota Acad. Sci. Proc., v. 31, p. 190. Geographically extended into southeastern South Dakota. It is difficult to distinguish Fort Hays and Smoky Hill members on lithologic basis, but, this investigation demonstrated that they could be distinguished on basis of microfossils. Thickness of Fort Hays varies from 50 to 80 feet.

R. B. Johnson and J. G. Stephens, 1954, U.S. Geol. Survey Oil and Gas Inv. Map OM–146. Described in La Veta area, Huerfano County, Colo., where it crops out as prominent hogback on flanks of Greenhorn anticline. Consists of thick beds of light-gray chalky limestone alternating with thin interbeds of gray calcareous shale. Average thickness 60 feet. Underlies Smoky Hill marl member; overlies Codell sandstone member of Carlile shale.

M. A. Jenkens, Jr., 1957. Rocky Mountain Assoc. Geologists Guidebook to the geology of North and Middle Parks basin, Colorado, p. 53, pl. 1. Described in Red Dirt area, Grand County, Colo., where it is about 14 feet thick; underlies Smoky Hill member; overlies Codell sandstone here included in the Benton because Graneros, Greenhorn, and Carlile cannot be distinguished in this area. Believed that names Fort Hays and Smoky Hill have priority over terms Timpas and Apishapa; use of the former terms would help standardize Niobrara terminology in west-central Colorado.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. Shown on chart as Fort Hays limestone member of Niobrara chalk. Underlies Smoky Hill chalk member; overlies Codell sandstone.

Named for old Fort Hays, well-known landmark in western Kansas.

Fort Hunter Sandstone Member (of Mahantango Formation)

Middle Devonian: Central Pennsylvania.

Bradford Willard, 1939, *in* Bradford Willard, F. M. Swartz, and A. B. Cleaves, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 138, 139, 164, 165 (fig. 38), 180–182. Thin, very hard dark-gray rusty-weathering sandstone. At type locality, unit is interbedded in more shaly lower part of Montebello sandstone facies of the Mahantango. Occurs near base of Skaneatels facies of Mahantango from Perry County east of the Schuylkill River. Thickness about 5 feet. Was called Rockville by Willard and Cleaves (1938), but that name is preoccupied.

Type locality: Southernmost quarry at Rockville, Dauphin County. Named for Fort Hunter, 4 miles north of Harrisburg.

Fort Johnson 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), 84–85. Name proposed for basal member of formation in Mohawk Valley. Breccia of dolomite cobbles or a sandstone stratum commonly forms base. Lower part is predominantly dolomite (dolomisiltite and dolomarenite). Above is a transition zone of calcite dolomite and dolomitic limestone. Upper part is primarily thick-bedded white-weathering blue-black dolomitic calcilutite in which irregular buff-weathering dolomite patches stand out in relief. Thickness 28 feet at type locality where base is concealed. Thickened extension of lower half of unit reaches 90 feet in northeastern part of Amsterdam quadrangle; this interval, when traced into Saratoga Springs area, is coextensive with Gailor dolomite. Underlies Palatine Bridge member (new) and is overlapped by it northward; contact gradational west of Cranesville and unconformable to the east. Overlies an unnamed dolomite, usually conformably.

Type locality: Abandoned quarry and West Shore Railroad cut 2 miles east of Fort Hunter, Montgomery County. Named for village of Fort Johnson on north side of Mohawk River northeast of Fort Hunter.

Fort Kent Shale

Lower Devonian: Northern Maine, and northwestern New Brunswick, Canada.

O. O. Nylander, 1940, Geological formations of the St. John River valley, northern Maine and New Brunswick; Caribou, Maine, privately printed, p. 3–4. Name proposed for distorted, folded beds of shale. Overlies unnamed sandstone.

Crops out in vicinity of hill in southern part of town of Fort Kent about 1¼ miles northwest of Daigle post office, Aroostook County, Maine. Well-exposed in village of Edmunston and along road to St. Basil, New Brunswick, Canada.

†Fort Knox Sandstone[1]

Pennsylvanian: Southwestern Indiana.

Original reference: J. Collett, 1874, Indiana Geol. Survey 5th Rept., p. 323.

Named for Fort Knox, Knox County.

Fort Littleton Formation (in Portage Group)[1]

Upper Devonian: Eastern and central Pennsylvania.

Original reference: Bradford Willard, 1935, Geol. Soc. America Bull., v. 46, no. 8, p. 1199, 1218.

Bradford Willard *in* Bradford Willard, F. M. Swartz, and A. B. Cleaves, 1939, Pennsylvania Geol. Survey, ser. 4, Bull. G 19, p. 210–218. Summary discussion. Underlies Chemung group or Catskill facies group; overlies Rush formation. Since there is a definite line of separation between Burket member of the Rush and Harrell member of the Fort Littleton, use of terms Fort Littleton and Rush in sense of formations is convenient.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Stratigraphically restricted; Parkhead sandstone is shown as distinct unit overlying Fort Littleton formation, not a member of the latter.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 3. Fort Littleton contains Trimmers Rock sandstone, Brallier shale, and Harrell shale members.

Named for Fort Littleton, a village in northeastern part of Fulton County.

Fort Logan Beds[1]

Miocene, lower: Western central Montana.

Original reference: E. Douglas, 1903, Carnegie Mus. Annals, v. 2, p. 150–151.

W. T. Thom, Jr., 1957, Billings Geol. Soc. Guidebook, 8th Ann. Field Conf., p. 11 (table 1). Name appears on generalized stratigraphic section for Crazy Mountain Basin and nearby areas. Underlies Deep River beds, together the two units are dated as middle and upper Miocene.

Named for military post in Meagher County near which beds are best exposed.

Fort Mountain Gneiss

Precambrian: Northwestern Georgia.

A. S. Furcron, K. H. Teague, and J. L. Calver, 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1195. Thrust faults supplementary to the mapped overthrust, which separates the eastern crystalline block from known Paleozoic sediments of the Great Valley, bring up a Precambrian biotite augen gneiss, Fort Mountain gneiss, intruded by granite, upon which Ocoee rocks are unconformable. Talc deposits and associated schists, Cohutta schist, occur in upthrust block of Fort Mountain gneiss but not in the Ocoee series.

A. S. Furcron and K. H. Teague, 1947, Georgia Geol. Survey Bull. 53, p. 9–11, pl. 1. Fort Mountain gneiss, as mapped, is a complex of igneous and metamorphic rocks which contains numerous bodies of Corbin granite and Cohutta schist. Intruded by Corbin granite. Derivation of name given.

G. W. Stose and A. J. Stose, 1949, Geol. Soc. America Bull., v. 60, no. 2, p. 277–278. Fort Mountain (granite) gneiss forms narrow belt 4 to 5 miles long on west slope of Fort and Cohutta Mountains and lies south of Holly Creek embayment of Cartersville thrust block. Hayes (U.S. Geol, Survey Dalton folio, unpub.) states that the gneiss is overlain by basal arkosic conglomerate, black slate, graywacke, and conglomerate. Lower part of sedimentary series that overlies the granite gneiss should be Hurricane graywacke (new). Fort Mountain gneiss considered a hybrid rock and regarded as part of injection complex below Ocoee series.

Named from Fort Mountain, Murray County. Crops out in two distinct belts in the Fort and Cohutta Mountain district, east of Chatsworth.

Fort Niobrara Formation[1]

Pliocene: Nebraska, Colorado, and Wyoming.

Original reference: H. F. Osborn, 1909. U.S. Geol. Survey Bull. 361, p. 115.

F. W. Johnson, 1936, Am. Jour. Sci., 5th, v. 31, p. 469. Name Valentine has priority over Fort Niobrara formation.

F. W. Walker, 1938, Am. Jour. Sci., 5th, v. 36, no. 213, p. 215, 219. Proposed to consider terms Fort Niobrara and Niobrara River as obsolete and incompatible to good geologic nomenclature. Name Valentine beds should be retained and applied to lower 175 to 225 feet of unconsolidated sands of Ogallala formation in Valentine area.

Type locality: On Niobrara River, near Fort Niobrara, Cherry County, Nebr.

Fort Payne Chert[1] or **Formation**

Lower Mississippian: Northern and eastern Alabama, northwestern Georgia, Kentucky, northeastern Mississippi, and Tennessee.

Original reference: E. A. Smith, 1890, Alabama Geol. Survey Rept on Cahaba coal field, p. 155–156, sec. opposite p. 152, map.

H. J. Klepser, 1937, Ohio State Univ. Abs. Doctors' Dissert. 24, p. 182. Formation, in Eastern Highland Rim area, includes a northern facies, Greasy Creek, and a southern facies, Short Mountain (both new).

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 52–54. Referred to as formation. Term Fort Payne has been used in many ways since its original definition by Smith (1890). As presently used in Tennessee, restricted to the characteristically cherty strata between Chattanooga shale (or Maury or New Providence, if present) and the so-called Warsaw formation. Age of top and bottom of unit varies with locality; main mass of unit is primarily of Keokuk age. Maximum thickness in Tennessee about 275 feet. Includes Greasy Creek facies and Short Mountain facies.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (columns 86–88, 90, 92–94). Shown on correlation chart as Osagean.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, p. 106–108, pt. 1, pls. Grainger formation is recognized in belts southeast of Whiteoak Mountain and Wallen Valley faults, and Fort Payne chert in those northwest, except that belt along Cumberland escarpment northeast of Jacksboro fault is shown as grading from Fort Payne chert near La Follette to Grainger formation near Cumberland Gap. Thickness 100 to 200 feet.

A. T. Allen and J. G. Lester, 1953, Georgia Geol. Survey Bull. 60, p. 192, 193. Columnar section at Little Sand Mountain, Ga., shows Fort Payne chert, 390 feet thick, overlies Chattanooga shale and underlies St. Louis limestone.

G. T Malmberg and H. T. Downing, 1957, Alabama Geol. Survey County Rept. 3, p. 16 (table 3), 34–39. Chert crops out in northwestern Madison County over area of about 50 square miles. Thickness (determined from well logs) 95 to 160 feet. Unconformably overlies Chattanooga shale; conformably underlies Tuscumbia limestone. Osage.

Named for development at Fort Payne, De Kalb County, Ala.

Fort Pena Formation[1]

Middle Ordovician: Southwestern Texas.

Original reference: P. B. King, 1931, Am. Assoc. Petroleum Geologists Bull., v. 15, no. 9, p. 1066, 1070.

T. S. Jones, 1953, Stratigraphy of the Permian basin of West Texas: West Texas Geol. Soc., p. 7–8. Age given as Middle Ordovician.

W. B. N. Berry, 1960, Texas Univ. Bur. Econ. Geology Pub. 6005, p. 20–23. In the Solitario and old Jones Ranch areas, Alsate shale is not present between characteristic limestones of Marathon limestone and Fort Pena formation; in its place is white to buff quartzose sandstone 20 to 50 feet thick herein named Rodriquez Tank sandstone. Underlies Woods Hollow shale. Graptolite fauna discussed.

Type locality: On ridge directly north of old Fort Pena Colorada, Brewster County.

Fort Plain[1]

Fort Plain Shale Member (of Canajoharie Shale)

Fort Plain zone (of Fairfield Member of Canajoharie Formation)

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. 119. Referred to as Fort Plain shale member of Canajoharie. Underlies Chuctenunda shale member.

Marshall Kay, 1953, New York State Mus. Bull. 347, p. 57–58. Uppermost zone of Fairfield member. Composed of silty shale at Canajoharie, but of black shale along West Canada Creek. Underlies Utica shale; overlies rocks of Dolgeville facies in Little Falls and southeastern Utica quadrangles. Thin metabentonite occurs just above contact with Dolgeville in stream south of County Home, Utica quadrangle; thickness of zone here at least 50 feet.

Type locality and derivation of name not given but may have been named for Fort Plain, Montgomery County.

Fortress Mountain Formation

Lower Cretaceous: Northern Alaska.

W. W. Patton, Jr., 1956, *in* George Gryc and others, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 219–221, figs. 2, 5. Consists of shale and large percentage of coarse graywacke sandstone and conglomerate. Conglomerate and sandstone typically green to gray and composed chiefly of chert, feldspar, and mafic igneous fragments in mudstone matrix. Beds of coarse clastics several feet to more than 1,000 feet thick, and intercalated with dark gray soft clay and silt shale and gray to green siltstone. Thickness at type section, the thickest known section, approximately 10,000 feet; over most of foothills, less than 5,000 feet and generally less than 3,000 feet. Locally overlies Okpikruak formation and older rocks with angular discordance; overlies Tiglukpuk formation at type locality. Succeeded stratigraphically possibly by part of Torok formation and by Nanushuk group.

R. M. Chapman and E. G. Sable, 1960, U.S. Geol. Survey Prof. Paper 303–C, p. 69–73, pls. 8, 9, 18. Described in Utukok-Corwin region where it is more than 4,400 feet thick and consists mostly of marine shale, siltstone, graywacke-type sandstone, and some conglomerate. No distinct contact with overlying Torok formation exposed in mapped area. Early Cretaceous.

Type section: A composite of several partial sections exposed along Kiruktagiak River and on Castle Mountain. Named from exposures on Fortress Mountain (lat 68°34'30'' N., long 152°58' W.), where typically exposed. Mapped over wide area in southern half of Arctic Foothills province from Sagavanirktok River west beyond Kukpowruk River.

Fort Ridgely Granite (in Minnesota Valley Granite Series)

Precambrian: Southwestern Minnesota.

E. H. Lund, 1956, Geol. Soc. America Bull., v. 67, no. 11, p. 1482, 1483. Pinkish-gray porphyritic granite with aligned phenocrysts 2 inches or more in length that stand out prominently on slightly weathered surfaces. Dark inclusions locally abundant, and where these are present the rock resembles Morton gneiss but lacks typical contorted structure of the Morton. May be a less contaminated and more massive facies of the Morton.

Exposed in vicinity of Fort Ridgely State Park, Nicollet County.

Fort Riley Limestone (in Chase Group)[1]

Fort Riley Limestone Member (of Barneston Limestone)

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

Original reference: G. C. Swallow, 1866, Kansas Geol. Survey Prelim. Rept., p. 14.

G. E. Condra and J. E. Upp. 1931, Nebraska Geol. Survey Bull. 6, 2d ser., p. 41. Uppermost member of Barneston formation (new).

R. C. Moore, 1936, Kansas Geol. Soc. Guidebook 10th Ann. Field Conf., p. 12 (fig. 4), 69 (fig. 45). Overlies Oketo shale member (new).

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 44–45. Limestone, light-gray and tan, massive and thin-bedded, with minor amount of gray shale. Basal part contains thin, more or less shaly beds that are overlain by massive "rim rock," which contains fossil algae; thin shaly beds and locally clay shale deposits occur in middle part; upper strata rather massive but less so than the "rim rock." Thickness 30 to 45 feet. Underlies Holmesville shale member of Doyle shale. Wolfcamp series.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped as Fort Riley limestone in Chase group.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 80, p. 111–114. Currently considered to be top member of Barneston formation. Underlain in turn by Oketo shale member and Florence limestone (Florence flint) member. These subdivisions of Barneston have been traced across Kay County, Okla. Between Kay and Pawnee Counties, Florence limestone member disappears and only a noncherty limestone, here considered to be Fort Riley member, extends southward as far as Pawnee County. In Kay County, consists of about 31 feet of soft light-gray to buff limestone with massive algal bed more than 10 feet thick occurring locally in lower part. Overlies Matfield shale; underlies Doyle shale.

Named for Fort Riley, Geary County, Kans.

†Fort Scott coal series[1]

Pennsylvanian: Eastern Kansas.

Original reference: G. C. Swallow, 1866, Kansas Geol. Survey Prelim. Rept., p. 25–26.

Probably named for exposures at Fort Scott, Bourbon County.

Fort Scott Limestone[1] (in Marmaton Group)

Fort Scott Limestone (in Henrietta Group)

Fort Scott Limestone Member (of Henrietta Formation)[1]

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

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

L. M. Cline, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 25–26 (fig. 2), 36–37, measured sections. Basal formation in Henrietta group. From Missouri River northward, formation includes parts of three cyclothems. At type section, southeastern Kansas, formation is predominantly limestone, but, northeastward in Missouri, shale becomes increasingly prominent, and, in latitude of Missouri River, shale is predominating rock type; if formation has been correctly traced, there are three limestone members which persist into Iowa. In ascending order, these limestones are called by Missouri Survey the lower Fort Scott ("Mulky cap rock"), the "Rhomboidal," and upper Fort Scott "Lexington bottom-rock"). These limestones are herein named (ascending) Blackjack Creek, Houx, and Higginsville. Underlies Labette shale; overlies Cherokee shale (group).

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 38, pt. 11, p. 302–309. Cline (1941) named lower member the Blackjack Creek, the upper, the Higginsville, and a thin limestone that occurs between them, the Houx. Name Little Osage shale is here proposed for beds between Blackjack Creek and Higginsville limestones, and Houx limestone is considered bed in Little Osage shale. Bennett (1896, Kansas Univ. Geol. Survey, v. 1) probably regarded exposure in cut a short distance east of Missouri Pacific Railway station in Fort Scott as type exposure; a better type exposure is herein designated. Thickness at this exposure 27¾ feet. Overlies Cherokee shale; underlies Labette shale.

H. S. McQueen, 1943, Missouri Geol. Survey and Water Resources, 2d ser., v. 28, p. 93–96, measured sections, pl. 7. Fort Scott, in east-central Missouri, consists of alternating beds of shale and limestone below which there is section of shale, base of which is marked by a sandstone, the Squirrel. Although the Squirrel is usually placed in upper part of Cherokee, it is believed that more detailed work will show that it belongs at base of Henrietta group. Unconformably overlies Lagonda shale of Cherokee group. Thickness in Callaway County about 54 feet.

J. R. Clair, 1943, Missouri Geol. Survey and Water Resources, 2d ser., v. 27, pl. 1. Columnar section, Jackson and Cass Counties, shows formation includes (ascending) Blackjack Creek limestone, Houx limestone, Backwater [Blackwater] Creek shale (new), and Higginsville limestone members. Overlies Lagonda sands and shales; underlies Labette shale. Henrietta group.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. v (fig. 1), 5–6 Name Henrietta group suppressed. Fort Scott reallocated to Marmaton group Missouri. Includes (ascending) Blackjack Creek limestone, Little Osage, and Higginsville limestone members. Little Osage member includes (ascending) Houx limestone, Blackwater Creek shale, and Flint Hill sandstone (new). Underlies Labette formation.

W. B. Howe, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 9, p. 2093. Breezy Hill limestone member of Cherokee formation seems rather consistently to have been identified as lower Fort Scott in northern Oklahoma, whereas the true lower Fort Scott limestone (Blackjack Creek) of type area is actually the next limestone unit above the Breezy Hill. Lithologically, the Breezy Hill in northern Oklahoma is very much like lower Fort Scott limestone of type region, and the true lower Fort Scott (Blackjack Creek) has developed a somewhat different lithology.

M. C. Oakes, 1952, Oklahoma Geol. Survey Bull. 69, p. 20–25, pl. 1. Described in Tulsa County. According to present usage, term Fort Scott is applied to two limestones and an intervening shale at type locality where aggregate thickness is about 30 feet. Formation maintains its tripartite character southward into Oklahoma, but upper limestone member does not extend south of T. 25 N., R. 16 E., southeastern Nowata County. Lower limestone member extends southward beyond Tulsa County and is overlain, at least locally by middle shale member. These two members are not more than 10 feet thick in most exposures south of Arkansas River. Conformably overlies Senora formation; conformably underlies Labette shale.

W. V. Searight and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 12, p. 2748 (fig. 1). Fort Scott formation, Marmaton group, shown on northern midcontinent composite stratigraphic section above Excello formation, Cabaniss group.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 33, fig. 5. Fort Scott has not been completely differentiated in Iowa, but the following members have been identified (ascending): Blackjack Creek limestone, Summit coal, Houx limestone, and Higginsville limestone. Shale section underlies Higginsville; this interval is about 15 feet thick in Appanoose County and about 7 feet in Madison County. Underlies Labette shale; overlies Cherokee shale. Marmaton group. Classification of Marmaton group used in this report is that agreed upon by State Geological Surveys in northern midcontinent region (Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11). Although Iowa Survey is not entirely in agreement on this classification, it is used here for convenience of those who may be familiar with grouping as used in other states of region.

Type exposure: Cement plant quarry NE¼ sec. 19, T. 25 S., R. 25 E., northeast of Fort Scott, Bourbon County, Kans.

†Fort Scott Marble (in Cherokee Shale)[1]

Pennsylvanian: Eastern Kansas.

Original reference: G. C. Swallow, 1866, Kansas Geol. Survey Prelim, Rept., p. 26.

Probably named for exposures at Fort Scott, Bourbon County.

†Fort Scott marble series (in Cherokee Shale)[1]

Pennsylvanian: Eastern Kansas.

Original reference: G. C. Swallow, 1866, Kansas Geol. Survey Prelim. Rept., p. 26.

Probably named for exposures at Fort Scott, Bourbon County.

Fort Shafter (Schafter) Gravel[1]

Pleistocene(?): Oahu Island, Hawaii.

Original reference: C. K. Wentworth, 1926, Bernice P. Bishop Mus. Bull. 30, p. 62, 64, 65–71.

G. A. Macdonald and D. A. Davis, 1956, *in* Jacques Avias and others, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 82–83. Fort Schafter gravel included by Stearns (1935, Hawaii Div. Hydrog. Bull. 1) in older alluvium. Underlies lowest tuff of Honolulu volcanic series in area northeast of Pearl Harbor. Pleistocene(?). Type locality.

Type locality: Bluff on edge of Fort Shafter Terrace overlooking Moanalau Gardens and lower gorge of Moanalau Stream. South side of Koolau Range about 17 miles west of Makapuu Head.

Fort Sill Limestone } (in Arbuckle Group)
Fort Sill Formation[1] }

Upper Cambrian: Southern Oklahoma.

Original reference: E. O. Ulrich, 1932, Geol. Soc. America Bull. v. 43, no. 3, p. 742–747.

C. E. Decker, 1939, Oklahoma Geol. Survey Circ. 22, p. 16 (table 1), 20–21, measured sections. Basal formation of Arbuckle group. Consists chiefly of thin beds of limestone; thick beds occur at intervals. Thicknesses: 120 to 283 feet in Arbuckle Mountains; 224 to 369 feet in Wichita Mountains. At type section, underlain by 44 feet of Honey Creek limestone and overlain by conglomerates of Signal Mountain formation. In Wichita Mountains, Fort Sill and Signal Mountain formations are separated by about 200 feet of Royer dolomite; in Arbuckle Mountains, separated by 675 to 771 feet of Royer.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped as Fort Sill limestone.

Type section: On west end of McKenzie Hill, in secs. 7 and 8, T. 2 N., R. 12 W., Comanche County. Named for Fort Sill military post where part of formation is exposed in quarry near south edge of post.

†Fort Sill Series[1]

Tertiary(?): Southwestern Oklahoma.

Original reference: T. B. Comstock, 1890, Texas Geol. Survey 1st Ann. Rept., p. 322, 324, 328.

Named for Fort Sill, Comanche County.

†Fort Smith Formation[1]

Pennsylvanian (Allegheny): Western Arkansas.

Original reference: A. J. Collier, 1907, U.S. Geol. Survey Bull. 326, p. 12, 18–20, map.

Named for Fort Smith, Sebastian County.

Fort Stanton Shale[1]

Upper Cretaceous: Southern central New Mexico.

Original reference: G. H. Hansen, 1931, George Washington Univ. Bull., Summ. Theses 1925–1928, p. 84.

Near Fort Stanton Reservation, Sierra Blanca region.

Fort Thompson Formation[1]

Pleistocene: Southern Florida.

Original reference: E. H. Sellards, 1919, Florida Geol. Survey 12th Ann. Rept., p. 71–72, 75, 76, 118.

J. R. DuBar, 1957, Illinois Acad. Sci., Trans., v. 50, p. 192 (table 1); 1958, Gulf Coast Assoc., Geol. Soc. Trans., v. 8, p. 133, 135, 144–147. Includes Coffee Mill Hammock marl member above and Okaldakoochee marl member (new). Overlies Caloosahatchee marl and where that unit is absent rests on Tamiami formation. Underlies Pamlico formation or Lake Flirt marl.

J. R. DuBar, 1958, Florida Geol. Survey Bull. 40, p. 38, 64–71, 82–83, 85, 122–136, 142–144. Represented along Caloosahatchee River by thin succession of alternating fresh-water and marine marls that bear unconformable relationship to underlying Caloosahatchee. Downstream from Fort Denaud where Caloosahatchee is absent, Fort Thompson beds rests on Tamiami formation. Overlying beds are unconformable and belong either to Pamlico formation or Lake Flirt marl. Maximum thickness about 8 feet. Marine sediments are subdivided into *Chalmys* bed and Coffee Mill Hammock marl. Fresh-water deposits are interbedded with marine sediments. Wisconsinan.

Typically exposed at Fort Thompson, just below Goodno's Landing.

ortune Formation

Devonian: Southwestern Missouri.

J. G. Grohskopf, E. L. Clark, and S. P. Ellison, Jr., 1943, Missouri Geol. Survey and Water Resources 62d Bienn. Rept., app. 4, p. 9–15. Name applied to the sequence of sandstone, chert, and limestone which intervenes between Cotter dolomite below and Sylamore sandstone above. Thickness at type section 6 feet. Locally, the Compton or Chattanooga may lie on the Fortune.

Type section: NE¼SW¼SW¼ sec. 4, T. 23 N., R. 26 W., Barry County. Name derived from Fortune Branch. Formation restricted in its outcrops to eastern one-fourth of Cassville quadrangle and western one-fourth of Shell Knob quadrangle, an area of approximately 100 square miles.

Fortune Lakes Slate (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), 39. Uppermost formation in group. Consists mostly of slate and minor graywacke, with characteristic thin beds (10 feet or less) of course massive graywacke about 300 feet above the base; sideritic slate is present in some areas between Crystal Falls and Alpha; one exposure near Fortune Lakes contains oxidized chert-sideritic rock (iron formation). Aggregate thickness probably at least 4,000 feet. Overlies Stambaugh formation (new).

Main areas of exposure are between Crystal Falls and Fortune Lakes, and in the area between Alpha and Brule, Iron County. Name derived from Fortune Lakes.

Fort Union Formation[1]

Fort Union Group or Series

Upper Cretaceous and Paleocene: North Dakota, northwestern Colorado, Montana, South Dakota, and Wyoming.

Original reference: F. B. Meek and F. V. Hayden, 1862, Philadelphia Acad. Nat. Sci. Proc., v. 13, p. 433.

W. G. Pierce, 1936, U.S. Geol. Survey Bull. 847–B, p. 57–64. Formation, in Rosebud coal field, Montana, comprises Lebo shale member below and Tongue River member above. Overlies Lance formation. Eocene.

G. G. Simpson, 1937, U.S. Natl. Mus. Bull. 169, 287 p. Fort Union group in Crazy Mountain field, Montana, comprises Lebo formation below and Melville formation (new) above. Thickness about 6,350 feet. Overlies Bear formation (new). Paleocene. Mammalian faunas described.

A. J. Collier and M. M. Knechtel, 1939, U.S. Geol. Survey Bull. 905, p. 11–12, pls. 1, 3. Formation is about 1,000 feet thick in McCone County, Mont. Comprises Lebo shale member below and Tongue River member above. Overlies Lance formation. Eocene.

G. L. Jepsen, 1940, Am. Philos. Soc. Proc., v. 83, no. 2, p. 231–238. Term Polecat Bench formation proposed to replace term "Fort Union" in vicinity of Polecat Bench, Park County, Wyo.

Erling Dorf., 1940, Geol. Soc. America Bull., v. 51, no. 2, p. 213–236. Discussion of relationship between floras of type Lance and Fort Union formations. Paleobotanical evidence supports known vertebrate evidence in placing boundary between true Lance and the "Fort Union" at base of nondinosaur-bearing Tullock, Ludlow, or Bear formations or their equivalents; that is, at top of *Triceratops*-bearing Hell Creek or Lance formations as originally defined. Table of proposed revision shows Fort Union group comprises Tullock formation (equivalent to Ludlow formation and Cannonball marine member) in lower part, and several formations (not discussed) in upper part. Overlies Lance formation (equivalent to Hell Creek formation). Paleocene.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 20, pl. 1. Referred to as Fort Union series or group. Paleocene.

W. M. Laird and R. H. Mitchell, 1942, North Dakota Geol. Survey Bull. 14, p. 16–23, measured sections. Group, in southern Morton County, comprises Ludlow, Cannonball, and Tongue River formations. Overlies Hell Creek formation. Paleocene.

W. E. Benson and W. W. Laird, 1947, (abs.) Geol. Soc. America Bull., v. 58, no. 12, pt. 2, p. 1166–1167. Formation in North Dakota; underlies Golden Valley formation (new).

R. W. Brown, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 7, p. 1265–1274. Recent paleontologic and stratigraphic evidence points toward retention of Sentinel Butte shale within Fort Union formation of Paleocene series. Unit has been considered by some geologists to be of Wasatch (Eocene) age.

W. D. Johnson, Jr., and R. P. Kunkel, 1954, U.S. Geol. Survey Oil and Gas Inv. Map OM–148. Formation in Oliver and Mercer Counties, N. Dak., is about 500 feet thick, underlies Golden Valley formation and overlies Cannonball formation.

C. P. Ross, D. A. Andrews, and I. J. Witkind, 1955, Geologic map of Montana (1:500,000): U.S. Geol. Survey. Formation, as mapped, includes Tongue River, Lebo shale, and Tullock members.

P. R. May, 1954, U.S. Geol. Survey Bull. 995–G, p. 267–268. Described in Wibaux area, Montana and North Dakota, where it comprises Ludlow, Tongue River, and Sentinel Butte members. Conformably overlies Upper Cretaceous Hell Creek formation.

W. J. Mapel, 1959, U.S. Geol. Survey Bull. 1078, p. 60–62, pls. Formation, in Buffalo-Lake De Smet area, Wyoming, consists of nonmarine sandstone, shale, and conglomerate which overlies Lance formation and underlies Kingsbury conglomerate member of Wasatch formation. In west-central part of area, formation is divided into two members by an angular unconformity, beneath which as much as 2,600 feet of strata in middle and lower parts of formation may locally have been removed by erosion. Thickness about 3,900 feet south of Buffalo.

Named for exposures at old Fort Union, near mouth of Yellowstone River, later called Fort Buford and now town of Buford, McKenzie County, N. Dak.

Fort Wallace 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), 253–254. Name applied to volcanic ash bed. At type locality 1½ feet thick. Occurs 29 feet above Ogallala-Pierre shale contact and 65½ feet below top of the "algal limestone." Lies stratigraphically above Rawlins ash bed (new) and below Fort Wallace ash bed (new).

Named for exposures south of old Fort Wallace in tributary canyons along south side of Smoky Hill River valley in west line of SW¼ sec. 7, T. 14 S., R. 38 W., Wallace County.

Fort Washington[1]

Eocene: Southern Maryland.

Original reference: T. A. Conrad, 1830, Acad. Nat. Sci. Philadelphia Jour., v. 6, p. 205–217.

Fort Washington and vicinity, Prince Georges County.

Fort Washington Gneiss[1]

Precambrian: New York.

Original reference: R. P. Stevens, 1867, New York Lyc., Nat. History Annals, v. 8, p. 116–120.

Occurs in and around Fort Washington Park.

Fort Worth Limestone[1] } (in Washita Group)
Fort Worth Formation }

Fort Worth Limestone Member (of Georgetown Limestone)

Lower Cretaceous (Comanche Series): Central and eastern Texas, southwestern Arkansas, and central southern and southeastern Oklahoma.

Original reference: R. T. Hill, 1889, Texas Geol. Survey Bull. 4, p. xiv, xxi, xxii.

L. W. Stephenson and others, 1942, Geol. Soc. America Bull., v. 53, no. 3, chart 9. Correlation chart shows Fort Worth limestone above Duck Creek formation and below Denton clay member of Denison formation.

R. W. Imlay, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 3. Correlation chart shows Fort Worth limestone above Duck Creek limestone and below Denton clay. [Denison formation abandoned and members raised to formation rank.] Washita group, Comanche series, Lower Cretaceous.

D. L. Frizzell, 1954, Texas Univ. Bur. Econ. Geology Rept. Inv. 22, p. 26–27, table 4. Foraminifera of formation described.

W. J. Fox and O. N. Hopkins, Jr., 1960, Baylor Geol. Soc. Guidebook 5th Field Conf., p. 88, 91. In central Texas, considered member of Georgetown limestone. Overlies Duck Creek limestone member and underlies Denton shale member.

B. F. Perkins, 1960, Geol. Soc. America Mem. 83, p. 9 (fig. 3), 12 (fig. 4), 27–29, pl. 2. Limestone described in Tarrant County, Tex., where it is about 32 feet thick and consists of regularly alternating dense gray limestone beds, 6 to 12 inches thick, and gray marls, 2 feet or less in thickness. Apparently conformable with underlying Duck Creek formation and overlying Denton marl member of Denison formation. Washita group.

Named for exposures at Fort Worth, Tarrant County, Tex.

Fortymile Granite[1]

[Precambrian]: Eastern Alaska.

Original reference: J. E. Spurr, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 3, p. 135, 137.

Fortymile district.

†Fortymile Group[1]

†Fortymile Series[1]

Precambrian and Paleozoic: Central eastern Alaska.

Original reference: J. C. Spurr, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 3, p. 145–155.

Named for exposures along canyonlike valley of Fortymile Creek.

Fossil Creek Volcanics[1]

Middle Ordovician: 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. Appears on map legend.

Typically exposed in White Mountains, about 50 miles north of Fairbanks, where they crop out just north of Fossil Creek, in belt about 40 miles long, Yukon-Tanana region.

Fossil Lake Formation[1]

Pleistocene: Central southern Oregon.

Original reference: W. D. Smith, 1926, Oregon Univ. Commonwealth Rev., v. 8, p. 207–214.

Type locality: Fossil Lake, northern part of Lake County.

Fountain Formation[1]

Pennsylvanian and Permian: Eastern Colorado and southeastern Wyoming.

Original reference: W. Cross, 1894, U.S. Geol. Survey Geol. Atlas, Folio 7.

A. K. Miller and H. D. Thomas, 1936, Jour. Paleontology, v. 10, no. 8, p. 723–724. Results of this study indicate that Fountain sandstone of Colorado thins northward by continental overlap and that the Fountain of Laramie Basin, which near Laramie interfingers with marine beds of the Casper, represents only upper part of type Fountain in Colorado. The arkosic beds disappear north of Laramie and are replaced by marine beds of different lithology.

R. H. Beckwith, 1941, Geol. Soc. America Bull., v. 52, no. 9, p. 1451–1453. Formation in Elk Mountain district, Carbon County, Wyo., is 150 feet thick; consists of red sandstone, shaly sandstones, white limestones, and pink arkosic grits; partly marine. Overlies Madison limestone; underlies Tensleep sandstone. Unit here called Fountain lies between Madison and Tensleep in same position as beds of comparable lithology and thickness called Amsden in Rollins uplift (Dobbin and others, 1928, U.S. Geol. Survey Bull. 796). Pennsylvanian.

G. E. Condra, E. E. Reed, and O. J. Scherer, 1940, Nebraska Geol. Survey Bull. 13, p. 2 (fig. 2), 35, 44. Includes Fairbank tongue.

L. W. LeRoy, 1946, Colorado School Mines Quart., v. 41, no. 2, p. 14 (fig. 3), 15 (table 1), 16–24. Described in Golden-Morrison area, where it is 760 to 1,130 feet thick and consists typically of red, arkosic sandstones, conglomerates, and minor beds of red, arenaceous mudstones. Rests nonconformably on Precambrian gneisses and schists; underlies Lyons formation. Upper Pennsylvanian.

K. P. McLaughlin, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 11, p. 1937–1968. Described in Colorado Springs quadrangle where it consists of thick series of red irregularly bedded coarse-grained arkosic sandstones and conglomerates sparsely interbedded with thin shales and locally fossiliferous. Greatest known thickness is at type locality where nearly 4,400 feet of red sandstones and conglomerates are exposed in valley of Fountain Creek between Manitou and West Colorado Springs. Paleozoic exposures are cut out for distance of about 10 miles along mountain front by overthrusting along Cheyenne Mountain thrust. As result, Fountain exposures in Manitou embayment are separated from those in southwestern part of quadrangle. In latter area, thickest surface exposures are of order of 1,500 feet. Rests on Glen Eyrie formation in most of Manitou embayment. In southwestern part of quadrangle, Fountain overlies older Paleozoic formations with angular unconformity or rests directly on eroded Precambrian rocks. Along Little Bear Creek is in contact with Ordovician Manitou dolomite and Harding sandstone and Mississippian Madison limestone; south of Little Bear Creek rests on Pikes Peak granite. Underlies Lyons sandstone.

T. S. Lovering and E. N. Goddard, 1950, U.S. Geol. Survey Prof. Paper 223, p. 33–34. Lower part of Pennsylvanian along eastern side of Front Range is Fountain formation. Maximum thickness about 4,500 feet near Colorado Springs where it includes Glen Eyrie shale member at base. In northern part of Colorado, underlies Ingleside formation; underlies Lyons sandstone south of Loveland.

J. C. Maher, 1950, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 39. In Pueblo County, Colo., overlies Beulah limestone.

S. L. Pederson, 1953, Wyoming Geol. Assoc. Guidebook 8th Ann. Field Conf., p. 18–21, 23. Boundary between Permian and Pennsylvanian systems has been determined on paleontological evidence in Gilmore Canyon section, Albany County, Wyo., (Thomas and Thompson, 1953, Wyoming Geol. Survey Bull. 46) and if projected into the other section it seems possible that upper part of Fountain formation may be Permian in age.

Typically developed on Fountain Creek below Manitou Springs in Colorado Springs quadrangle, and at head of same stream in northeastern corner of Pikes Peak quadrangle.

Fountain Peak Rhyolite

Miocene(?): Southern California.

J. C. Hazzard, 1954, California Div. Mines Bull. 170, chap. 4, p. 33, pl. 2. Includes at least two intrusive facies and an unknown amount of pyroclastic material having general composition of rhyolite vitric tuff.

Occurs in northern Providence Mountains, San Bernardino County. Forms main intrusive mass around Fountain Peak, as well as dike system that extends therefrom.

Fourmile Limestone (in Wreford Limestone)[1]

Permian: Southeastern Nebraska, eastern Kansas, and northern Oklahoma.

Original reference: G. E. Condra and J. E. Upp, 1931, Nebraska Geol. Survey Bull. 6, 2d ser., p. 31.

Type locality: Head of a branch of Fourmile Creek, near Kansas-Nebraska line, about 10½ mile south and one-half mile east of Humboldt, Nebr. Named for Fourmile Creek, in southwestern part of Richardson County, Nebr.

†Fourmile Sandstone Member (of Nelagoney Formation)[1]

Pennsylvanian (Missouri Series): Northeastern Oklahoma.

Original reference: C. F. Bowen, 1918, U.S. Geol. Survey Bull. 686–D, p. 17–20.

U.S. Geological Survey has abandoned both the Nelagoney Formation and the Fourmile Sandstone. The Fourmile is equal to Cochahee Sandstone member of Vamoosa Formation.

Named for exposures on the point south of Fourmile Creek in SW¼ sec. 30, T. 24 N., R. 10 E., Osage County.

Four Mile Dam Formation (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. Fossiliferous limestone, which at its type section is a part of a reef of uncertain thickness overlain unconformably by Norway Point formation.

A. S. Warthin, Jr., and G. A. Cooper, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 5, p. 579 (fig. 3), 587–589. Overlies Alpena limestone. Includes Dock Street clay member at base. Thickness at type section 8 feet; thickness where Dock Street clay member is present about 16 feet. Included in Traverse group.

Type section: At Four Mile Dam on Thunder Bay River, Alpena County.

Fowkes Formation

Fowkes Formation (in Wasatch Group)[1]

Eocene, upper: Southwestern Wyoming and eastern Utah.

Original reference: A. C. Veatch, 1907, U.S. Geol. Survey Prof. Paper 56.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 20, pl. 1. Tentatively assigned to late Paleocene (Tiffanian and Clarkforkian).

J. L. Tracey, Jr., and Steven S. Oriel, 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 128 (table 1), 129, 130. Formation, as defined by Veatch, and its lithologic equivalents to the north in Fossil Basin are of late Eocene age and are youngest of early Tertiary rocks yet found in basin. Formation appears to be valid formation despite Veatch's misconception regarding its stratigraphic position (between Almy and Knight formations) and its erroneous inclusion in Wasatch group. His lithologies are accurate, and unit is distinctive, recognizable, and mappable. Unit is cut by faults limited in distribution. Formation is here removed from Wasatch group. Separated from underlying Green River formation by unnamed unit consisting of pink and green to red mudstone, sandstone, conglomerate, and interbedded limestone.

A. J. Eardley, 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 167. Fowkes formation was presumed by Veatch to lie between Almy and Knight formations. He pointed out hills on west side of Bear River valley northwest of Evanston as locality where this relation could best be seen and recognized that in other places the Fowkes is absent. Norwood tuff of early Oligocene age (Eardley, 1944) had been traced from area east of Coalville anticline nearly to Evanston, Wyo., into tuffaceous outcrops labeled Fowkes by Veatch. Reexamination of geologic map of Evanston area showed Fowkes outcrops to be compatible with a post-Knight age, except those on west side of Bear River. This area was revisited, and the conclusion was reached that the contact is due to normal faulting. These relations are deceptive because a red unit exists in tuffs adjacent to fault, a gray unit exists on other side of fault in the red Knight, and it appears from most ground positions that the Fowkes extends under the Knight. Concluded that the Fowkes is Norwood and of early Oligocene age. Name Fowkes has priority and is applied to all Norwood outcrops.

Named for exposures at Fowkes Ranch, about 9 miles from Evanston, Uinta County, Wyo.

Fowler Limestone[1]

Upper Ordovician: Southern Kentucky.

Original reference: A. F. Foerste, 1901, Geol. Soc. America Bull., v. 12, p. 434.

Named for Fowlers Landing, Cumberland County.

Fox Member (of Santa Rosa Island Formation)

Pleistocene, upper: Santa Rosa Island, California.

P. C. Orr, 1950, Geol. Soc. America Bull., v. 71, no. 7, p. 1113, 1115–1116. Consists of basal marine facies and overlying of calcareous clays, sand, and eolianite. Sands have been dated at more than 33,000 years B. P. Thickness about 10 feet. Overlies Garanon member (new); underlies Tecolote member (new). Fox platform cuts both Garanon terrestrial alluvium and Rincon shale.

Deposits occur in Garanon Canyon, Gasoline Alley (present head of Fox Gulch), Skull Gulch, Tecolokito Canyon, Tecolote Canyon, and Deer Gulch.

Fox Canyon Member (of San Pedro Formation)

Pleistocene, lower: Southern California.

California State Water Resources Board, 1953 (revised 1956), California State Water Resources Board Bull. 12, v. 2, p. B–80, B–103, pls. B–1C, B–2. Basal member of formation. Consists of sand and gravel with some clay and silt lenses; generally white or gray; irregularly bedded. Thickness 100 to 400 feet. Overlies Grimes Canyon member (new) of Santa Barbara formation.

T. L. Bailey, 1954, *in* Pacific Petroleum Geologist, v. 8, no. 9, p. 1. Mostly gravel and coarse sand, the lower 200 to 500 feet of the formation.

R. G. Thomas and others, 1954, California Div. Mines Bull. 170, chap. 6, p. 20, pls. 2, 6, 7. About 300 feet thick. Lies at or near base of formation.

Named from exposures in Fox Canyon, about 1 mile west of Bradley Road, Ventura County.

Foxen Mudstone

Foxen Formation[1]

Pliocene, middle(?) and upper: Southern California.

C. F. Tolman, 1927, Econ. Geology, v. 22, no. 5, p. 459. Named on stratigraphic column. Described as fine sandstone and diatomite 750 feet thick. Underlies the lower Fernando; overlies Harris formation. Pliocene.

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), 1353–1355. Consists chiefly of mudstone and siltstone but includes fine-grained silty sandstone and fine-grained volcanic ash. Maximum exposed thickness 800 feet (at type locality). In complete sections, such as type region, gradationally overlies diatomaceous strata of Sisquoc and grades upward into Cebada fine-grained member of Careaga sandstone. Type region designated.

W. P. Woodring, M. N. Bramlette, and K. E. Lohman, 1943, Am. Assoc. 222, p. 10 (table), 36–42. History of name given. Term mudstone used as a more appropriate lithologic designation. As defined here, formation is not represented along Foxen Canyon, which furnished the name and was presumably intended by proposers as the type region. Diatomaceous strata along and near Foxen Canyon are now referred to the Monterey shale and the upper part of Sisquoc. In most sections where the Foxen is thick, typical diatomaceous strata of the Sisquoc formation are separated from typical Foxen strata by a transition zone as much as 100 feet thick. Middle(?) and late Pliocene.

Type region. North slope of western Purisima Hills, Santa Maria district, Santa Barbara County.

Fox Ford Bed (in Strawn Formation)[1]

Pennsylvanian: Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 374, 378.

D. A. Zimmerman and G. D. Glover, 1956, Soc. Econ. Paleontologists and Mineralogists Permian Basin Sec. [Guidebook] Spring Mtg., p. 76. Sandstone about 500 feet thick. Underlies Horse Creek clays and shales; overlies 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.

Fox Hills Sandstone (in Montana Group)[1]

Fox Hills Formation

Upper Cretaceous: South Dakota, eastern Colorado, Montana, North Dakota, and Wyoming.

Original reference: F. B. Meek and F. V. Hayden, 1862, Philadelphia Acad. Nat. Sci. Proc., v. 13, p. 419, 427.

J. Henderson, 1920, Colorado Geol. Survey Bull. 19. Fox Hills sandstone, in northeastern Colorado, includes Milliken sandstone member.

W. T. Thom, Jr., and C. E. Dobbin, 1924, Geol. Soc. America Bull., v. 35, no. 3, p. 484–495. Includes Colgate member.

W. V. Searight, 1934, South Dakota Geol. Survey Rept., Inv. 22, p. 4–15. In South Dakota, Fox Hills sandstone includes all beds between uppermost transition beds of the Pierre and gumbo clays and gumbo sands of lower Hell Creek member of Lance. In Stoneville coal area, Meade County, formation is divided into four members, which consist of basal member of alternating beds of shale and sandstone, sandstone member with thin beds of shale, Stoneville member (new), and sandstone member composed of thin interbedded shale. Thickness 435 to 465 feet.

C. H. Dane and W. G. Pierce, 1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 10, p. 1312–1313. Fox Hills sandstone described in Denver basin, Colorado, where it is 200 to 300 feet thick; overlies Pierre shale and underlies Laramie formation. Consists, in lower part, of buff or brown sandstone and sandy shale containing large gray to brown hard sandy concretions and, in upper part, chiefly of soft, poorly consolidated white sandstone.

Erling Dorf, 1938, (abs.) Geol. Soc. America Proc. 1937, p. 275; 1942, Carnegie Inst. Washington Pub. 508, p. 1–78, pls. [preprint 1938]. Medicine Bow formation of southern Wyoming and the so-called "Laramie" formation of northwestern Colorado occupy similar stratigraphic positions above a marine sandstone which carries a distinctive Fox Hills fauna, including the diagnostic *Sphenodiscus lenticularis*. This marine sandstone, hitherto included in Medicine Bow or underlying Lewis shale, is separated as distinct unit and referred to Fox Hills formation. Thickness of Fox Hills 375 to 400 feet in Hanna basin, Wyoming; about 475 feet in northwestern Colorado.

R. E. Morgan and B. C. Petsch, 1945, South Dakota Geol. Survey Rept. Inv. 49. p. 11–18. fig. 4. Described as formation in Dewey and Corson Counties. Contains two identifiable units of almost pure sandstone but two others that, over considerable part of area, are much less sandy in character. Sandstone members are herein named Trail City (below) and Timber Lake. Thickness 120 to 250 feet. Overlies Pierre formation; underlies Hell Creek formation.

S. P. Fisher, 1952, North Dakota Geol. Survey Bull. 26, p. 10–16. Most extensive of formations outcropping in Emmons County. Trail City and

Timber Lake members recognized. These members pinch out eastward and disappear between southwestern corner and center of county. Upper 160 to 230 feet of formation is series of gray to brown sands with thin gray shales. It lies above *Halymenites* bench of Timber Lake member and is capped by sandstone bed. Overlies Pierre formation; underlies Hell Creek formation.

R. E. Stevenson, 1957, Areal geology of McIntosh quadrangle (1:62,500): South Dakota Geol. Survey. Formation includes (ascending) Trail City member, 65 feet thick; Timber Lake member, 20 to 25 feet; Bullhead member (new), and Colgate member, 15 feet. Underlies Hell Creek formation.

Named for exposures in Fox Ridge, northwestern Armstrong and southwestern Dewey County, S. Dak.

Foys Limestone (in Allegheny Formation)[1]

Pennsylvanian: Western Pennsylvania.

Original reference: J. P. Lesley, 1879, Pennsylvania 2d Geol. Survey Rept. Q_2, p. xxii, 320.

Foy's Knob, Wayne Township, Lawrence County.

Fra Cristobal Formation (in Mud Springs Group)

Pennsylvanian (Derry Series): Central New Mexico.

M. L. Thompson, 1948, Kansas Univ. Paleont. Contr. 4, Protozoa, art. 1, p. 73. Name proposed to replace Hot Springs formation proposed by Thompson (1942). Term Hot Springs preoccupied. Overlies Apodaca formation; underlies Cuchillo Negro formation.

Type locality: West end of Whiskey Canyon, just west of westernmost box canyon, near north end of Mud Springs Mountains, Sierra County. Name derived from Fra Cristobal Range on east side of the Rio Grande.

Fraction Breccia[1] (of Esmeralda Formation)

Miocene, upper: Central Nevada.

Original reference: J. E. Spurr, 1905, U.S. Geol. Survey Prof. Paper 42, p. 39, map.

Named for occurrences around Fraction No. 1 and No. 2 mine, Tonopah district.

Frailes Formation

Upper Cretaceous: Puerto Rico.

C. A. Kaye, 1959, U.S. Geol. Survey Prof. Paper 317–A, p. 7 (chart), 9 (fig. 3), 10 (fig. 4), 16–19, pl. 2. Marine accumulation of shale, siltstone, and graywacke, with lenticular limestone in lower part, La Muda limestone member, massive lapilli tuff in middle, and well-bedded tuffaceous limestones, Leprocomio limestone member (new), in upper part. Thickness 2,300 feet. Underlies Monacillo formation (new); overlies Tortugas andesite (new) and locally Hato Puerco tuff; in some areas, La Muda member rests on what seems to be Guaynabo formation; in at least one locality, overlies an unnamed andesite porphyry sill. Variable nature of lower contact is taken in part to result from lenticular nature of La Muda member and in part from discordant and overlapping nature of Frailes onto eroded surface of older rocks. Faunal evidence, particularly the ammonites, shows formation to be Late Cretaceous.

Named after Barrio Frailes, east of Guaynabo, in which formation is well developed. Typical section (described in detail) is exposed in roadcuts on Highway 175 along left bank of Río Grande de Loíza west and north of Trujillo Alto.

Fraileys Shale

Mississippian (Chester Series): Southeastern Illinois, southwestern Indiana, and northeastern Kentucky.

A. C. McFarlan and others, 1955, Kentucky Geol. Survey, ser. 9, Bull. 16, p. 18, 19–20. New name is needed for the "Golconda" as recognized east of Todd County, Ky., and north into Indiana. Fraileys shale is proposed for the middle "Golconda," that is, the interval between Haney limestone (new) and Beech Creek limestones wherever sandstone [Big Clifty] is insignificant or lacking. Consists largely of shale with minor amounts of limestone and mudstone. Typically 70 to 90 feet thick in Illinois with extremes of about 45 to 140 feet; at type locality 94 feet.

Type locality: Easternmost exposure of the Golconda in Illinois, on the south slope of hill along west edge of NE¼SE¼ sec. 9, T. 12 S., R. 10 E., Cave in Rock quadrangle, Hardin County, Ill. Named for an abandoned village 1 mile to northeast, known variously as Fraileys, Fraileys Landing, or Fraileys Store.

Frame Shale Member[1] (of Mahantango Formation)

Middle Devonian: South-central Pennsylvania.

Original references: Bradford Willard, 1935, Geol. Soc. America Proc. 1934, p. 361; 1935, Geol. Soc. America Bull., v. 46, no. 8, p. 1279, 1283.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Shown on correlation chart at top of Mahantango formation, above Chaneysville sandstone member.

Named for Frame School about 6 miles north of Chaneysville, Bedford County.

Francis Formation[1]

Pennsylvanian (Missouri Series): Central and central southern Oklahoma.

Original reference: G. D. Morgan, 1924 [Oklahoma] Bur. Geology Bull. 2, p. 113–119.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped as extending northward from Pontotoc County across Seminole County; north of Seminole County, name Francis is dropped and other terminology (Coffeyville, Nellie Bly) is used.

W. F. Tanner, 1956, Oklahoma Geol. Survey Bull. 74, p. 62, pl. 1. In this report [Seminole County], northern names are carried south to Canadian River; interval designated by Morgan as "Francis" is herein described under headings "Coffeyville" and "Nellie Bly." Type locality stated.

Type locality: Town of Francis, northeastern Pontotoc County, and "all that portion of the outcrop which extends for distance of 3 miles north, and for a similar distance south of Canadian River" (Morgan, 1924).

Franciscan Formation[1]

Franciscan Group

Jurassic and Cretaceous: Western California.

Original references: A. C. Lawson, 1895, Am. Geologist, v. 15, p. 347; 1895, U.S. Geol. Survey 15th Ann. Rept., p. 415.

N. L. Taliaferro, 1943, California Div. Mines Bull. 118, p. 123–125 [preprint 1941]. In Oregon, the Franciscan overlies the Galice unconformably, and the Galice, both faunally and lithologically, is equivalent to the Mariposa, the age of which has been well established as Kimmeridgian and slightly older (Portlandian). In northern California, the Galice has been converted into slate, whereas the Franciscan is unmetamorphosed. In northern California, unmetamorphosed Franciscan occurs in proximity to Mariposa-Galice slates. Franciscan is therefore younger than Kimmeridgian. It is believed that the Franciscan does not extend below Portlandian or, at the lowest, the upper Kimmeridgian. Field evidence does not support theory of unconformity between Franciscan and "Knoxville."

N. L. Taliaferro, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 2, p. 109–219. Franciscan-Knoxville problem discussed. The unconformity between Franciscan and Knoxville, reported by many writers, is unsupported by field evidence. The Knoxville is herein regarded as upper phase of Franciscan. Since these names have become fixed in the literature, it is here suggested that name Franciscan-Knoxville group be used for entire sequence.

I. F. Wilson, 1943, California Jour. Mines and Geology, v. 39, no. 2, p. 195–198, 225 (fig. 4), 226 (fig. 5). In San Benito quadrangle, Franciscan group is in fault contact with Santa Lucia granite, believed to be pre-Franciscan. Thickness difficult to determine because of strong folding and lack of exposures of base and top. Thickness of 10,000 feet measured across section on north limb of syncline exposed along Las Aguilas Creek. Most of the contacts with younger rocks are faults, except for many of those with San Benito gravels which are depositional.

A. S. Huey, 1948, California Div. Mines Bull. 140, p. 15–23, pls. 1, 2, 3. Franciscan formation and related intrusive rocks comprise most of southern half of Tesla quadrangle and extend into adjacent quadrangles. Base of formation not exposed, and top cannot be distinguished. Thickness of sediments as obtained graphically from cross-sections E-E' and H-H' about 12,000 feet. Tolman (1915) reported section of 15,000 feet in this area and divided section into three members: Corral Hollow shales, dense bluish-gray arkosic sandstone, as lower part; folded and crumpled cherts as middle member; and Oak Ridge [Oakridge] sandstone as upper member. Because Oak Ridge is a divide in northwest corner of Mount Hamilton quadrangle, Tolman probably extended his section into this area adjoining on the south. In Tesla area, sandstone is predominant rock type throughout Franciscan section; likewise shales and cherts occur throughout section as interbeds in the sandstone; hence, Tolman's divisions are not recognized in this report, and section of Franciscan rocks is left undivided. In fault contact with Lower Cretaceous Horsetown formation; Plio-Pleistocene Livermore gravels is only younger formation which is in depositional contact with Franciscan.

J. A. Cushman and Ruth Todd, 1948, Cushman Lab. Foram. Research Contr., v. 24, pt. 4, no. 322, p. 90–98. Paper records foraminiferal fauna from New Almaden quicksilver district, Santa Clara County, in rocks ascribed to Franciscan group. Limestone in which the foraminifera occur has been traced to that mapped as Calera limestone member in Santa Cruz quadrangle to west. Foraminifera seem to indicate that beds are younger than Jurassic.

T. W. Dibblee, Jr., 1950, California Div. Mines Bull. 150, p. 22. Honda formation (new) may be equivalent to type Knoxville, but its highly sheared condition and unconformable relationship with Espada formation (new) suggests that it may be shale member of Franciscan.

M. D. Crittenden, Jr., 1951, California Div. Mines Bull. 157, p. 15–26. Formation crops out or is present beneath alluvium in almost two-thirds of San Jose-Mount Hamilton area. Comprises sandstone and shale, conglomerate, chert, and contemporaneous volcanics, and schists. Thickest continuous section is just east of Calaveras fault, where at least 6,000 feet of beds are exposed. In fault contact with Knoxville.

C. C. Church, 1952, Cushman Foundation Foram. Research Contr., v. 3, pt. 2, p. 68–70. Discussion of Cretaceous foraminifera from Calera limestone member of Cahil sandstone of the Franciscan. Evidence indicates that the Calera is somewhere near middle Cretaceous or basal Upper Cretaceous. It now seems to be general conclusion that Franciscan-type rocks cover wide range in age from Upper Jurassic to middle or even basal Upper Cretaceous. More detailed work is necessary to narrow the age limits of various members.

B. A. Ogle, 1953, California Div. Mines Bull. 164, p. 12–16, pl. 1. In Eel River valley area, Humboldt County, Franciscan formation is about 10,000 feet thick. In fault contact with Yager formation (new); unconformably overlain by Wildcat group (undifferentiated).

L. I. Briggs, Jr., 1953, California Div. Mines Bull. 167, p. 11–20, pls. 1, 3. In Ortigalita Park quadrangle, the Franciscan (group, formation) is exposed in eastern limb of asymmetrical anticline, overturned adjacent to Ortigalita thrust. Total thickness difficult to estimate because faults are difficult to trace in homogeneous graywacke sediments, but erratic attitudes and some development of phyllonites indicate a zone of dislocation southwest of Sugarloaf. The layered sequence above this zone is 8,000 to 10,000 feet in thickness, and if repetition is absent or minor, the thickness (measured on section E-E' through Ortigalita Peak) is at least 20,000 feet. Neither top nor bottom of group is represented. In fault contact with Lower Cretaceous Wisenor formation (new). Map bracket shows age Jurassic(?).

Julius Schlocker, M. G. Bonilla, and R. W. Imlay, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 11, p. 2372–2381. *Douvilleiceras* sp., an ammonite of Early Cretaceous age, has been found in graywacke-type sandstone that is part of narrow band of exposures in cliffs along southern shore of inlet to San Francisco Bay—an area regarded as in type locality of Franciscan group. Thus, age of part of group is Early Cretaceous, Albian. Because Franciscan rocks in other localities are overlain by beds containing Upper Jurassic fossils, it is proposed that Franciscan group be assigned to both the Cretaceous and Jurassic(?) periods pending subdivision and more precise age designations within the group.

G. D. Robinson, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–88. Group, in Hayward quadrangle, comprises greenstone volcanic rocks, mainly lava with thin pyroclastic and sedimentary interbeds; chert with shale partings; sandstone; and muscovite-rich graywacke with interbedded arenaceous shale, conglomerate, chert, and greenstone. Relative ages of these units not known. Aggregate exposed thickness 2,000 to 3,000 feet. Unconformably overlain by Upper Jurassic Knoxville. Unconformity may be local and does not necessarily conflict with generalization (Taliaferro, 1941) that Franciscan and Knoxville are regionally conformable and gradational, nor is it incompatible with his conclusion that Franciscan was deposited in a brief part of Late Jurassic time. However, fossils found in recent years in western part of Franciscan make it difficult to accept so limited an age for entire formation. Presence of these fossils has been explained by appealing to elaborate faulting mechanism, but it is here suggested that Franciscan eugeosynclinal sedimentation continued in peninsular area long after it gave way to miogeosynclinal sedimentation of Shasta series type farther east. In Hayward quadrangle, Franciscan rocks seem to be no younger than Late Jurassic.

W. P. Irwin, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 10, p. 2284–2297. Franciscan group is assemblage of detrital and chemical sedimentary and volcanic rocks that crop out discontinuously in a structurally complex, northwesterly trending belt along Coast Ranges. On the east, along west side of Sacramento Valley, a thick section of detrital sedimentary rocks has been subdivided into Knoxville, Paskenta, and Horsetown formations, of Late Jurassic and Early Cretaceous age, and several units of Late Cretaceous age. Franciscan group is widely held to be restricted to Late Jurassic age, the Knoxville formation to be a shaly phase of Franciscan group, and the two overlain unconformably by detrital strata of Cretaceous age. Paleontologic evidence indicates this view to be incorrect. The Franciscan group seems to have been deposited contemporaneously with the Knoxville, Paskenta, Horsetown, and lower Upper Cretaceous strata, because fossils ranging from Late Jurassic to early Late Cretaceous in age have been found in the group. The Franciscan group and strata of Sacramento Valley section may represent two facies of same stratigraphic section.

C. A. Hall, Jr., 1958, California Univ. Pubs. Geol. Sci., v. 34, no. 1, p. 3–6, fig. 2, geol. map. Discussion of geology of Pleasanton area, Alameda and Contra Costa Counties. Questionable Jurassic rocks mentioned in this paper have been referred to as Franciscan group; this does not imply that any of the formations mapped by Lawson are included or mapped in Pleasanton area. In adjoining areas, Crittenden (1951) and Huey (1948) called questionable Jurassic rocks Franciscan "formation." This term is considered inappropriate for a complex group of various lithologic types which here includes, metamorphic rocks, sandstone and interbedded shale, basalt, chert, and serpentine. Thickness of about 6,000 feet estimated from Indian Creek northeast to large chert outcrop shown near eastern edge of geologic map; top and base not recognized in area. In Arroyo del Valle region, Franciscan rocks are in fault contact with Upper Cretaceous Del Valle formation (new) and are unconformably overlain by Pliocene Livermore gravels. In Indian Creek area, group is unconformably overlain by Ciebo sandstone. Briones serpentine-arenite overlies Franciscan basalt unconformably near south fork of Apperson Creek; in southern part of La Costa Valley quadrangle, Franciscan rocks are in fault contact with Tertiary rocks or locally unconformably overlain by Oursan sandstone.

C. G. Higgins, 1960, California Univ. Pubs. Geol. Sci., v. 36, no. 3, p. 203–205, geol. map. In northwestern Sonoma County, formation unconformably underlies Ohlson Ranch formation (new).

Named for exposures at San Francisco, San Francisco County.

Francis Creek Shale (in Carbondale Group)

Francis Creek Shale and Limestone (in Carbondale Formation)[1]

Francis Creek Shale Member (of Carbondale Formation)

Pennsylvanian: Western and central Illinois.

Original reference: T. E. Savage, 1927, Am. Jour. Sci., 5th, v. 14, p. 309.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 88–89, 203. In Carbondale, group thickness 40 to 45 feet near Lewistown and near type locality; 55 feet near Colchester. Shale is wholly or partially truncated in areas of Pleasantview sandstone channels; replaced by Jake Creek sandstone (new) in southern part of Vermont quadrangle. Included in Liverpool cyclothem where it occurs below the Jake Creek sandstone and above Colchester (No. 2) coal. Type locality given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 35, 46 (table 1), pl. 1. Termed Francis Creek shale member of Carbondale formation (redefined). Occurs about Colchester (No. 2) coal member and below Jake Creek sandstone member. Presentation of new rock-stratigraphic classification of Pennsylvanian strata of Illinois.

Type locality: Roadcut on west side of Francis Creek, NE¼SW¼ sec. 22, T. 5 N., R. 1 E., Vermont quadrangle, Fulton County.

Francoisian series[1]

Precambrian: Missouri.

Original reference: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 253.

Derivation of name not stated.

Franconia Breccia[1]

Upper Devonian or Upper Carboniferous: West-central New Hampshire.

Original reference: New Hampshire Geol. Survey 4th Ann. Rept. 1872, as interpreted by J. D. Whitney and M. E. Wadsworth *in* Harvard Coll. Mus. Comp. Zoology Bull., v. 7, (geol. ser. I), opposite p. 396.

M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000): U.S. Geol. Survey. Formed by injection of numerous binary granite dikes into the Kinsman quartz monzonite. Mapped as part of the latter.

M. P. Billings, 1956, Geology of New Hampshire, pt. 2, Bedrock geology: Concord, New Hampshire State Plan. Devel. Comm., p. 63–64. Abandoned as a formation name in New Hampshire although it has priority over the Franconia of the upper Mississippi Valley.

Occurs in Franconia and Lincoln [Townships], Grafton County.

†Franconia Gravel[1]

Pleistocene: Eastern Virginia.

Original reference: L. F. Ward, 1895, U.S. Geol. Survey 15th Ann. Rept., p. 326–330, 339.

Well exposed at gravel pits of Alexandria & Fredericksburg Railroad at Franconia Station, 6 miles southwest of Alexandria.

Franconia Sandstone[1]

Franconia Formation

Upper Cambrian: Southeastern Minnesota, northern Illinois, and southwestern Wisconsin.

Original reference: C. P. Berkey, 1897, Am. Geologist, v. 20, p. 345–383.

A. C. Trowbridge and others, 1935, Kansas Geol. Soc. Guidebook 9th Ann. Field Conf., p. 81, 92, 134, 140, 159, 431, 446, 449, 455. Comprises (ascending) Ironton sandstone, Goodenough (new), Hudson (new), and Bad Axe (new) members.

C. R. Stauffer, G. M. Schwartz, and G. H. Thiel, 1938, (abs.) Geol. Soc. America Bull., v. 49, no. 12, pt. 2, p. 1902. In suggested classification of Minnesota Upper Cambrian, the Franconia includes (ascending) Ironton member, Taylors Falls (new) or Goodenough member, Minnesika (new) or Hudson member, and Bad Axe member. Underlies Judson member (new) of St. Lawrence formation.

C. R. Stauffer, G. M. Schwartz, and G. A. Thiel, 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1228 (table 1), 1236–1239. Minnesota classification shows Franconia formation subdivided into (ascending) Ironton, Taylors Falls, Hudson, and Bad Axe members. Underlies Nicollet Creek member (new) of St. Lawrence formation. Overlies Galesville member of Dresbach formation. St. Croixian series.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 9, 35–41, measured sections. Formation described in detail in southeastern Minnesota where it comprises (ascending) Ironton, Taylors Falls, Hudson, and Bad Axe members. Overlies Dresbach formation; underlies St. Lawrence formation, St. Croixian series.

R. R. Berg, 1951, Minnesota Geologist, v. 8, no. 4, p. 1–3. Twenhofel, Raasch, and Thwaites (1935) proposed faunal zonation of the Franconia and applied geographic member names to the zones. Present study has resulted in discrimination of units of uniform lithic character, properly called member. Previously proposed names are rejected. Formation consists of (ascending) Woodhill, Birkmose, Tomah, and Reno members. Mazomanie sandstone member represents a nonglauconitic facies that interfingers with and replaces glauconitic sandstones to north and east. Distribution of faunal zones of Franconia stage is largely independent of lithic units of Franconia formation.

H. B. Willman and J. S. Templeton, 1951, Illinois Acad. Sci. Trans., v. 44, p. 109–113. Oldest formation exposed in northern Illinois. About 30 feet exposed in quarry in or near Oregon, Ogle County. Underlies Trempealeau formation.

G. O. Raasch, 1951, Illinois Acad. Sci. Trans., v. 44, p. 147. Bad Axe member of Franconia underlies Arcadia member (new) of Trempealeau formation.

R. R. Berg, 1954, Geol., Soc. America Bull., v. 65, no. 9, p. 857–882. Redefined Franconia formation described in detail. Redefinition of formation based on rock types results in different interpretation of lower and upper contacts and adds as much as 30 feet to its total thickness. Formation consists of quartzose sandstones that range from 150 to 210 feet thick within outcrop area. Member names—Ironton, Goodenough, Hudson, and Bad Axe which were in reality faunal zones—are rejected, and names Woodhill, Birkmose, Tomah, and Reno are applied to members. Mazomanie member interfingers with and replaces Reno member. Overlies Galesville member of Dresbach; underlies St. Lawrence formation.

Named for exposures in vicinity of Franconia, Chisago County, Minn.

Franconian 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 Franconian consists of six faunal zones: *Elvinia*, *Ptychopleurites*, *Conaspis*, *Prosaukia-Ptychaspis*, *Briscola*, and *Dikelocephalus postrectus*.

R. R. Berg, 1954, Geol. Soc. America Bull., v. 65, no. 9, p. 857–882. Limits of Franconian stage were defined to coincide with Franconia formation, and this has resulted in artificial faunal boundaries. Greatest faunal change takes place between *Ptychaspis* and *Prosaukia* subzones. Saukinid trilobites first appear in *Prosaukia* subzone, and together with species of *Dikelocephalus* they form dominant group in overlying Trempealeauan stage. Redefinition of stage boundaries would place the contact at the faunal change within the Reno and Mazomanie members.

W. C. Bell, R. R. Berg, and C. A. Nelson, 1956, Internat. Geol. Cong., 20th, Mexico, Cambrian Symposium, pt. 2, p. 425–436. Franconian stage originated with Correlation Chart (Howell and others, 1944) and was defined by faunal criteria as a time-stratigraphic unit conincident with Franconia formation. When lithostratigraphic nomenclature is separated from biostratigraphic nomenclature, upper boundary of Franconia formation cannot be made to coincide with a biostratigraphic, and therefore stage, boundary. Recommended that boundary between Franconian and Trempealeauan stages be placed at top of *Ptychaspis-Prosaukia* zone. This produces nomenclatorial paradox; the upper part of Franconia formation in places belongs in Trempealeauan rather than Franconian stage. It is not likely that geologists in upper Mississippi Valley will abandon use of Franconia formation, though there are reasons for doing so. Type section of formation included only lower Mazomanie member, and nowhere in St. Croix Valley is exposed above river level a complete section of the formation as it is now defined. Might be more satisfactory to propose a new stage name.

Name derived from Franconia, Chisago County, Minn.

Frankford Gneiss[1]

Precambrian: Southeastern Pennsylvania.

Original reference: T. D. Rand, 1900, Philadelphia Acad. Nat. Sci. Proc., pt. 1, p. 279.

Exposed at Frankford, Philadelphia County.

Frankfort Shale[1]

Upper Ordovician: Central and east-central New York.

Original reference: L. Vanuxem, 1840, New York Geol. Survey 4th Rept., p. 372–373.

G. M. Kay, 1943, Am. Jour. Sci., v. 241, no. 10, p. 601 (fig. 3). Stratigraphic diagram shows Harter shale member (new) of Frankfort formation.

G. M. Kay, 1953, New York State Mus. Bull. 347, p. 59 (fig. 42), 64–67. Formation described in Utica quadrangle where it comprises (ascending) Harter shale, Hasenclever sandstone (new), and Moyer (new) members. Thickness about 540 feet. Overlies Utica shale; underlies Silurian Oneida conglomerate. Eden group, Cincinnatian series.

D. W. Fisher and L. V. Rickard, 1953, New York State Mus. Circ. 36, p. 13, fig. 1. At Sharon Springs, unconformably underlies Brayman shale (redefined).

Typical exposure: Along Moyer Creek, southwest of Frankfort, Herkimer County.

Franklin Formation } (in Puget Group)
Franklin Series[1]

Eocene: Western Washington.

Original reference: G. W. Evans, 1912, Washington Geol. Survey Bull. 3, p. 42–49.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 26 (table), 55–62. Described in Green River area as Franklin formation in Puget group. Consists of a series of interbedded sandy and argillaceous and carbonaceous shales together with thick beds of massive brown sandstone; basal part of formation includes a 210-foot basal sandstone, the Franklin. Thickness about 3,600 feet. Underlies Kummer formation; overlies Bayne formation.

Probably named for town in King County.

Franklin Limestone[1]

Franklin Formation

Precambrian: Western New Jersey, Delaware, and eastern Pennsylvania.

Original reference: J. E. Wolff and A. H. Brooks, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 2, p. 431–456.

D. M. Fraser *in* B. L. Miller, D. M. Fraser, and R. L. Miller, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. C–48, p. 162–170, 172, pl. 1. In Northampton County, associated graphitic quartz schist has been included with limestone to comprise Franklin formation. May also include clastic sediments of somewhat more argillaceous type; most extensive member is the coarse-grained graphite-bearing limestone. There is little evidence to indicate relative age of Franklin and Moravian Heights (new) formations and Pochuck gneiss, but this is the assumed sequence. In Chestnut Hill area, Franklin limestone occurs adjacent to Moravian Heights formation; no contact is observable; both formations have been injected and altered by invasions of Byram granitic material.

W. S. Bayley, 1941, U.S. Geol. Survey Bull. 920, p. 1–12, 19–46, pl. 5. Described in Delaware Water Gap and Easton quadrangles, Pennsylvania, where it is dominant formation. Associated with it are sedimentary schists, slaty rocks, and gneisses (here mapped as Pickering gneiss) and generally believed to be older. Relationship to Hardyston quartzite not observable in area of report.

Named for occurrence at Franklin Furnace, Sussex County, N.J.

Franklin Limestone (in Washington Formation)[1]

Permian: Southwestern Pennsylvania.

Original reference: J. J. Stevenson, 1907, Geol. Soc. America Bull., v. 18, p. 97, 102.

Franklin and Amwell Townships, Greene County.

Franklin Sandstone[1]

Eocene: Western Washington.

Original reference: G. W. Evans, 1912, Washington Geol. Survey Bull. 3, p. 42–49.

Probably named for town in King County.

Franklindale Limestone Lentil (of Chemung Formation)[1]

Upper Devonian: Central northern Pennsylvania.

Original reference: H. S. Williams and E. M. Kindle, 1905, U.S. Geol. Survey Bull. 244.

Exposed in Gulf Brook section, west of Franklindale, Bradford County.

†Franks Conglomerate[1]

Pennsylvanian (Desmoinesian and Missourian): Central southern Oklahoma.

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

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, an older consisting of "Franks" and Deese, and a younger consisting of Collings Ranch (new) and Vanoss. All but the Vanoss (youngest) are preserved in synclinal grabens and are moderately to strongly folded and faulted. The "Franks," which contains rocks chiefly from Hunton through Arbuckle, has maximum thickness of 1,500 feet and consists of conglomerate interbedded with and grading into fossiliferous shales, limestone, and sandstones. The "Franks" is considered an orogenic product of the first great period of uplift in the Arbuckle Mountains, which began as broad domal folding of the Hunton anticline in early Desmoinesian time; the conglomerates were closely folded, locally overturned, and faulted in late Pennsylvanian (middle Missourian) time.

Named from exposures in vicinity of Franks, Pontotoc County.

Franson Member or **Tongue** (of Park City Formation)

Permian: Eastern Utah, northwestern Colorado, eastern Idaho, southwestern Montana, and western Wyoming.

T. M. Cheney *in* V. E. McKelvey and others, 1956, Am. Assoc. Petroleum Geologist Bull., v. 40, no. 12, p. 2842–2843; 1959, U.S. Geol. Survey Prof. Paper 313–A, p. 15–19, 31, 37, pls. 2, 3. Proposed for light-gray and grayish-brown carbonate rock, cherty or sandy carbonate rock, and calcareous sandstone that overlie Meade Peak tongue (new) of Phosphoria formation and underlie Woodside formation. In Montana, Wyoming, and Idaho, has been considered upper part of Rex chert member or the C member of Phosphoria formation (Klepper, 1951, U.S. Geol. Survey Bull. 969–C). At type locality, about 235 feet thick and consists of a lower unit, about 65 feet thick, of dominantly light-gray and grayish-brown carbonate rock; middle unit, about 85 feet thick, dominantly light-gray and brownish-gray carbonatic sandstone containing chert as beds and nodules; and upper unit, about 85 feet thick, dominantly white and light-gray carbonate rock; some beds of the upper unit, are reddish brown and are probably laterally continuous with Mackentire tongue of Woodside formation. Lower contact gradational but placed at top of gray and greenish-gray cherty phosphatic carbonate rock of upper part of Meade Peak tongue. Thickness 830 feet in southern Wasatch Mountains, but over most of its extent ranges from 50 to 200 feet in thickness. In most of Utah, western Wyoming, and parts of Montana, underlain by tongue of Phosphoria, either Meade Peak or Rex; in eastern Utah and northwestern Colorado, underlain by

Weber sandstone; in parts of Montana and Wyoming where Meade Peak and Rex are absent, Franson is difficult to separate from lower (unnamed) member of Park City; in northernmost Utah, eastern Idaho, western Wyoming, and southwestern Montana, interfingers basinward with the Rex, Tosi, and Meade Peak members of Phosphoria, and in Utah intertongues shoreward with red and greenish gray shales of Woodside formation; in western Wyoming, Montana, and northeastern Idaho, Franson tongue is overlain by Retort phosphatic shale member (new) of Phosphoria.

Named from exposures on north side of Franson Canyon near the mouth in S½SE¼ sec. 15, and N½NE¼ sec. 22, T. 1 S., R. 6 E., Summit County, Utah.

Frazier Well Gravel

Pre-Pleistocene: Northwestern Arizona.

Donaldson Koons, 1948, Science, v. 107, no. 2784, p. 475. Consists of well-rounded pebbles and boulders of vein quartz, granite, gneiss, schist, red and white quartzite, and sandstone. Deposits vary in thickness from thin veneer to more than 200 feet. Found at elevations ranging from 5,660 feet, 12 miles southwest of Frazier Well, to 7,150 feet, 5 miles northwest of the Well.

Best exposed near Frazier Well, Hualpai Reservation, after which the gravels are named.

Freda Sandstone (in Oronto Group)[1]

Precambrian: Northern Michigan and northern Wisconsin.

Original reference: A. C. Lane and A. E. Seaman, 1907, Jour. Geology, v. 15, p. 680, 692.

S. A. Tyler and others, 1940, Geol. Soc. America Bull., v. 51, no. 10, p. 1474–1479. Oronto group revised to exclude Eileen sandstone and Amnicon formation. Thickness of Amnicon given by Thwaites (1912) —5,000 feet—is included in his estimate of the Freda, and the 2,000 feet assigned to the Eileen is included in the Orienta (in Bayfield group). Thickness of Freda 12,000 feet. Overlies Nonesuch shale; underlies Orienta sandstone.

W. S. White, H. R. Cornwall, and R. W. Swanson, 1953, U.S. Geol. Survey Geol. Quad. Map GQ–27 In Ahmeek quadrangle, Michigan, Freda consists of red fine- to medium-grained sandstone with prominent white streaks and blotches; contains minor amounts of red shale and conglomerate. Lowermost 700 feet of formation exposed here consists of light-gray fine- to medium-grained sandstone with purple streaks. Total thickness of formation where more fully exposed about 5,000 feet. Contact with underlying Nonesuch shale transitional.

Named for exposures at new stamp mills at Freda, Houghton County, Mich., and along adjacent shore.

Frederick Limestone[1]

Upper Cambrian: Central northern Maryland.

Original reference: C. R. Keyes, 1890, Johns Hopkins Univ. Circ. 84, v. 10, p. 32.

A. J. Stose and G. W. Stose, 1946, Maryland Dept. Geology, Mines and Water Resources [Rept.] Carroll and Frederick Counties, p. 43–47. Thickness in Frederick Valley 480 feet. Underlies Ordovician Grove limestone in center of Frederick Valley syncline and in several narrow areas northwest of Frederick. In eastern part of valley, unconformably overlaps Lower Cambrian Antietam quartzite; here Lower Cambrian Tomstown dolomite, which overlies the Antietam in normal sequence in foothills west of Triassic border, is not present.

Probably named for occurrence in vicinity of Frederick.

Fredericksburg Gneiss[1]

Precambrian: Northeastern Virginia.

Original reference: J. T. Lonsdale, 1927, Virginia Geol. Survey Bull. 30.

Well exposed in quarries northwest of Fredericksburg, Spotsylvania County.

Fredericksburg Granite[1]

Precambrian: Northeastern Virginia.

Original reference: J. T. Lonsdale, 1927, Virginia Geol. Survey Bull. 30.

Well exposed along Rappahannock River in Stafford and Spotsylvania Counties.

Fredericksburg Group[1]

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

Original reference: R. T. Hill, 1887, Am. Jour. Sci., 3d, v. 33, p. 296–299.

Elliot Gillerman, 1953, U.S. Geol. Survey Bull. 987, pl. 1. As mapped in Eagle Mountains, Hudspeth County, Tex., comprises Finlay limestone and Kiamichi formation. Overlies Cox sandstone of Trinity group; underlies Georgetown limestone of Washita group.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. As mapped, includes Goodland limestone and Walnut clay. Kiamichi mapped with Washita group.

D. L. Frizzell, 1954, Texas Univ. Bur. Econ. Geology Rept. Inv. 22, p. 20–22. As used in this report [Cretaceous Foraminifera of Texas] group includes (ascending) Walnut clay, Goodland limestone, Edwards limestone, and Kiamichi formation. Overlies Paluxy formation of Trinity group; underlies Duck Creek formation of Washita group.

P. E. Lozo, 1959, Texas Univ. Bur. Econ. Geology Pub. 5905, p. 3 (fig. 2), 28 (fig. 13), measured sections. In this report [Symposium on Edwards limestone], Fredericksburg group comprises (ascending) Paluxy sand, Walnut formation, Comanche Peak limestone, Edwards limestone, and Kiamichi formation. Overlies Glen Rose limestone of Trinity group; underlies Georgetown limestone of Washita group or Kiamichi shale where Kiamichi is considered part of Washita group. A southern complex of the Edwards, Comanche Peak, and Walnut formations is indicated to pass northward into a complex composed of the Goodland, Walnut, and Paluxy formations. Classification of included stratigraphic intervals as Fredericksburg division follows Hill's early nomenclature and concept of an integrated subseries representing a major and distinct cycle of sedimentation.

B. F. Perkins, 1960, Geol. Soc. America Mem. 83, p. 9 (fig. 3), 11–21, pls. 1, 2. In Fort Worth area, group comprises (ascending) Walnut marl and Goodland formation. Overlies Paluxy sandstone of Trinity group; underlies Kiamichi formation of Washita group.

L. V. Davis, 1960, Oklahoma Geol. Survey Bull. 86, p. 16 (table 5), 31–34. In McCurtain County, only Goodland limestone is included in Fredericksburg group. No mappable stratigraphic boundary present between Kiamichi formation and Goodland limestone, and Kiamichi is mapped with Washita group. Unconformably overlies Paluxy sand of Trinity groups.

Named for Fredericksburg, Gillespie County, Tex.

†Fredericksburg Sandstone[1]

Lower Cretaceous: Virginia.

Original reference: W. B. Rogers, 1842, Philadelphia Acad. Nat. Sci. Proc., v. 1, p. 142.

Fredericksburg, Spotsylvania County.

†Fredericktown dolomite[1]

Upper Cambrian: Southeastern Missouri.

Original reference: C. R. Keyes, 1895, Missouri Geol. Survey Sheet Rept. 4, v. 9, p. 18, 19, 48.

Named for exposures at Fredericktown, Madison County.

Fredonia Limestone or **Oolite Member** (of Ste. Genevieve Formation)[1]

Fredonia Member (of Ste. Genevieve Limestone)

Upper Mississippian: Western Kentucky, southern Illinois, southern Indiana, southeastern Missouri, and western Tennessee.

Original reference: E. O. Ulrich and W. S. T. Smith, 1905, U.S. Geol. Survey Prof. Paper 36, p. 24, 40.

F. E. Tippee, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 11, p. 1655–1656. Fredonia member is divisible into three units: upper limestone, middle sandstone, and lower limestone. Name Spar Mountain sandstone is here proposed for the middle sandstone member, heretofore known as a "sub-Rosiclare sandstone."

T. G. Perry and N. M. Smith, 1958, Indiana Geol. Survey Bull. 12, p. 19–20, pl. 1. Termed Fredonia member by Indiana Geological Survey. Unit does not contain a higher proportion of oolite than do other members of formation. Thickness 30 to 115 feet. Base of member is 10 to 20 feet below Lost River chert (Elrod, 1899). Lowest member of formation; underlies Rosiclare member.

Named for exposures at Fredonia, Caldwell County, Ky.

Freedhem Tonalite

Precambrian (late Algoman): Central Minnesota.

M. S. Woyski, 1949, Geol. Soc. America Bull., v. 60, no. 6, p. 1002, 1009, 1010, pl. 1. Metatonalite to granodiorite, tonalite most common; black to light gray, fine to medium granitoid, weak primary foliation. 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, Hillman tonalite, Freedhem tonalite, and Warman quartz monzonite are indeterminate because no contacts are exposed.

Name applied because most of its outcrops are around town of Freedhem, Morrison County.

Freedom Dolomite[1]

Precambrian: Central southern Wisconsin.

Original reference: S. Weidman, 1904, Wisconsin Geol. Nat. History Survey Bull. 13, p. 51.

Named for occurrence southwest of North Freedom, Sauk County.

Freeman-Jewett Shale

Miocene: Southern California.

T. W. Dibblee, Jr., and C. W. Chesterman, 1953, California Div. Mines Bull. 168, p. 12 (fig. 2), 38, pls. 1, 2, 3. Light-grayish-brown thin-bedded, somewhat punky semisiliceous or diatomaceous shale; commonly contains thin laminae of fine silty sand. Thickness about 500 feet. Conformably underlies Bena gravels; conformably overlies Walker formation. Equivalent of lower Miocene Freeman-Jewett silt of the east side of San Joaquin Valley oil fields.

Crops out in Cottonwood Canyon, Kern County.

Freeport Clay[1]

See Upper Freeport Clay and Lower Freeport Clay.

Freeport coal group (in Allegheny Formation)[1]

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

Original references: H. D. Rogers, 1858, Geology of Pennsylvania, v. 2, pt. 1, p. 474–492; J. P. Lesley, 1877, Pennsylvania 2d Geol. Survey Rept. H_3, p. xxiii.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 78. Rogers (1858) used Freeport as a group name for strata between Lower Freeport and Lower Mahoning sandstones. Strata in above interval are now recognized as including three cyclothems (ascending) Lower Freeport, Bolivar, and Upper Freeport.

Name taken from town of Freeport, Armstrong County, Pa.

Freeport Formation[1] (in Allegheny Group)

Pennsylvanian: Pennsylvania.

G. H. Ashley, 1923, Eng. and Mining Jour.-Press, v. 115, no. 25, p. 1108; 1926, Pennsylvania Geol. Survey, 4th ser., Topog. and Geol. Atlas 65, p. 28, pl. 4. Allegheny group, of Pittsburgh series, subdivided into (ascending) Clarion, Kittanning, and Freeport formations. Freeport comprises (ascending) Freeport sandstone, Freeport lower limestone, Freeport lower clay, Freeport lower or D coal, Butler sandstone, Bolivar flint clay, Freeport upper limestone, Freeport upper clay, Freeport Upper or E coal. Underlies Mahoning formation.

M. N. Shaffner, 1946, Pennsylvania Geol. Survey, 4th ser., Topog. and Geol. Atlas 55, p. 51–65. Allegheny group subdivided into (ascending) Clarion, Kittanning, and Freeport formations. The Freeport includes all rocks between top of Upper Freeport coal and top of Upper Kittanning coal. Comprises (ascending) Freeport and Kittanning sandstones, Lower Freeport clay and limestone, Lower Freeport coal, Butler sandstone, Bolivar fire clay, Upper Freeport limestone, and Upper Freeport coal and clay.

R. R. Dutcher and others, 1959, Geol. Soc. America Guidebook Field Trip Pittsburgh Mtg., p. 70 (fig. 5), 71. Allegheny group subdivided into three formations (ascending): Clarion, Kittanning, and Freeport.

E. G. Williams, 1960, Jour. Paleontology, v. 34, no. 5, p. 910 (fig. 2). Formation includes (ascending) Lower Freeport sandstone, Lower Freeport coal, Butler sandstone, and Upper Freeport coal. Overlies Kittanning formation which contains Upper Kittanning coal at top. Allegheny group.

Name taken from town of Freeport, Armstrong County, Pa.

Freeport Gravel[1]

Pleistocene: Northwestern Illinois.

Original reference: O. H. Hershey, 1897, Am. Geologist, v. 19, p. 207–209.

Occurs 2 miles east of Freeport, Stephenson County.

†Freeport Limestone Member (of Allegheny Formation)[1]

Pennsylvanian: Western Pennsylvania, Maryland, eastern Ohio, and northern West Virginia.

Original reference: H. D. Rogers, 1858, Geology Pennsylvania, v. 2, pt. 1, p. 492.

R. E. Lamborn, 1951, Ohio Geol. Survey, 4th ser., Bull. 49, p. 27. Discussion of limestones of eastern Ohio. From 3 to 12 feet below base of Upper Freeport coal, there is an irregular bed of limestone which Rogers (1858) called Freeport limestone in northwestern Pennsylvania and which Newberry (1878, Ohio Geol. Survey, v. 3) apparently described as the White limestone in Mahoning County. In his report on Lawrence County, Pa., White (1879, Pennsylvania 2d Geol. Survey Rept. Q_2), at the suggestion of Lesley, renamed Butler limestone, which underlies Lower Freeport coal and which was not recognized by Rogers, the Lower Freeport and called the Freeport limestone of Rogers, the Upper Freeport. This terminology has been accepted in reports dealing with geology of coal measures in Pennsylvania, West Virginia, and Ohio.

Name taken from town of Freeport, Armstrong County, Pa.

Freeport Sandstone Member (of Allegheny Formation)[1]

Freeport Sandstone (in Allegheny Group)

Freeport Sandstone (in Freeport Formation)

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.

G. H. Ashley, 1926, Pennsylvania Topog. and Geol. Atlas 65, p. 28, pl. 4. Freeport sandstone included in Freeport formation.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C26, p. 60, 74–75. Formation in Allegheny group. Lies below Lower Freeport coal and fire clay and above Upper Kittanning coal. Consists of thin- to medium-bedded brown medium-grained micaceous sandstone, locally crossbedded. Thickness as much as 15 feet exposed in roadcut 1 mile southwest of Indian Head. Two miles southwest of Markleysburg along State line, a massive sandstone bed crops out which appears to be about 80 to 100 feet below Upper Freeport coal. Area of report, Fayette County.

Name taken from town of Freeport, Armstrong County, Pa.

†Freezeout Limestone[1]

Triassic(?): Central Wyoming.

Original reference: F. B. Peck, 1904, Wyoming Hist. and Geol. Soc. Proc. and Coll., v. 8, p. 28–41.

Freezeout Mountains.

Freezeout Shale (in Phosphoria Group)

Freezeout Tongue (of Chugwater Formation)[1]

Permian: Southeastern Wyoming.

Original reference: H. D. Thomas, 1934, Am. Assoc. Petroleum Geologists Bull., v. 18, no. 12, p. 1664, 1670.

G. E. Condra, E. C. Reed, and O. J. Scherer, 1940, Nebraska Geol. Survey Bull. 13, p. 2; 1950, Nebraska Geol. Survey Bull. 13–A, p. 2 (fig. 2), 3. Chugwater, as used in Wyoming, is synonymous with Spearfish redefined. Freezeout tongue of Chugwater is here designated as a member or a formation. Chart shows Freezeout shale in Phosphoria group.

N. C. Privrasky, 1958, Wyoming Geol. Assoc. Guidebook 13th Ann. Field Conf., p. 50, 52. Term Freezeout shale should be abandoned in Powder River Basin and unit referred to as unnamed shale member of Goose Egg formation.

Present in Freezeout Hills.

Fremont Limestone[1] or Dolomite

Fremont Formation

Middle and Upper Ordovician: Eastern and central Colorado.

Original reference: C. D. Walcott, 1892, Geol. Soc. America Bull., v. 3, p. 154–167.

J. C. Maher, 1950, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 39. Described along Front Range where it consists of limestone as much as 50 feet thick. Overlies Harding sandstone; underlies Williams Canyon limestone.

T. S. Lovering and E. N. Goddard, 1950, U.S. Geol. Survey Prof. Paper 223, p. 32. At type section, limestone is 190 feet thick; maximum thickness 290 feet a few miles north of Priest Canyon.

J. W. Gabelman, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 8, p. 1582 (fig. 3), 1583. In Sangre de Cristo Mountains, Fremont consists of fairly uniform dark-gray to black crystalline dolomite. Overlies Harding quartzite; underlies Parting member of Chaffee formation. Thickness as much as 400 feet.

W. C. Sweet, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 2, p. 294–300. Referred to as formation. Thickness 283½ feet. Lower 208 feet is massive dolomite; upper 75 feet is shale and dolomite and is here named Priest Canyon member. Overlies Harding formation; underlies Williams Canyon formation.

M. G. Dings and C. S. Robinson, 1957, U.S. Geol. Survey Prof. Paper 289, p. 13. In Garfield quadrangle, Fremont is dolomite. Thickness 15 to 135 feet. Uncomformably overlies Harding quartzite; uncomformably underlies Parting member of Chaffee formation.

Type section: Harding Quarry at Canon City. Named for exposures in Fremont County.

French Slate[1] (in Snowy Range Series)

Precambrian: Southeastern Wyoming.

Original reference: E. Blackwelder, 1926, Geol. Soc. America Bull., v. 37, p. 620, 622, 645, 649.

J. J. Runner, 1928, Geol. Soc. America Bull., v. 39, no. 1, p. 202. Included at top of 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.

Named for French Creek in Medicine Bow Mountains.

Frenchburg Siltstone Member (of Brodhead Formation)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 76, 180, 182, 183–184, pl. 17. Included in Morehead facies (new), Brodhead formation. Occurs in massive beds up to 6 feet thick. Thickness of member 10 to 17 feet. Underlies Haldeman siltstone member (new); overlies Christy Creek siltstone member (new).

Type section: Quarry one-half mile west of Frenchburg, Menifee County.

French Creek limestone member[1]

Mississippian: Northwestern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 135–136.

Type section: Ravine at "Glendale" Cemetery, in Meadville City, Crawford County.

French Creek Shale Member (of Root Shale)

French Creek Shale (in Wabaunsee Group)[1]

Pennsylvanian (Virgil Series): Northeastern Kansas, southwestern Iowa, and southeastern Nebraska.

Original reference: R. C. Moore, May 1935, Kansas Geol. Survey Bull. 20, table opposite p. 14.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2274 (fig. 1), 2275. Rank reduced to member status in Root shale (new). Overlies Jim Creek limestone member; underlies Nebraska City limestone member of Wood Siding formation (redefined).

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 11, fig. 5. Geographically extended into southwestern Iowa where it is uppermost unit in Wabaunsee group. Overlies Jim Creek limestone.

Type locality: French Creek, northeastern part of Pottawatomie County, Kans.

French Flat Sandstone

Pliocene, middle: Southern California.

D. I. Axelrod, 1950, Carnegie Inst. Washington Pub. 590, pl. 1. Shown on plate 1 as stratigraphically below Piru Gorge sandstone (new). [Text refers to a thick sand unit near French Flat. French Flat sandstone may be basal formation of Ridge Basin group.]

Occurs in Ridge Basin area along U.S. Highway 99 between Los Angeles and Bakersfield, in the region from 5 miles north of Castaic to the vicinity of Gorman.

French Lick Coal Member (of Mansfield Formation)

Pennsylvanian: South-central Indiana.

H. H. Gray, R. D. Jenkins, and R. M. Weidman, 1960, Indiana Geol. Survey Bull. 20, p. 26, 27, pl. 1. Important stratigraphic marker or key bed about 50 feet below top of lower unit of Mansfield. Average thickness about 1 foot. Coal named by D. W. Franklin (1939, unpub. thesis). Franklin's type section for coal, in SW¼NW¼ sec. 4, T. 2 N., (sic) R. 2 W., not located. Another locality noted which may be one to which Franklin referred.

Type locality: Quarry and mine in NE¼NE¼ sec. 5, T. 1 N., R. 2 W., approximately 1 mile west of town of French Lick, Orange County.

French Lick Stone (in Chester Group)[1]

Mississippian: Southwestern Indiana.

Original reference: E. T. Cox, 1871, Indiana Geol. Survey 2d Ann. Rept., p. 81.

Named for French Lick Springs, Orange County.

Frenchmans Bay Series

Silurian: Southeastern Maine.

G. H. Chadwick, 1942, (abs.) Geol. Soc. America Bull., v. 53, no. 12, pt. 2, p. 1797. Named to include Bar Harbor detrital facies and Cranberry Island volcanic facies. Replaces four series of Shaler (1889), Schooner Head, Suttons Island, Cranberry Island, and Bar Harbor. Presumably Silurian.

G. H. Chadwick, 1944, New York Acad. Sci. Trans., ser. 2, v. 6, no. 6, p. 172–173, 176–177. Includes all sedimentary rocks overlying Bartletts Island schist; these form a seemingly indivisible succession exhibiting two contrasting and interfingering facies, Bar Harbor and Cranberry Island facies.

Occurs on Mount Desert Island, Hancock County, which is bordered on the east by Frenchman Bay.

French Pond Granite[1] (in New Hampshire Plutonic Series)

Upper Devonian(?): West-central New Hampshire.

Original reference: M. P. Billings, 1935, Geology of Littleton and Moosilauke quadrangles, New Hampshire, Moosilauke map, p. 28, 36.

M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000): U.S. Geol. Survey. Included in New Hampshire plutonic series of Upper Devonian(?) age.

M. P. Billings, 1956, Geology of New Hampshire, pt. 2, p. 61. Heterogeneous rock composed of five phases. In New Hampshire plutonic series.

Confined to circular stock 3 miles in diameter 3 miles southeast of Woodsville. Named from French Pond, 4½ miles southeast of Woodsville, Moosilauke quadrangle.

Frenchtown Diorite[1]

Age(?): Northeastern Maryland.

Original reference: G. P. Grimsley, 1894, Cincinnati Soc. Nat. History Jour., v. 17.

Near Frenchtown, Cecil County.

Frenck Shale[1]

Pennsylvanian: Northeastern Kansas and southeastern Nebraska.

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. Guidebook 6th Ann. Field Conf., p. 94, 96.

Derivation of name not given.

Frensley Limestone (in Dornick Hills Group)

Frensley Limestone Member (of Lake Murray Formation)

Pennsylvanian: Eastern Oklahoma.

Jerome Westheimer, 1936, Correlation of the Pennsylvanian formations of the Ardmore basin and the Franks graben, Oklahoma: Ardmore Geol. Soc., last 3 pages of mimeographed program of a conference on correlation of the Pennsylvanian System of the Ardmore basin, held May 5, 1936. At base of the Pumpkin Creek south of Ardmore, nodular white dense limestone varying in thickness from 1 to 10 feet or more. Limestone contains an undescribed species of Fusulina which also occurs 50 feet below top of the Atoka in the so-called Red Oak member. Name Frensley is here proposed for this limestone and the shale overlying it and beneath the overlying prominent sandstone. Frensley marks top of the Atoka or Red Oak of eastern Oklahoma.

B. H. Harlton, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 7, p. 854 (fig. 1). Shown on correlation chart of area south of Arbuckles. Pennsylvanian (Des Moines).

R. M. Jeffords, 1942, Kansas Geol. Survey Bull. 41, pt. 5, p. 250. Corals collected from Frensley limestone, Lampasas age, southeast of Ardmore, Okla.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 37). Shown on chart as Frensley limestone, in Dornick Hills group; Lampasas series.

B. H. Harlton, 1956, *in* Ardmore Geol. Soc., Petroleum geology of southern Oklahoma—a symposium, v. 1: Tulsa, Am. Assoc. Petroleum Geologists, p. 137 (fig. 2), 139, 140 (fig. 3). Rank reduced to member status in Lake Murray formation (new). Overlies Griffin sandstone (equivalent to Lester) member; underlies Big Branch formation. Atoka series.

Well exposed on Frensley Farm in SE¼ sec. 30, T. 3 S., R. 2 E., Carter County.

Fresnal Group

Pennsylvanian (Virgil Series): Central and southwestern New Mexico.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 27 (table 2), 73–79. Term proposed for all sedimentary rocks that are definitely referable to the Virgil series between top of the Keller group (new) and base of the Permian Wolfcamp (above). Thickness at type locality 530 feet; in San Andres Mountains apparently more than 1,000 feet thick. At type locality, composed of argillaceous to essentially pure limestone, arkosic sandstone, conglomerates, and gray to red shale; more than 50 percent of rocks are clastics, but most of them are of marine origin. In central part of State, group is composed largely of red shale, with interbedded thin nodular to irregularly bedded fossiliferous limestone and arkosic sandstone. Many faunal as well as lithologic units recognized in type section of group, but formational names not applied at this time; includes Bruton formation (new) in lower part in area of Oscura Mountains. In Fresnal Canyon in north end of Sacramento Mountains, upper Virgil strata of Fresnal group are overlain unconformably by 250 feet of strata of undetermined age. These strata are composed largely of clastic red shale, gray shale, sandstone, and conglomerates. In some areas, the Abo formation rests directly on the Bruton.

Carel Otte, Jr., 1959, New Mexico Bur. Mines Mineral Resources Bull. 50, p. 18, 19. Holder formation includes the Fresnal and Keller groups in classification of Thompson (1942). Thompson's detailed section of Fresnal group forms upper 530 feet of Pray's (1952, unpub. thesis) Holder formation and is overlain by Laborcita formation (new).

Type locality: Fresnal Canyon along State Highway 83, east of La Luz, in north end of the Sacramento Mountains. Section is mainly in NW¼ sec. 30, T. 15 S., R. 11 E., Otero County.

†Fresnian Stage

Eocene, late: California.

V. S. Mallory, 1953, (abs.) Jour. Paleontology, v. 27, no. 6, p. 903; 1954, Pacific Petroleum Geologist, v. 8, no. 11, p. 1. One of six stages, based on foraminiferal assemblages, in lower Tertiary of California. Includes interval between Oligocene Refugian stage above and Narizian stage. Also spelled Fresnoian.

V. S. Mallory, 1959, Lower Tertiary biostratigraphy of the California Coast Ranges: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 18. Term discontinued. Fresnian incorporated in redefined Narizian stage.

Fresnoian Stage

See Fresnian Stage.

Friant Formation

Miocene or Pleistocene(?): Southern California.

G. H. Jones, 1940, Am. Geophys. Union Trans., v. 21, pt. 1, p. 62 (fig. 2), 66. Composed of cemented sandy, tuffaceous lake-laid sediments; overlies granite.

G. A. Macdonald, 1941, California Univ. Pub., Dept. Geol. Sci. Bull., v. 26, no. 2, p. 262–265, map 1. Thickness varies; along northwestern side of Table Mountain about 250 feet; thickens to southwest; near lower end of Little Dry Creek, minimum exposed thickness 320 feet; entire series dips southwestward from 2° to 4°. Unconformably overlaps Ione formation near Little Table Mountain; on eastern side of San Joaquin Valley, lies on granitic rocks and crystalline schists; in some areas, capped by basaltic lava flows.

F. D. Trauger, 1950, (abs.) Geol. Soc. America Bull., v. 61, no. 12, pt. 2, p. 1531. Probably Pleistocene.

Typically exposed both east and west of San Joaquin River in vicinity of Friant, Fresno County.

Friedrich Shale Member (of Root Shale)

Friedrich Shale (in Wabaunsee Group)[1]

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

Original reference: R. C. Moore, 1935, Kansas Geol. Survey Bull. 20, table opposite p. 14.

G. E. Condra and E. C. Reed, 1938, Nebraska Geol. Survey Paper 12, p. 9. In Nebraska, formation includes (ascending) Minersville shale, Palmyra limestone, and Otoe shale members (all new).

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2274 (fig. 1), 2275. Rank reduced to member status in

Root shale (new). Underlies Jim Creek limestone member; overlies Grandhaven limestone member of Stotler limestone (new).

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 11, fig. 5. Geographically extended into southwestern Iowa. Bluish gray to light gray, micaceous, and silty in upper part. Thickness 10 feet. Underlies Jim Creek limestone. Overlies Grandhaven limestone. Wabaunsee group. Interval from lower part of Friedrich shale through Grandhaven limestone is exposed along bluffs of Missouri River and major tributaries in Fremont County extending from NW¼ sec. 1 to NW¼ sec. 13, T. 69 N., R. 43 W. Condra and Reed suggest that their Otoe shale, Palmyra limestone, and Minersville shale may occupy horizon of Friedrich shale.

Type locality: Friedrich Creek, sec. 6, T. 22 S., R. 11 E., Greenwood County, Kans.

Friendsville Black Shale (in Conemaugh Formation)[1]

Pennsylvanian: Western Maryland.

Original reference: C. K. Swartz, W. A. Price, and H. Bassler, 1919, Geol. Soc. America Bull., v. 30, p. 574.

Probably named for occurrence at Friendsville, Garrett County.

Friendsville 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 at base of formation about 50 feet below McClearys Bluff coal member. Coal named by Fuller and Clapp (1904, U.S. Geol. Survey Geol. Atlas, Folio 105). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: Secs. 13 and 24, T. 1 N., R. 13 W., Wabash County.

Friendsville Formation[1]

Pennsylvanian: Southwestern Indiana.

Original reference: Marshall Harrell, 1935, Indiana Div. Geology Pub. 133, p. 73 (chart).

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 84. Division of post-Alleghenian in western Indiana between McClearys Bluff above and St. Wendells formations, which is supposed to include Friendsville coal, Wabash County, Ill.; correlations between Friendsville and southwestern Indiana may have been erroneous, and Friendsville coal may be higher than its supposed equivalent in Indiana.

Type locality and derivation of name not given.

†Frijole Limestone Member (of Delaware Mountain Formation)[1]

Permian: Western Texas.

Original reference: W. G. Blanchard, Jr., and M. J. Davis, 1929, Am. Assoc. Petroleum Geologists Bull., v. 13, p. 973, 987.

Named for exposures at Frijole post office, Culberson County.

Frijole Shale[1]

Permian: Western Texas.

Original reference: J. E. Adams, 1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 6. p. 785.

Occurs in wells at top of Delaware Mountain section Loving County.

Frio Clay[1]

Oligocene(?): Eastern Texas.

Original reference: E. T. Dumble, 1894, Jour. Geology, v. 2, p. 554.

M. C. Israelsky, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 2, p. 376–382. Annotated bibliography of pertinent papers dealing with term Frio; also shows various uses of term as interpreted by the reviewer.

A. C. Ellisor, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 9, p. 1344–1375. Anahuac formation (new) lies between basal sands of Fleming above and subsurface Frio below.

A. D. Warren, 1957, Gulf Coast Assoc. Geol. Soc. Trans., v. 7, p. 221–227. Plummer (1932, Texas Univ. Bull. 3232) and Ellisor (1933, Am. Assoc. Petroleum Geologists Bull., v. 17, no. 11) used Frio as term for subsurface strata thought to be equivalent to surface beds of same name as restricted and defined by Plummer. However, it has been determined that surface Frio of Texas is outcrop equivalent of subsurface Vicksburg. Suggested that term Frio could be suppressed in case of the surface Vicksburgian equivalent in Texas and another name applied to that unit.

D. H. Eargle and J. L. Snider, 1957, Texas Univ. Bur. Econ. Geology Rept. Inv. 30, p. 11 (fig. 2), 14. Frio clay discussed in report on uranium-bearing rocks, Karnes County area. Believed to be present in subsurface beneath Catahoula tuff in central and southern Karnes County. Formation consists of light-greenish-gray clay that is bentonitic and slightly calcareous and which weathers to a characteristic brown silty or clayey soil. Although its strike is apparently same as that of underlying beds, the Frio is believed to rest unconformably on sands of Jackson formation. Downdip from outcrop, lower part of Frio of subsurface contains fauna characteristic of Vicksburg of east Gulf Coastal Plain and formation is therefore classed as Oligocene(?) in age. Thickness about 200 feet (well data in Karnes County).

D. H. Eargle, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 11, p. 2634. Discussion of Jackson group of south-central Texas. Southwest from point in northern Live Oak County, near community of Esseville, Frio clay, of Oligocene(?) age, extends to the Rio Grande. This usage of Frio is in the sense that Bailey (1926, Texas Univ. Bull. 2645) described the formation, restricting it to clays that lie conformably on the Jackson and that are overlain unconformably by Catahoula tuff (the Gueydan formation of Bailey).

Named for exposures at and near mouth of Frio River, Live Oak County.

Frio Formation

Frio Stage

Oligocene: Subsurface in Louisiana and Texas.

Alexander Deussen and K. D. Owen, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 11, p. 1616–1620, 1634. Inaccurate correlation of so-called subsurface Frio with surface Frio formation noted. Name Van Vleck sands suggested to replace "Frio" in subsurface.

M. C. Israelsky, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 2, p. 376–382. An annotated bibliography of pertinent papers dealing with term Frio; also shows various uses of term as interpreted by reviewer.

A. D. Warren, 1957, Gulf Coast Assoc. Geol. Soc. Trans., v. 7, p. 221–227. History of usage of term Frio in subsurface and proposal of formal type section for Frio Formation and Stage. Plummer (1932, Texas Univ. Bull. 3232) and Ellisor (1933, Am. Assoc. Petroleum Geologists Bull. 17, no. 11) used Frio as term for subsurface strata thought to be equivalent to surface beds of same name as restricted and defined by Plummer. It has been determined, however, that surface Frio of Texas is outcrop equivalent of subsurface Vicksburg. Between 1933 and 1940, workers, unaware of equivalency of subsurface Vicksburg to surface Frio, adopted term Frio for subsurface strata between middle Oligocene (Anahuac) and Vicksburg. This usage is firmly entrenched in the literature. Suggested that term Frio could be suppressed in case of the surface Vicksburgian equivalent in Texas and another name applied to that unit. Frio Stage is that part of subsurface stratigraphic section between base of Anahuac sediments and top of Vicksburg Stage. In type well, Frio Formation is present from 7,663 feet to 9,725 feet, whereas the stage continues down to 9,961 feet. Formation consists of dark to very dark, varicolored shales and silty shales and massive to thin-bedded strata of sand and silty sand. Top of formation is top of first sand below *Marginulina* zone of the Anahuacian, and base of lowest sand above Vicksburg Stage is considered base of Frio Formation. Stage in subsurface of Louisiana extends across southern half of State from Sabine River to Pearl River and is situated between base of Anahuacian *Marginulina* zone and top of Vicksburgian. Threefold division of Frio into upper, middle, and lower units is facilitated on basis of lithology and paleontology.

Type locality and well (formation and stage): China gas-distillate field in northeast Jefferson Davis Parish, La.; field is 6 miles southwest of Elton, La. Type well: Continental Oil-Union Sulphur, H. J. Shoesmith No. 1. Well is located 330 feet south and 330 feet east of NW cor. sec. 1, T. 8 S., R. 4 W.

Frisbie Limestone[1] Member (of Wyandotte Limestone)

Frisbie Limestone 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. Guidebook 6th Ann. Field Conf., p. 92, 97.

J. R. Clair, 1943, Missouri Geol. Survey and Water Resources, 2d ser., v. 27, pl. 1. Shown on columnar section of Jackson and Cass Counties, Mo., as limestone member of Iola formation; underlies Quindaro shale member; overlies Liberty Memorial shale member (new) of Chanute shale.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2031 (fig. 4), 2032, 2033; 1949, Kansas Geol. Survey Bull. 83, p. 103. Settlement of the "Iola problem" has led to a number of changes in the Missouri Survey's classification of middle and upper Kansas City beds so as to bring interstate agreement in nomenclature. Frisbie limestone, Quindaro shale, and Argentine limestone, which were indicated as members of Iola limestone in western Missouri, are classified with overlying Island Creek shale and Farley limestone as members of the Wyandotte.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 35. Thickness 1 to 3 feet in Kansas, ⅔ foot in Cass County, Nebr., and a few inches on Middle River, southwest of Winterset, Iowa.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 25, fig. 5. In Madison County, the Frisbie is a blue dense, locally fossiliferous limestone. Thickness one-half foot. Basal member of Wyandotte; underlies Quindaro shale member; overlies Lane shale.

Named for Frisbie, Johnson County, Kans. Well exposed at middle of north side of sec. 17, T. 12 S., R. 23 E.

Frisco Limestone[1] (in Hunton Group)

Lower Devonian: Northeastern and south-central Oklahoma.

Original reference: C. A. Reeds, 1926, Am. Mus. Nat. History Jour., v. 26, p. 470–473.

T. W. Amsden, 1957, Oklahoma Geol. Survey Circ. 44, p. 6 (fig. 3), 7, 47–49. In south-central Oklahoma, formation is a fossiliferous calcarenite with almost no argillaceous calcilutite. Maximum thickness about 41½ feet. Overlies Fittstown member (new) of Bois d'Arc limestone. Underlies Woodford formation. Reeds did not designate type section but mentioned that best exposures were along Bois d'Arc Creek; these exposures can be used as type section.

G. G. Huffman, 1958, Oklahoma Geol. Survey Bull. 77, p. 14 (fig. 2), 33–35, pl. 4. Described on flanks of Ozark uplift, northeastern Oklahoma. Light- to dark-gray, fine- to medium-crystalline, thick bedded, coquinoid fossiliferous limestone. Locally, sandy, cherty, and dolomitic beds may be present. Thickness 0 to 7 feet. Unconformably overlies St. Clair limestone; separated from overlying Sallisaw or Sylamore by unconformity, and locally, small cavities in Frisco are filled with Sylamore sandstone. Early Devonian.

Type section: Along Bois d'Arc Creek and near Coal Creek, NE¼ sec. 11, T. 2 N., R. 6 E., 7 miles south of Frisco, Pontotoc County.

Frog Mountain Sandstone[1]

Lower or Middle Devonian: Northern and central Alabama and northwestern Georgia.

Original reference: C. W. Hayes, 1894, Geol. Soc. America Bull., v. 5, p. 470.

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.

H. E. Rothrock, 1949, Alabama Geol. Survey Bull. 61, pt. 1, p. 11–12, fig. 2. Described in Coosa coal field, St. Clair County, Ala., where it is 80 feet thick and unconformably underlies Chattanooga(?) shale. Lower or Middle Devonian.

W. H. Robinson, J. B. Ivey, and G. A. Billingsley, 1953, U.S. Geol. Survey Circ. 254, p. 50. In Birmingham area, crops out along Red Mountain above Red Mountain formation.

Type locality: Frog Mountain, Cherokee County, Ala.

Frondosa limestone[1]

Ordovician: Southern New Mexico.

Original references: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 257–259; 1915, Conspectus of geologic formations of New Mexico: Des Moines, Robert Henderson, State Printer, p. 4, 7.

Derivation of name not stated.

Frontier Formation (in Colorado Group)[1]

Frontier Sandstone Member (of Mancos Shale)

Frontier Formation (in Mancos Group)

Upper Cretaceous: Western Wyoming, Colorado, Idaho, southern Montana, and Utah.

Original reference: W. C. Knight, 1902, Eng. Mining Jour., v. 73, p. 721, in a paper on Uinta County, Wyo.

C. T. Lupton, 1916, U.S. Geol, Survey Bull. 621, p. 167, 169, 171. In Basin oil field, includes (ascending) Peay and Torchlight sandstone members. Thickness about 565 feet. Overlies Mowry shale; underlies Cody shale.

J. D. Sears, 1926, U.S. Geol. Survey Bull. 781–B, p. 16 (table), 18, 19. In Rock Springs uplift, Sweetwater County, Wyo., Frontier formation is 70 to 160 feet thick; overlies Aspen shale and underlies Baxter shale.

W. T. Thom, Jr., 1935, U.S. Geol. Survey Bull. 856, p. 49. Thickness of formation about 410 feet in Soap Creek field. Consists chiefly of dark shale and beds of bentonite lithologically similar to lower part of overlying Carlile shale. Division between the two formations arbitrarily placed at top of thick bentonite bed exposed east of Soap Creek dome, which lies a short distance above several thin layers of coarse sandstone containing small chert pebbles and shark teeth. These layers are confined to top 100 feet of formation at Soap Creek but apparently become thicker toward northwest. Overlies Mowry shale. Colorado group.

P. T. Walton, 1944, Geol. Soc. America Bull., v. 55, no. 1, p. 101, 102, 103. Member of Mancos shale in Uinta basin, Utah. Thickness 156 feet at Red Creek; 157 feet at Rim Rock; 163 feet at Colorado border. Overlies Middle shale member; underlies Upper shale member. Stratigraphically above Aspen shale member.

A. J. Eardley, 1944, Geol. Soc. America Bull., v. 55, no. 7, p. 824 (table 1), 839–840. In north-central Wasatch Mountains, underlies Henefer formation (new) and overlies Aspen formation. Consists of coal-bearing series of hogback-making gray sandstones separated by dark shales and friable sandstones; coarse conglomerate in middle of section. Thickness about 10,000 feet.

D. M. Kinney and J. F. Rominger, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim, Map 82; D. M. Kinney, 1951, U.S. Geol. Survey Oil and Gas Inv. Map OM–123. Member of Mancos shale in Whiterocks River-Ashley Creek area, Uintah County, Utah, where it is 80 to 90 feet thick; overlies Mowry member and underlies unnamed member. Member, in Duchesne and Uintah Counties, Utah, is 210 to 250 feet thick; overlies Mowry member and underlies unnamed member.

H. L. Foster, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 9, p. 1538 (table), 1577–1584. Frontier formation in this area [Teton County, Wyo.] is characterized by tan sandstones with some interbedded sandstones, a few thin nodular limestones, many fossiliferous beds. Thickness about 2,750 feet. Overlies Mowry shale; contact placed at base of typical Frontier-type sandstone, above which no bentonite or porcellanite beds were observed. Conformably underlies Cody shale.

J. D. Love, 1948, Wyoming Geol. Assoc. Guidebook 3d Ann. Field Conf., p. 108–109. Frontier, as defined in central Wyoming, consists of sandstone and shale sequence overlying Mowry and underlying Cody shale. Frontier, as defined in type area and other parts of western Wyoming, comprises quite different set of beds. Correlation from southwest corner of Wind River basin southwestward through Bison basin, Rock Springs uplift, and Church Buttes to type area indicates that Cody shale and probably at least part of Mesaverde formation of central Wyoming are age equivalent of type Frontier and that part of Frontier formation of central Wyoming is age equivalent of Aspen shale of western Wyoming. Name Frontier is applied in this report [Wind River basin] to the sandstone and shale above the Mowry shale and below the Cody shale, in conformity with long-accepted usage, but not with the implication that formation is the same age as at type area. Thickness 650 to 1,030 feet.

G. E. Untermann and B. R. Untermann, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 5, p 688–689 (table 1) Shown on generalized columnar section as formation in Mancos group in Green River and Yampa River Canyons. Thickness 200 feet. Overlies Mowry formation; underlies an upper Mancos shale.

P. W. Richards and C. P. Rogers, Jr., 1951, U.S. Geol. Survey Oil and Gas Inv. Map OM–111, sheet 2. In Hardin area, Montana and Wyoming, includes Soap Creek bentonite bed (new).

Keith Young, 1951, Jour, Paleontology, v. 25, no. 1, p. 35–68. Formation in southern Montana is divided into seven stratigraphic units (unnamed). Faunas obtained from units of formation of southern Montana are compared with faunas from Frontier formation and Carlile shale of other areas. Suggested that term Carlile shale be discontinued as rock name in southern Montana and that Frontier be redefined to include all rocks between top of Mowry shale and base of Niobrara formation. Frontier section (Thom and others, 1935) east of Soap Creek oil field was used as section of reference.

T. H. Kiilsgaard, 1951, Idaho Bur. Mines and Geology Pamph. 92, p. 14–17. Extent and thickness of Frontier formation in Horseshoe area has long been subject of conjecture. Schultz (1918, U.S. Geol. Survey Bull. 543) mentioned its occurrence and noted that it contained producing coals in Lincoln County. Kirkham (1922, Idaho Bur. Mines Bull. 4) and Stalder (1928, unpub. rept., Teton County) mentioned that formation covers large parts of the district. In present report [Horseshoe Creek], term Frontier is restricted to those Upper Cretaceous sediments, essentially gray to buff sandstones, shales, and beds of coal, which overlie basal conglomerate separating Aspen and Frontier formations. Thickness 3,905 feet. Formation occupies most of Horseshoe Creek basin. It is bounded on west by Jackson fault and is underlain to south and east by Aspen formation. Northward, it passes beneath Tertiary volcanics.

A. E. Granger and others, 1952, Utah Geol. Soc. Guidebook 8, p. 15, pl. 2. In Wasatch Mountains, east of Salt Lake City, overlies Kelvin formation and underlies Cretaceous(?) conglomerate. Thickness at least 8,000 feet. Tuffaceous beds similar to porcellanites of Aspen formation crop out near base.

W. A. Cobban and J. B. Reeside, Jr., 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 10, p. 1913–1961. Formation in its type area, consists of about 2,000 feet of sandstone, coal, bentonite, and porcellanite. At Cumberland Gap. Wyo., 15 miles south of Frontier, lower half of formation consists of nonmarine sandstone, siltstone, mudstone, and water-laid volcanic rocks with some coal, carbonaceous shale, and limestone. Upper half consists of sandstone, mudstone, and some coal. Underlain by marine Aspen shale of Early Cretaceous age; overlain by 6,000 feet of marine Hilliard shale of middle Late Cretaceous age, which in turn is overlain by 4,000 feet of largely nonmarine Adaville formation. Nonmarine lower half cannot be precisely dated, but is probably Cenomanian. Marine beds in upper half are dated as of late Greenhorn (Turonian), early Carlile (Turonian), and early Niobrara (Coniacian) ages. Nonmarine unit near top believed to be of late Carlile age (Turonian). Northward from type area, formation does not appear to change greatly as far as Fontenelle basin, but upper half of overlying Hilliard shale changes to sandstone and shales of Adaville aspect. Farther north in Snider basin, a thin equivalent of typical Frontier can be identified, but it is overlain by great thickness of sandstone and shale that is not greatly different from the Frontier. Surface measurements suggest as much as 13,000 feet, but there may be duplication of beds not readily seen on surface. Uppermost part has not yielded fossils, but main part of these beds contains Niobrara fossils, and the entire sequence above the Aspen has been called Frontier by some authors. Formation passes eastward into dominantly marine rocks with fewer and thinner beds of resistant sandstone. Inasmuch as the sandstone beds that locally form top of Frontier pass eastward into shale, the upper limit of formation changes in age. Ordinarily one of three large units of sandstone forms top of formation. Youngest sandstone unit, of early Niobrara age, is tongue shaped, extending from southwest and northwest corners of Wyoming into central part of State. Sandstone beds of about middle Carlile age form top of formation for some distance eastward in Wyoming, northeastern Utah, and northwestern Colorado, beyond the eastern limits of the sandstone beds of early Niobrara age. In much smaller area in north-central Wyoming and south-central Montana, sandstone beds of pre-Carlile age form top of the Frontier. In Cumberland Gap section, formation contains Oyster Ridge sandstone member. Detailed discussion of specific areas. Correlation chart.

C. C. O'Boyle, 1955, Intermountain Assoc. Petroleum Geologists Guidebook 6th Ann. Field Conf., p. 33 (columnar section), 34. In northwestern Colorado (western part), overlies the Mowry and underlies Mancos formation; in eastern part, occurs above Dakota formation and below Niobrara equivalent.

M. M. Knechtel and S. H. Patterson, 1956, U.S. Geol. Survey Bull. 1023, p. 15. Nomenclature revised in Hardin district, Montana and Wyoming. Names Frontier and Eagle, which appear on maps published by Thom and others (1935), Richards and Rogers (1951), and Knechtel and Patterson (1952, U.S. Geol. Survey Circ. 150; 1955, U.S. Geol. Survey Mineral Inv. Field Studies Map MF-36), have been eliminated from nomenclature in present report. Strata that were designated Frontier formation are assigned to Belle Fourche member of Cody shale.

J. D. Haun, 1958, Wyoming Geol. Assoc. Guidebook 13th Ann. Field Conf., p. 84–89. In Powder River Basin, top of Frontier is placed at top of Wall Creek sandstone member. Base of Frontier placed at base of Clay Spur bentonite. Overlies Mowry shale; underlies Carlile shale except in Buffalo-Crazy Woman Creek area where it underlies Cody shale. Thickness varies from almost 1,000 feet in southwest part of basin to 600 feet in subsurface northeast of Kaycee and to 800 feet in southeastern part of basin. Use of name Frontier, with Wall Creek sandstone member at top, can be extended to east and northeast to region where Greenhorn limestone becomes distinct. If Greenhorn limestone is distinctly present, Black Hills nomenclature should be used.

W. J. Mapel, 1959, U.S. Geol. Survey Bull. 1078, p. 43–46, pls. 1, 3. In Buffalo-Lake De Smet area, formation is 500 feet thick and consists of interbedded light-gray sandstone and dark-gray shale with a few beds of bentonite and conglomerate. Overlies Mowry shale; underlies Cody shale.

H. R. Ritzma, 1959, Utah Geol. and Mineralog. Survey Bull. 66, p. 34, 36–37. Frontier sandstone member of Mancos overlies Mowry shale member and underlies main body of Mancos in Daggett County. Average thickness about 200 feet.

N. C. Williams and J. H. Madsen, Jr., 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 122–123. In Coalville area, Utah, beds previously assigned to Frontier formation contain a heretofore unnoted major tectonic interruption; hence, the Frontier formation should be divided in recognition of this unconformity. Name Frontier is retained for beds below the angular unconformity, and name Wanship is applied to immediately overlying beds. Thickness of restricted Frontier 2,132 feet.

L. A. Hale, 1960, Wyoming Geol. Assoc. Guidebook 15th Ann. Field Conf., p. 136–146. Formation revised is Coalville area. Comprises (ascending) Longwell sandstone, Spring Canyon, Chalk Creek, Coalville, Allan Hollow, Oyster Ridge, Dry Hollow, Grass Creek, Judd shale, and Upton sandstone members. All member names except Oyster Ridge are new. Overlies rocks tentatively assigned to Aspen shale; underlies Henefer formation. Intraformational unconformity recognized, but formation is not divided on basis of this hiatus; hence, Williams and Madsen's (1959) Wanship not used in present report. On correlation chart, column credited to Trexler (1955, unpub. thesis) shows Frontier formation comprises (ascending), Aspen zone, Skunk Point sandstone, Chalk Creek, Grass Valley shale, Oyster Ridge, Coalville conglomerate, Dry Hollow sandstone, Meadow Creek sandstone, Judd shale, and Upton shale members. Between Skunk Point sandstone and Chalk Creek member are about 2,800 feet of sandstone, shale, and conglomeratic sandstone not recognized as Frontier. Most of this interval is Chalk Creek member of present report.

Type area: Southwestern Wyoming. Named for exposures near Frontier, 2 miles north of Kemmerer, Lincoln County, Wyo. Characteristically exposed at Cumberland Gap, 15 miles south of Frontier.

Front Range Granite Group[1]

Precambrian: Colorado.

Original reference: T. S. Lovering and others, 1935, Geologic map of Colorado.

Includes following named units: Cripple Creek Granite, Curecanti Quartz Monzonite, Eolus Granite, Mount Rosa Granite, Pikes Peak Granite, Powderhorn Granite, Sherman Granite, Silver Plume Granite, Tenmile Granite, Trimble Granite, Twilight Granite, Vernal Mesa Quartz Monzonite, and Whitehead Granite.

Named for development in Front Range.

†Frostburg Formation[1]

Permian: Western Maryland.

Original reference: P. T. Tyson, 1837, Maryland Acad. Sci. Trans., v. 1, p. 92–98.

Named for Frostburg, Allegany County.

Frozen Head Sandstone (in Vowell Mountain Group)

Frozenhead Grit (in Anderson Sandstone)[1]

Pennsylvanian (Pottsville Series): Eastern Tennessee.

Original reference: L. C. Glenn, 1925, Tennessee Geol. Survey Bull. 33–B, p. 324–328.

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, 4. Reallocated to Vowell Mountain group (new) and referred to as Frozen Head sandstone. In type locality 35 feet thick; in Cross Mountain section 60 feet thick; maximum thickness 100 feet. Occurs near top of group; overlies an unnamed shale unit; underlies shale interval below Low Gap sandstone (new) of Cross Mountain group (new).

Exposed on Frozen Head Mountain, Petros quadrangle, Morgan County. [Board on Geographic Names gives Frozen Head as correct spelling.]

Fruitland Formation[1]

Upper Cretaceous: Northwestern New Mexico and southwestern Colorado.

Original reference: C. M. Bauer, 1916, U.S. Geol. Survey Prof. Paper 98–P.

Harley Barnes, E. H. Baltz, Jr., and P. T. Hayes, 1954, U.S. Geol. Survey Oil and Gas Inv. Map OM–149. Described in Red Mesa area, La Plata and Montezuma Counties, Colo., where it is 510 to 520 feet thick and consists of a sequence of sandstone, shale, and coal beds. Underlies Kirtland shale; overlies Pictured Cliffs sandstone.

P. T. Hayes and A. D. Zapp, 1955, U.S. Geol. Survey Oil and Gas Inv. Map OM–144. Discussed in Baker-Dome-Fruitland area, New Mexico, where it underlies Kirtland shale and intertongues with underlying Pictured Cliffs sandstone.

Named for small settlement on San Juan River, San Juan County, N. Mex.

Frye Mesa Beds (in Gila Conglomerate)

Pleistocene: Southeastern Arizona.

P. A. Wood, 1959, Arizona Geol. Soc. Guidebook 2, p. 60. Consist of conglomerate containing large boulders set in brown silty matrix. Maximum thickness adjoining Graham Mountains about 700 feet. Unit thins rapidly toward center of Safford Valley. Conformably overlie Solomonsville beds. Name credited to W. L. Van Horn and L. A. Heindl (unpub. theses).

In Stafford Valley, [Graham County].

Fulda Limestone (in Mansfield Group)

Pennsylvanian (Pottsville): Southwestern Indiana.

D. W. Franklin, 1944, Illinois Acad. Sci. Trans., v. 37, p. 87 (fig. 1), 88–89. Dark-blue-gray dense pure brittle, sparsely fossiliferous limestone. Thickness 2½ feet. Occurs near top of group about 15 feet below Ferdinand limestone (new).

C. L. Cooper, 1946, Illinois Geol. Survey Bull. 70, p. 16 (fig. 2), 19. Included in Ti Valley series (new).

Named for exposures along road between Fulda and New Boston, eastern Spencer County. Well exposed in S½SW¼ sec. 33, T. 4 S., R. 4 W.

Fulda Sandstone[1]

Permian: Central northern Texas.

Original reference: E. C. Case, 1907, Am. Mus. Nat. History Bull. 23, p. 660-662.

Named for prominent development near station of Fulda, Baylor County.

Fullerton Formation[1]

Fullerton Member (of Blanco Formation)

Fullerton Member (of Chase Channel Formation)

Pleistocene (Aftonian): Southern, central, and northern Nebraska and western Kansas.

Original reference: A. L. Lugn and G. E. Condra, 1932, Geol. Soc. America Bull., v. 43, no. 1, p. 190.

O. S. Fent, 1950, Kansas Geol. Survey Bull. 85, p. 64–65. Top member of Chase Channel formation (new), a subsurface unit in western Kansas. Maximum thickness 30 feet. Gray silty clay containing much sand. Gradationally overlies Holdrege member; underlies Meade formation.

G. E. Condra and E. C. Reed, 1950, Nebraska Geol. Survey Bull. 15–A, p. 12 (fig. 6), 16. Formation is composed of silt and calcareous clay grading locally into fine sand. Occurs between Holdrege and Grand Island formations in Loess Plains area. Thickness varies between a few feet and 50 feet or more; average 20 to 30 feet. Grades westward into "Aftonian formation" which was developed generally on the Holdrege sand and gravel plain where subdrainage was not active.

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 52 (fig. 2), 59–60, 61, 64. Considered upper member of Blanco formation in Kansas. Where exposed in Sedgwick County, consists of 8 feet of gray to greenish-gray silt and sand and overlies Permian shale; underlies red sandy silts and silty sands tentatively classed as Crete-Loveland.

C. W. Hibbard, 1958, Am. Jour. Sci., v. 256, no. 1, p. 55 (fig. 1). Chart of revised classification of Kansas Pleistocene shows Fullerton as member of unnamed formation in Meade group. Overlies Holdrege member; and occurs below Afton soil.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. Shown as formation in Kansas. Nebraskan-Aftonian.

Named for exposures in vicinity of Fullerton, Nance County, Nebr.

Fullington Shale[1]

Lower Cretaceous (Comanche Series): Central southern Kansas.

Original reference: F. W. Cragin, 1895, Am. Geologist, v. 16, p. 361, 379.

Named for Fullington Ranch, at Belvidere, Kiowa County.

Fulton Shale (in Eden Group)[1]

Fulton Beds (in Economy Member of Latonia or Eden Formation)

Upper Ordovician: Southwestern Ohio, southeastern Indiana, and north-central Kentucky.

Original reference: A. F. Foerste, 1905, Science, new ser., v. 22, p. 150.

Wilber Stout, Karl Ver Steeg, and G. F. Lamb, 1943, Ohio Geol. Survey, 4th ser., Bull. 44, chart facing p. 108. Chart shows Fulton formation in

Utica group. Occurs below Latonia formation of Eden group and above Point Pleasant formation of Trenton group.

L. H. Lattman, 1954, Am. Jour. Sci., v. 252, no. 5, p. 257–276. Report is based on reexamination of stratigraphy of sub-Eden beds of Ordovician age along Ohio River at its crossing of Cincinnati arch. Review of the literature reveals several sources of confusion in nomenclature and correlation. Study of detailed section at West Covington and Carntown, Ky., and Point Pleasant, Ohio. Rogers Gap [member of Cynthiana] formation, uppermost member of the Mohawkian, and overlying Fulton shale, lowermost member of the Cincinnatian, are faunally indistinguishable in this area. They appear to be lithologic facies of same time-rock unit. Faunal and lithologic evidence indicates advisability of extending the Cincinnatian series downward to embrace the Cynthiana formation, rather than including this formation in the Mohawkian.

K. E. Caster, E. A. Dalve, and J. K. Pope, 1955, Elementary guide to the fossils and strata of the Ordovician in the vicinity of Cincinnati, Ohio: Cincinnati Mus. Nat. History, p. 12 (fig. 3). Chart shows Fulton beds at base of Economy member of Latonia formation.

W. C. Sweet and others, 1959, Jour. Paleontology, v. 33, no. 6, p. 1030–1031. In this report [Eden conodonts from Cincinnati region], Eden formation is classified as lowermost formation in Covington group and divided into (ascending) Economy (including basal Fulton beds), Southgate, and McMicken member. Economy member is also referred to as "Fulton-Economy" member.

Named for Fulton, formerly a suburb of Cincinnati, Ohio.

Fulton Shale Member (of Monongahela Formation)[1]

Fulton shale and sandstone member

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

Original reference: G. P. Grimsley, 1907, West Virginia Geol. Survey Rept. Ohio, Brooke, and Hancock Counties, p. 92.

R. E. Lamborn, 1951, Ohio Geol. Survey, 4th ser., Bull. 49, p. 36, 37. Thin shale member which in eastern Ohio occurs about midway between the Sewickley and Uniontown coals. In Jefferson County, Ohio, and northwestern West Virginia, underlies Arnoldsburg limestone.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 158 (table 13), 178, 180. Shale and sandstone member of Arnoldsburg cyclothem in report on Athens County. In Athens County, olive-green shaly sandstone that occurs above Benwood coal bed has been identified as the Fulton "green" shale. Here, the Fulton shale is separated from Benwood coal by bedded sequence of silty shale or fine-grained sandstone that averages nearly 10 feet in thickness. Fulton shale, itself, is an olive-green massive calcareous and micaceous unit that contains shaly partings and averages 4½ feet in thickness. Monongahela series.

Exposed at Fulton, Ohio County, W. Va.

Fults Member (of Salem Limestone)

Mississippian (Valmeyer Series): Southwestern Illinois.

J. W. Baxter, 1959, Dissert. Abs., v. 19, no. 11, p. 2910. Salem limestone is subdivided into four members [sequence not indicated] to which the names Kidd, Fults, Chalfin, and Rocher are assigned. Fults member consists of alternating beds of fine-grained dolomitic limestone and beds which contain admixtures of skeletal debris and microcrystalline non-skeletal grains.

J. W. Baxter, 1960, Illinois Geol. Survey Circ. 284, p. 2–3, 7, 22–24, pl. 1. Three general rock types predominate; very fine grained argillaceous silty earthy, mostly dolomitic limestone; mostly fine-grained dolomitic limestone with less detrital clay and silt; and medium-grained bioclastic limestone. Maximum thickness 34 feet. Conformably overlies Kidd member; contact with Chalfin member is at base of semilithographic bed.

Type section: In SE¼NE¼ sec. 20, T. 4 S., R. 10 W., near village of Fults, southern Monroe County.

Funeral conglomerate[1]

Tertiary: Southeastern California and southwestern Nevada.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 52, 78.

Well developed on flanks of Funeral Range, northeast of Death Valley in southeastern California.

Funeral Formation

Funeral Fanglomerate

Pliocene and Pleistocene(?): Southeastern California and southwestern Nevada.

L. F. Noble, 1941, Geol. Soc. America Bull., v. 52, no. 7, p. 956–957. In addition to fanglomerate and other arid-basin deposits, unit contains interbedded flows of basalt. Lies unconformably on all other formations; in Amargosa Valley, unconformably overlain by a series of flat-lying beds that contain Pleistocene fossils. Thickness 3,000 feet. Deposited later than Amargosa thrusting. Name credited to T. P. Thayer.

Typically exposed between base of Funeral Range and Ryan, in Death Valley, southeastern California.

Funks 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 Guinda formation and overlying Sites Formation (both new).

J. M. Kirby, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 3, p. 282, 284, 291, 293. Described as consisting mainly of greenish-gray clay shale and siltstone. Thickness 620 to 2,500 feet. Typical exposures noted.

Typical exposures in vicinity of Stone Corral Creek in W½ sec. 27, T. 17 N., R. 4 W., and along Funks Creek in W½ sec. 10, T. 17 N., R. 4 W., Colusa County.

Funk Valley Formation (in Indianola Group)

Upper Cretaceous: Central Utah.

E. M. Spieker, 1946, U.S. Geol. Survey Prof. Paper 205–D, p. 128, 133 (fig. 17). Thick unit of marine sandstone and shale of Niobrara age overlying Allen Valley shale (new). At type locality, formation consists of three clearly separable members: (1) basal series of sandstones with interbedded shale, about 900 feet thick; (2) middle unit of gray marine shale, 650 feet thick; and (3) upper sandstone 700 feet thick. Underlies Sixmile Canyon formation (new).

Type locality: Ridges bordering Funk Valley in secs. 34 and 35, T. 18 S., R. 2 E., Salt Lake Meridian, 3 to 4 miles southwest of Manti. Formation also forms marginal foothills of Wasatch Plateau for more than 4 miles south of Crystal Spring. In Salina Canyon, basal 600 feet of formation is exposed.

Funston Limestone (in Council Grove Group)[1]

Permian: Eastern Kansas and southeastern Nebraska.

Original reference: G. E. Condra and J. E. Upp, 1931, Nebraska Geol. Survey Bull. 6, 2d ser., p. 23.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 39, p. 64–65. Condra (1935) employed term Bigelow limestone to comprise three units (ascending): Sabetha limestone (Crouse limestone), Blue Rapids shale, and Funston limestone, It is here proposed that Bigelow be dropped as stratigraphic term and that Crouse limestone, Blue Rapids shale, and Funston limestone be recognized as formations.

M. R. Mudge and R. H. Burton, 1959, U.S. Geol. Survey Bull. 1068, p. 13 (table 2), 84–86, pls. Described in Wabaunsee County, Kans., where it commonly consists of three thin beds of moderately hard massive limestone separated by gray beds of shale. Contains biostrome that extends into parts of four counties in east-central Kansas. Thickness 8 to about 26 feet. Overlies Blue Rapids shale; underlies Speiser shale. Council Grove group.

Type locality: In bluffs of Kansas River valley south of Funston, Kans. Named for Camp Funston, Riley County.

Furnace Limestone[1]

Furnace Formation

Paleozoic: Southern California.

Original reference: F. E. Vaughan, 1922, California Univ. Pubs., Dept. Geol. Sci. Bull., v. 13, no. 9, p. 344, 352–365, map.

R. B. Guillou, 1953, California Div. Mines Spec. Rept. 31, p. 5, 10–12, pl. 1. Consists of three members, gray, white, and black. Stratigraphic position of only basal gray member is known. It crops out beneath Chicopee formation (new) in overturned and faulted limb of anticline southwest of Cactus Flat. White and black members are separated from the gray by granitic intrusions and faults, and their relative age is not known with certainty. Thickness about 6,000 feet. Intruded by Cactus quartz monzonite. Considered Mississippian-Pennsylvanian(?).

J. F. Richmond, 1960, California Div. Mines Spec. Rept. 65, p. 15–25, pl. 1. About one-third of total area of formation mapped by Vaughan is exposed in area of this report [south of type area]. Consists chiefly of calcite and dolomitic marbles which may be as much as 5,000 feet thick. Conformably overlies Chicopee Canyon formation which name replaces preoccupied Chicopee formation of Guillou (1953). Probably at least 1,000 feet of Furnace formation is Mississippian and remainder may be in part Pennsylvanian.

U.S. Geological Survey currently designates the age of the Furnace Limestone as Paleozoic on the basis of a study now in progress.

Named for Furnace Canyon, San Bernardino Mountains, San Bernardino County.

Furnacean series[1]

Miocene: California.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 52, 78. Crops out in Furnace Canyon, east of Death Valley, Inyo County.

Furnace Creek Formation

Miocene or Pliocene: Southern California.

H. D. Curry *in* D. I. Axelrod, 1940, Jour. Geology, v. 48, no. 5, p. 527, 528, 531. Consists of several thousand feet of lavas, pyroclastics and terrestrial sediments. Lower part of formation primarily highly colored volcanics and pyroclastics with some fanglomerates, all presumably in unconformable contact with earlier Tertiary rocks. Pyroclastics grade laterally and vertically into tuffaceous lake and playa sediments. Unconformably underlies Ryan formation (new). Beds strongly folded into an asymmetrical syncline striking northwest.

L. F. Noble, 1941, Geol. Soc. America Bull., v. 52, no. 7, p. 955–966. Unconformably underlies Greenwater volcanics (new); unconformably overlies Artist Drive formation (new). Thickness 2,500 feet.

Exposed in area drained by Furnace Creek Wash in central Death Valley region.

Furnace Creek Quartz Diorite Gneiss

Precambrian: Southeastern Pennsylvania.

T. V. Buckwalter, 1953, Pennsylvania Acad. Sci. Proc., v. 27, p. 115, 118. Name proposed for dark-greenish-gray medium-grained, usually homogeneous rock. Considered a recrystallized migmatic resulting from assimilation of hornblende gneiss and gabbro by Byram gneiss. Does not have obvious gneissic structure. Contains diffuse bands and clots of hornblende. Everywhere grades into Byram gneiss, Pochuck gneiss, or more common mechanically assimilated migmatites of these units.

Type locality: In South Mountain near headwaters of Furnace Creek and very near the Blainsport-Newmanstown Road. Area is near the point where Berks, Lancaster, and Lebanon Counties meet.

Furnace Ridge Conglomerate (in Gettysburg Sandstone lithofacies)

Triassic: Southeastern Pennsylvania.

D. B. McLaughlin and R. C. Gerhard, 1953, Pennsylvania Acad. Sci. Proc., v. 27, p. 136, 137. Coarse quartz-pebble conglomerate with interbedded red quartzose sandstone; occurs in lower part of lithofacies. Thickness 3,000 feet. Disappears rapidly westward near Mount Hope, Lancaster County, by interfingering with sandstones. Remains prominent to east beyond northeastern Lancaster County.

Maximum development along Hammer Creek, Lancaster County. May be named for Furnace Ridge in Lancaster quadrangle.

Furnaceville iron ore[1]

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, 1947, New York State Mus. Bull. 351, p. 38–46. In Genessee Gorge, the Furnaceville is underlain by 3 feet of rather typical basal Reynales and overlain by the *Pentamerus* part of the same formation.

This condition holds for only a short distance to the east where the hematitic limestone appears to gradually fade into a true limestone. A few miles farther east, the Furnaceville is present again but occupies a position at base of the Reynales. Furnaceville constitutes a lithologic unit easily recognized and mappable; it can be traced for a long distance and with more assurance than most Clinton formations. Hence, it seems preferable to use it as a formational name to designate the lowermost hematitic limestone of Clinton group. Genesee Gorge lentil is considered a part of Furnaceville iron ore.

H. L. Alling, 1947, Geol. Soc. America Bull., v. 58, no. 11, p. 996, 998 (fig. 2), 1000. Furnaceville is herein defined as the ore that occurs at or near the base of the Reynales limestone.

Typically developed in vicinity of Furnaceville, Wayne County.

Furnaceville Shale[1]

Silurian: Central and western New York, and Ontario, Canada.

Original reference: M. Y. Williams, 1919, Canada Geol. Survey Mem. 11, p. 47.

Tracy Gillette, 1947, New York State Mus. Bull. 341, p. 35. Now included in Neahga shale.

Fuson Member (of Lakota Formation)

Fuson Shale (in Dakota Group)

Fuson Shale (in Inyan Kara Group)[1]

Lower Cretaceous: Western South Dakota, northwestern Nebraska, and eastern Wyoming.

Original reference: N. H. Darton, 1901, U. S. Geol. Survey 21st Ann. Rept., pt. 4, p. 530.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 15 (fig. 7). Middle formation in Dakota group. Overlies Lakota formation; underlies Omadi sandstone (new).

K. M. Waagé, 1959, U. S. Geol. Survey Bull. 1081–B, p. 33, 84. History of stratigraphic nomenclature in Black Hills area and revision of nomenclature of Inyan Kara group. Darton's Fuson is key to difficulties that have arisen in attempts to map his threefold subdivision (Lakota, Fuson, and Dakota) in different parts of Black Hills. In southeastern corner of Black Hills where Minnewaste limestone is present and lower part of the Fall River is generally a massive sandstone affording a clearcut base, upper and lower contacts of Darton's Fuson are sharp and unmistakable. Minnewaste limestone is limited to small fraction of total outcrop of Inyan Kara group and basal part of Fall River formation is commonly shaly outside of limited area in southern Black Hills where they were first used. In subsequent work outside of southeastern Black Hills, Darton's interpretation of Fuson varied from one exposure to next [examples cited]. Consequently, both Darton's contact of Fuson and Dakota (Fall River) formations and his contact of the Lakota and Fuson formations wander up and down in the section with lateral changes in ratio of sand to clay-rock in beds above and below the persistent transgressive disconformity [see Dakota group]. Darton's measurement of type Fuson (Darton, 1901) and a revision (Darton and Paige, 1925, U.S. Geol. Survey Geol. Atlas, Folio 219) corresponds closely to section 10 (of present report), and his base of the Dakota (Fall River) is precisely at the transgressive disconformity. Fuson shale is reduced to member status in redefined Lakota formation. Name Fuson has been widely misapplied outside of Black Hills to beds equivalent to Skull Creek shale, as a result of Darton's miscorrelation with the Dakota equivalents of Colorado Front Range. Use of name Fuson as member of Lakota in limited area of southern Black Hills, where Minnewaste is present, may be helpful but should not be used beyond limits of Minnewaste. If this procedure is followed, Fuson member should be given new type locality. At Darton's type section, herein stated, is 92 feet thick; consists of siltstone, claystone, and sandstone; separated from overlying Fall River formation by transgressive disconformity.

W. A. Pettyjohn, 1960, (abs.) South Dakota Acad. Sci. Proc., v. 38, p. 34–38. Dakota controversy discussed. Suggested that term Dakota group be used to include Lakota, Fuson, Fall River, Skull Creek, and Newcastle formations.

Type section: At apex of sharp north bend in Dry Creek, Fuson Canyon, SW¼SE¼NE¼SW¼ sec. 36, T. 5 S., R. 6 E., Custer County, S. Dak.

Fusselman Dolomite

Fusselman Limestone[1]

Middle Silurian: Western Texas and southern New Mexico.

Original reference: G. B. Richardson, 1908, Am. Jour. Sci., 4th, v. 25, p. 476, 479–480.

L. A. Nelson, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 164, 170. In Franklin Mountains, Tex., underlies Canutillo formation (new).

L. P. Entwistle, 1944, New Mexico Bur. Mines Mineral Resources Bull. 19, p. 13, (table 2), 19–20, pl. 2. Referred to as dolomite. In Silver City, N. Mex., area, disconformably overlies Raven member (new) of Montoya dolomite; unconformably underlies Percha shale. Thickness 75 feet.

F. R. Stevenson, 1945, Jour. Geology, v. 53, no. 4, p. 220 (fig. 2), 223 (fig. 3), 225 (fig. 5), 226 (fig. 6). In Sacramento and San Andres Mountains, N. Mex., underlies Onate formation (new). Onate replaces term Canutillo in this area.

V. C. Kelley and Caswell Silver, 1952, New Mexico Univ. Pub. in Geology 4, p. 62, 66–68. In Caballo Mountains, thin sequence of light-gray-weathering, generally unfossiliferous claystone, limestone, calcitic dolomite, and dolomite referred to by Darton (1917, U.S. Geol. Survey Prof. Paper 108–C) as Fusselman(?) is here named Cutter formation and assigned to Montoya group. Fusselman dolomite poorly exposed in area of this report.

L. C. Pray and A. L. Bowsher, 1952, (abs.) Geol. Soc. America Bull., v. 63, no. 12, pt. 2, p. 1342. In Sacramento Mountains and other ranges farther west in south-central New Mexico, Darton identified the Upper Ordovician Montoya limestone, as well as two members of Fusselman limestone for which a Middle Silurian (Niagaran) age has been generally accepted. Recent study indicates that major erosional break within Montoya-Fusselman sequence occurs between the two members of Fusselman limestone in Sacramento Mountains. Fossils from lower member appear to be Upper Ordovician, and those of upper member appear to be Lower Silurian. Lower member of Fusselman is lithologically distinctive, widespread, and easily mappable in south-central New Mexico. In Sacramento

Mountains, it consists of 150 to 225 feet of medium to very light gray sublithographic dolomite that contains little chert; upper contact interpreted as disconformity. Upper member consists of resistant gray to brown cherty dolomite as much as 100 feet thick.

L. C. Pray, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 8, p. 1906–1917. Overlying cherty upper member of Montoya formation in Sacramento Mountains, and in many other ranges of south-central New Mexico, is lithologically distinctive unit that was termed lower member of Fusselman limestone by Darton (1917, U.S. Geol. Survey Prof. Paper 108–C). This lower member of Fusselman is herein designated as independent formation and named Valmont dolomite. The Valmont underlies unit termed "upper member of Fusselman limestone" by Darton (1928, U.S. Geol. Survey Bull. 794). Rock unit in Sacramento Mountains termed upper member of Fusselman limestone by Darton (1917; 1928) may be correlative with part of Fusselman limestone at type section designated by Richardson (1908) near El Paso. Correlation is open to question, and unit is herein referred to as Fusselman (?) formation.

L. C. Pray, 1958, West Texas Geol. Soc. Guidebook Franklin and Hueco Mountains, Tex., p. 30–43. Formation in Franklin Mountains is 608 feet thick, and consists largely of dolomite; divided into three lithologic units designated as lower, middle, and upper. Overlies Cutter dolomite of Montoya group. Type section suggested.

Type section (Pray): Northern Franklin Mountains, 6 miles north of Fusselman Canyon. Named for exposures in Fusselman Canyon, north of El Paso, Tex.

Fusselmannian series

Middle Siluric: Arizona and New Mexico.

Charles Keyes, 1940, Pan-Am. Geologist, v. 74, no. 2, p. 107; no. 4, p. 253. Appears only on charts of geologic formations.

Fuyk Sandstone Member (of Rondout Waterlime)

Upper Silurian: Southeastern New York.

G. H. Chadwick, 1940, New York State Geol. Assoc. 16th Ann. Mtg. Field Guide Leaflets, p. 2. Sandstone included in Rondout waterlime.

G. H. Chadwick, 1944, New York State Mus. Bull. 336, p. 45, 46, 51, 55, 146 [1946]. Member of Rondout waterlime. Lower beds locally shaly and consist of reworked Normanskill arkose. Maximum thickness 20 feet. Underlies Manlius limestone. Has been called "Binnewater;" younger than that unit and not connected with it. Type locality designated.

Type locality: Ledge on west ridge of the Fuyk, west of Catskill.