SUMMARY OF THE CRETACEOUS STRATIGRAPHY OF SOUTHEASTERN IDAHO AND WESTERN WYOMING[1]

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INTRODUCTION

Cretaceous rocks are widely distributed in southeastern Idaho and western Wyoming, as shown in Figure 1. The Cretaceous rocks of this region were first recognized and studied by geologists of the Hayden Survey and have received the attention of many other geologists intermittently over a period of many years. The recently renewed interest in the oil and gas possibilities of the Idaho-Wyoming overthrust belt has emphasized the need for a re-study of the stratigraphy of this structurally complex region. The scope as well as the accuracy of this summary is somewhat limited, owing to the lack of information in certain critical localities. In preparing this summary, information gathered by earlier workers is freely drawn upon and acknowledged, for the writer is not an expert in the field of Cretaceous stratigraphy. The few personal contributions to the problems involved derive from several summer field seasons of reconnaissance mapping, detailed mapping of small areas, and measuring of stratigraphic sections for the Phillips Petroleum Company.

This study was initiated by the Phillips Petroleum Company as part of an intensive stratigraphic research program in the western interior of the United States under the supervision of Alex W. McCoy III. The writer wishes to express his gratitude to C. O. Stark, D. E. Lounsbery and A. J. Hintze of the Land and Geological Department of the Phillips Petroleum Company for their support and interest in this project and for permission to present some of the results in this summary. During the period of the writer's field work, numerous geologists of the United States Geological Survey, under the direction of V. E. McKelvey, were actively engaged in studying the phosphate deposits of southeastern Idaho and adjacent regions, and these men were of invaluable assistance in locating stratigraphic sections. The writer also benefited from numerous field conferences and discussions of the stratigraphy of this region with L. L. Sloss and Alex W. McCoy III. The helpful criticism of J. B. Reeside, Jr., who reviewed the manuscript and suggested a number of corrections and additions, is gratefully acknowledged. Robert Storch, L. E. Marland, Marshall Stam, and Joseph J. Tanner rendered excellent assistance in the field during the course of the work. Any errors in the presentation of facts or the interpretation of data must, however, be attributed to the writer.

BECKWITH FORMATION

Veatch (1907, pp. 57-59) assigned the rocks that underlie the Bear River formation and overlie the Twin Creek limestone in southwestern Wyoming to the Beckwith formation. This unit, therefore, includes rocks that are now recognized to be of Lower Cretaceous and Upper Jurassic age. The name was extended to southeastern Idaho in some of the earlier reports, but Mansfield and Roundy (1916) revised the Beckwith formation of southeastern Idaho and proposed the term Gannett group for the Cretaceous beds of this unit; the Upper Jurassic units were re-named the Preuss sandstone and the Stump sandstone.

The formation was named for the Beckwith Ranch, situated just east of Beckwith Station on the Union Pacific R. R., where it consists of two members. The lower member consists of about 2,500 feet of sandy clays, sandstones, and conglomerates; the upper member is made up of 3,000 feet or more of light-colored clays and sandstones (Veatch, 1907, p. 57). The term Beckwith formation is still used in extreme southwestern Wyoming (southern Lincoln and Uinta Counties; see Cobban and Reeside, 1952a, Plate I, column 64). The writer made no attempt to study these beds in detail in this area, as they lie beyond the limits of the chief area of interest, but it is believed that a re-study of this portion of the section may result in the recognition of at least some of the units of the Gannett group in the lower portion of the upper member of the Beckwith formation, and beds of Bear River age in the upper portion (as suggested by Cobban and Reeside, 1952a, Plate I, column 64), and, therefore, the name Beckwith should probably be abandoned.

GANNETT GROUP

The Gannett group was named for the Gannett Hills in Lincoln County, Wyoming, and Bannock County, Idaho, where the beds are widely distributed and well exposed (Mansfield and Roundy, 1916, p. 82). In this region the Gannett group consists of about 3,500 feet of conglomerate, sandstone, siltstone, mudstone, shale, and fresh-water limestone, resting with

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relatively well exposed, and the lower contact can be established at the top of the Draney limestone; the upper beds, however are poorly exposed, making the upper contact less readily identifiable. This section has been previously published (Gardner, 1944, p. 7) and is approximately 900 feet thick.

South of the Snake River, particularly in the Cokeville-Afton region of western Wyoming and adjacent portions of southeastern Idaho, Rubey and Reeside are presently concerned with the stratigraphic problems of the Cretaceous beds that overlie the Gannett group. Rubey (1950) has briefly described this portion of the Cretaceous system, and, in an attempt to avoid problems of stratigraphic nomenclature, he has described these beds as Units A to E. Inasmuch as Rubey's (1950) original description is a loose, mimeographed "alternate return log" in the guidebook of the Fifth Annual Field Conference of the Wyoming Geological Association, it seems worthwhile to repeat it in part at this time, as follows:

> "Unit A, which overlies the Draney limestone, is a widespread but relatively thin sequence of black shales and tan quartzitic sandstones. . . . This unit yields abundant Cloverly (lower Cretaceous) invertebrates in its lower part and Bear River (upper Cretaceous) invertebrates and plants in its middle and upper parts. Unit A thins southward and westward from about 750 feet . . . in Tincup Canyon, Idaho, to about 400 feet near Cokeville and in the westernmost exposures in eastern Idaho.
>
> Unit B is a series of essentially non-fossiliferous red and variegated mudstones and sandstones. It is the unit exposed along the road in the syncline just southwest of the Fish Creek divide. This unit thins eastward and southward from approximately 2000 feet on the southwest side of Star Valley to a feather-edge in the Greys River valley and to about 400 feet near Cokeville.
>
> Unit C is a series of light-colored gray and tan sandstones and shales. It includes numerous coal beds that have been prospected widely and, to the southward, it contains increasingly abundant limestones in its lower part. These limestones carry an abundant brackish and fresh-water fauna of approximate Bear River age. The unit thins northward and westward from about 2,500 feet south of Cokeville to 400 feet west of Afton and to zero still farther north.
>
> Unit D is a second series of red and variegated mudstones and sandstones. The only fossils found thus far are trunks of the tree fern, **Tempskya**, which farther east is restricted to the Aspen shale. Unit D thins eastward and southward from about 2000 feet northwest of Afton to a feather edge in the Greys River valley and south of Cokeville. Northwestward from Freedom, Wyoming, to Grays Lake, Idaho, where Unit C is absent. Units B and D together make up a red and variegated unit that is 5000 feet thick.
>
> Unit E consists of the youngest Cretaceous beds exposed along the Wyoming-Idaho state line south of the Snake River. It includes gray shales, tan sandstones, and numerous porcellanite beds (like those of the Aspen) throughout. In its lower part and to the south, the unit contains coal beds that have been mined at several localities. In its upper part, it contains red mudstones and conglomerates. This is the series of poorly exposed beds see near Sage Junction and Cokeville. . . . Trunks of the tre ferns, **Tempskya**, are found throughout the unit. To th south the lower beds yield fresh-water, brackish and marin invertebrate faunas of approximate Aspen age. The onl fossils found thus far in the upper beds are plant leaves Unit E is bounded above by an unconformable contac with Tertiary and later sediments. From 2000 to 330(feet of the unit remain uneroded at several localities be tween Grays Lake, Idaho, and Sage, Wyoming."

The relationship of these units to Mansfield's Wayan formation, as suggested to the writer by Reeside (personal communication), is described later in this summary and shown on Figure 3.

The Bear River formation has been assigned to the Upper Cretaceous by workers in this region in the past (Hayden, 1869, and subsequent authors; see Wilmarth, 1938, pp. 133, 134), but Cobban and Reeside (1952a, p. 1030, annotation no. 40) have pointed out that the formation contains "in the lower part fossils related to the Cloverly and Kootenai formations and in the upper part fossils more peculiar to the formation—'the Bear River fauna' of the literature", and they have placed the formation in the Lower Cretaceous Albian stage (see Cobban and Reeside, 1952a, plate 1, columns 35, 62, 64, 66). Yen (1952, pp. 757-764), however, has compared the nonmarine faunas of the Bear River formation with those of Europe and argues for an Upper Cretaceous (Cenomanian) age. Reeside (personal communication) has pointed out that he and Cobban still feel that the marine faunas of the Aspen and Mowry are best placed in the late Lower Cretaceous (late Albian), but that "the difference of opinion is not really great, for the time involved—latest Albian to earliest Cenomanian—is only a small part of one European stage".

ASPEN SHALE

Veatch (1907, p. 64) defined and described the Aspen shale for exposures near Aspen Station, Uinta County, Wyoming. At the type locality the formation consists of 1,500 to 2,000 feet of black and gray shales that contain abundant fish scales and often weather to a silvery-gray color. In western Wyoming and southeastern Idaho the Aspen shale or its equivalent (Unit E of Rubey and Reeside) is made up chiefly of olive-green and gray-green siliceous shales, tan sandstones, porcellanites (see Tarr, 1937-38, pp. 20, 21 for the generally accepted definition of this term), and greenish siltstones or fine-grained sandstones. Relatively good exposures of these beds may be seen at several localities within this region. Along the Little Greys River, the writer assigned approximately 1,900 feet of beds to this unit. The lower contact was placed arbitrarily at the base of the first siliceous shale bed and the top of a covered interval which was assigned to the Bear River

formation; the upper contact was placed at the base of a prominent ledge of "salt and pepper" sandstone. At the locality along Palisade Creek (sec. 18, T. 2 N., R. 46 E., Bonneville Co., Idaho) the formation is about 2,000 feet thick. For a published description of this section, see Gardner, 1944, p. 6.

Until recently the Aspen shale has been assigned to the Upper Cretaceous, and it has been mapped and described as an Upper Cretaceous deposit in this region for many years. Cobban and Reeside (1951, pp. 1892, 1893 and 1952a, p. 1015), however, have called attention to the fact that impressions and crushed molds of ammonites that have been previously assigned to the Upper Cretaceous genera Metiococeras, Acompsoceras, and Neocardioceras belong to the Lower Cretaceous genera Gastroplites and Neogastroplites. Uncrushed specimens of these Lower Cretaceous genera have been collected from the Aspen shale of Wyoming (and its equivalent—the Mowry shale). The Aspen shale is, therefore, now assigned to the Lower Cretaceous (see Cobban and Reeside, 1952a, Plate 1, columns 63, 64, 66).

FRONTIER FORMATION

The Frontier formation was named and described for exposures near the town of Frontier, about two miles north of Kemmerer, Lincoln County, Wyoming (Knight, 1902, p. 721). Cobban and Reeside (1952b) have recently presented an excellent regional study of the Frontier formation of Wyoming and adjacent areas, and the reader is referred to this paper for stratigraphic and paleontologic details. Cobban and Reeside (1952b, pp. 1923-1927) selected the Cumberland Gap section, about 15 miles south of Frontier, Wyoming, as characteristic of the formation in its type area and presented a detailed measured section that is about 2,000 feet thick. In the northern portion of southeastern Idaho and adjacent portions of western Wyoming, particularly in the Snake River, Big Hole, Salt River, and Wyoming Ranges, the writer was unable to measure a complete section of the Frontier formation or its equivalents. Throughout most of this region, the Frontier formation is the youngest formation (exclusive of a few Tertiary beds and alluvial or terrace deposits), and the top of the formation is not usually present. In some cases the upper beds have been removed by erosion and in others they are concealed by Paleozoic rocks that have been thrust over the Cretaceous strata.

The formation is made up of a variety of lithologic types, including non-marine sandstones, siltstones, shales, and mudstones. The Oyster Ridge sandstone member in the upper portion of the formation is an excellent stratigraphic marker and is very useful in mapping in the region where it is developed. Cobban and Reeside (1952b) have identified Upper Cretaceous faunas of Greenhorn, Carlile, and Niobrara age from the upper half of the Frontier formation.

HILLIARD FORMATION

The Hilliard formation was named for exposures near Hilliard, Lincoln County, Wyoming, where it consists of about 5,000 feet of gray shale with a few interbedded sandstones (Knight, 1902, p. 721; 1903, pp. 542-544). No sections of this formation were measured during the course of the field work because it is neither well exposed, nor widely distributed within the limits of the area that was studied. The formation may be observed in a valley known as Mammoth Hollow, along the axis of the Lazeart syncline in T. 22, 23, 24, 25 N., R. 116 W., Lincoln County, Wyoming. Schultz (1914, p. 64) observed the Hilliard formation at only two other localities in Lincoln County:

1) "East of Labarge Ridge northeast of Saleys Mine (T. 27 N., R. 113 W.) where a small area is exposed in the depression between the pre-Carboniferous rocks and the Tertiary beds surrounding Labarge Ridge",

2) "in Snyder Basin north of Thompson Plateau, SE¼, NW¼, sec. 20, T. 29 N., R. 115 W."

Cobban and Reeside (1952b, p. 1934) collected and identified a marine fauna of Niobrara age from the Hilliard formation, and Veatch (1907, pp. 70-72) earlier collected involute species of Inoceramus of early Niobrara age from the middle of the Hilliard formation in the vicinity of Frontier, Wyoming. Consequently, Cobban and Reeside (1952a, plate 1, column 64) assigned the Hilliard formation to the Upper Cretaceous.

ADAVILLE FORMATION

Veatch (1907, pp. 72, 73) named the Adaville formation for exposures near the Adaville mine, about two miles south of Hodges Pass tunnel on the Union Pacific R. R., where it consists of 4,000 to 5,000 feet of yellow, gray, and black carbonaceous shales, irregularly-bedded, brown to yellow sandstones, and coal, one bed of which is 84 feet thick. The Adaville formation, like the underlying Hilliard formation, is not widely distributed or well exposed in the area that was studied. It was observed at only two localities; one of these is in Mammoth Hollow (T. 24, 25 N., R. 116 W.) and the other is east of Labarge Mountain in T. 27 N., R. 113 W., Lincoln County, Wyoming.

The basal member of the Adaville formation, which is a white, resistant, ridge-forming lentil, is a good stratigraphic marker, but it is not developed at the type locality. Veatch (1907, p. 73) named this lentil the Lazeart sandstone member of the Hilliard formation for

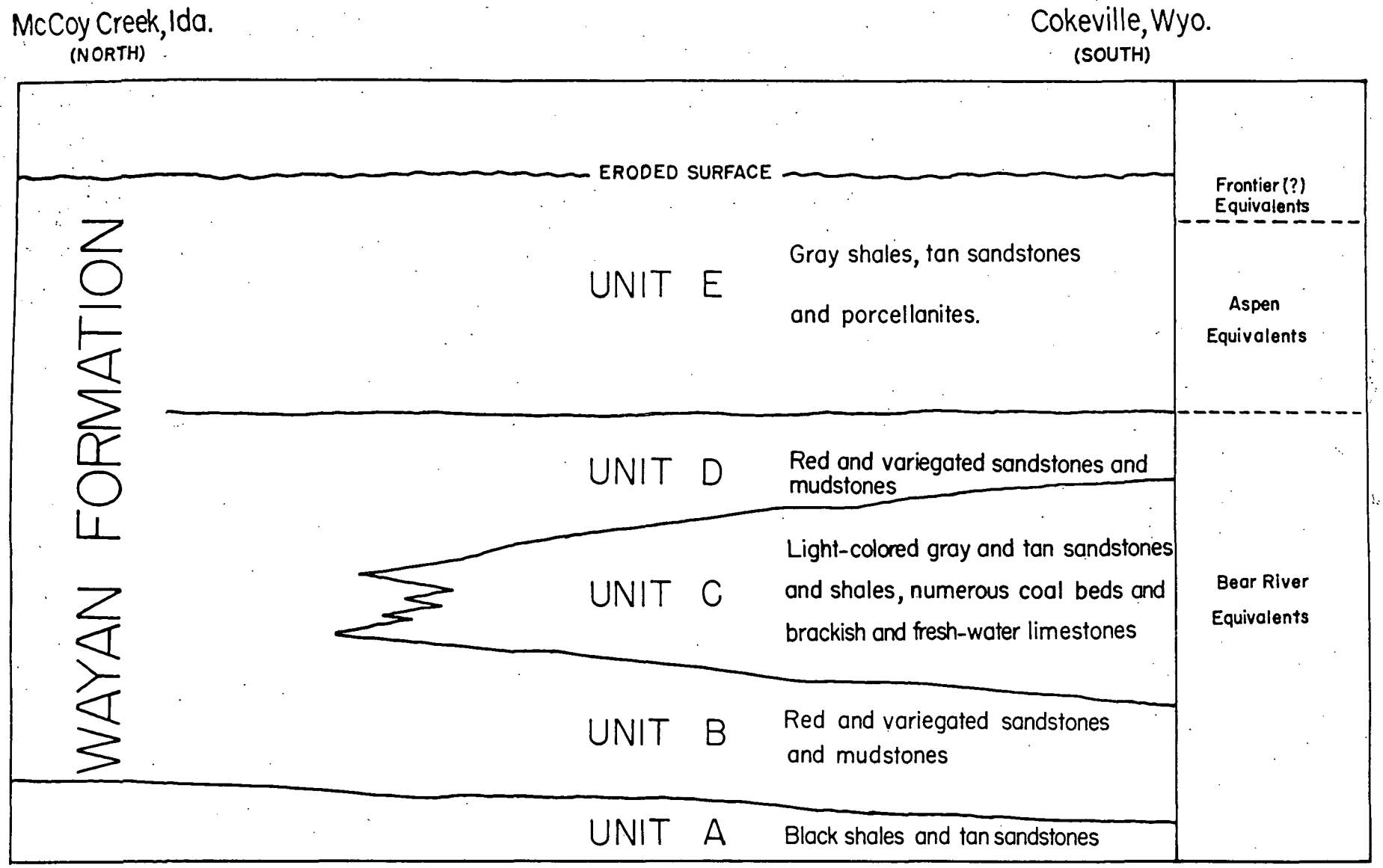

FIGURE 3.—Relation of the Wayan Formation to Units in Southwestern Wyoming.

exposures near the Lazeart coal mine (T. 15 N., R. 118 W., Uinta County, Wyoming).

Cobban and Reeside (1952a, p. 1030, annotation no. 42a; 1952b, p. 1934) have pointed out that the lower portion of the Adaville formation contains a marine fauna of Colorado age, whereas the upper portion is not well dated.

WAYAN FORMATION

The Wayan formation is restricted to southeastern Idaho and the extreme western portion of Wyoming along the state boundary. It was named for the settlement of Wayan, Bannock County, Idaho, and at the type locality, according to Mansfield and Roundy (1916, p. 83), it consists of more than 11,800 feet of interbedded conglomerates, sandstone, siltstones, mudstones, shales, and fresh-water limestones. According to Reeside (personal communication), Rubey has found that Mansfield's type section is an unfortunate mixup of infolded Gannett and younger beds and that the Wayan is perhaps only about 6,000 feet thick. The writer was unable to find a complete section of these beds anywhere in the region, for either the top or the bottom or both cannot be observed, owing to erosion or structural complications.

One of the most complete and best exposed sections of the Wayan formation known to the writer is found along McCoy Creek in the Grays Lake, Idaho, Quadrangle. The writer was unable to determine the thickness of the formation at this locality, because the top of the formation is not present and there is some repetition of beds due to folding. It is estimated that 7,000 to 8,000 feet of Wayan type beds are represented in this section, although that estimate may be too high. This section includes many prominent red mudstones, siltstones, and fine-grained sandstones, as well as numerous beds of "salt and pepper" sandstone, some of which are crossbedded. Some of the sandstones are well-sorted and others are rather poorly-sorted. The grains range from angular to well-rounded and include tuffaceous material in some zones. It is likely that some of the fresh-water limestones exposed in this section may belong in the Wayan formation, although it is possible that most of them may represent infolded limestone units of the Gannett group. Mansfield (1921a, p. 2; 1921b, p. 458, 459) proposed the name "Homer limestone of the Wayan formation" for one of these limestone units and mapped it in the Cranes Flat, Idaho, Quadrangle, but, as Reeside (personal communication) has pointed out, this unit is actually one of the Gannett limestones.

Mansfield and Roundy (1916, p. 77) originally assigned the Wayan formation to the Lower (?) Cretaceous. Later Read and Brown (1937, p. 127) studied the flora of these beds and stated that "the finding of Tempskya minor in the Wayan formation only forty miles from the Aspen localities in Wyoming, in a region of relatively similar lithologies, indicates a fairly close correlation in age, and the Wayan formation, or a portion of it, may reasonably be regarded as of Colorado age and the time equivalent of the Aspen shale of Wyoming. This conclusion was also independently reached by W. W. Rubey in his field studies of the stratigraphy and lithology of these beds." Reeside (personal communication) is of the opinion that "the age of the Wayan formation is that of the Bear River and Aspen together, with possibly a little Frontier". Cobban and Reeside (1952a, plate 1, column 62) have correlated the formation with the Upper Albian and Lower Cenomanian.

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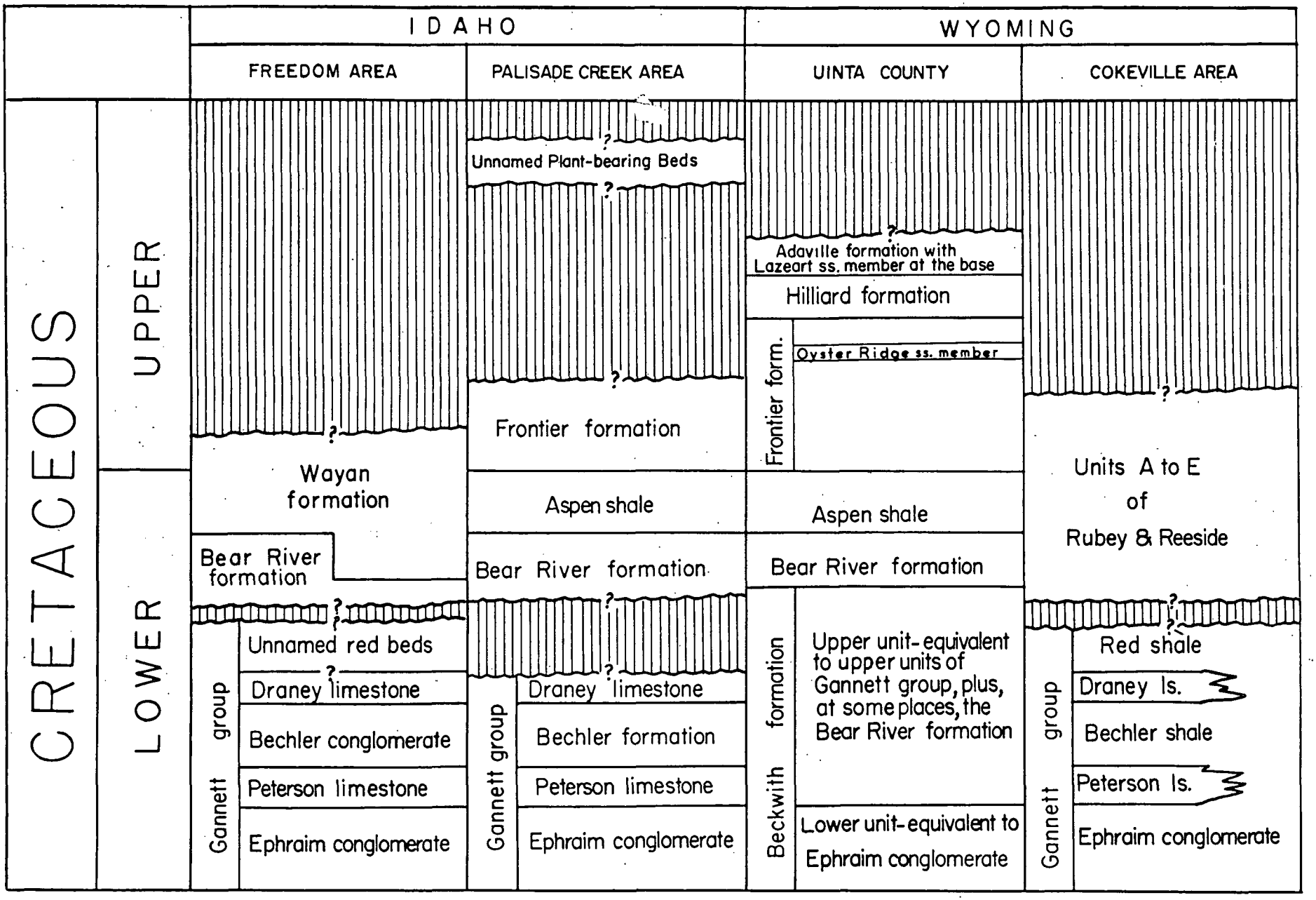

TABLE 1.—Correlation of the Cretaceous Formations of Southeastern Idaho and Western Wyoming. For Additional Stratigraphic and Paleontologic Details, see Cobban and Reeside, 1952a, plate 1.

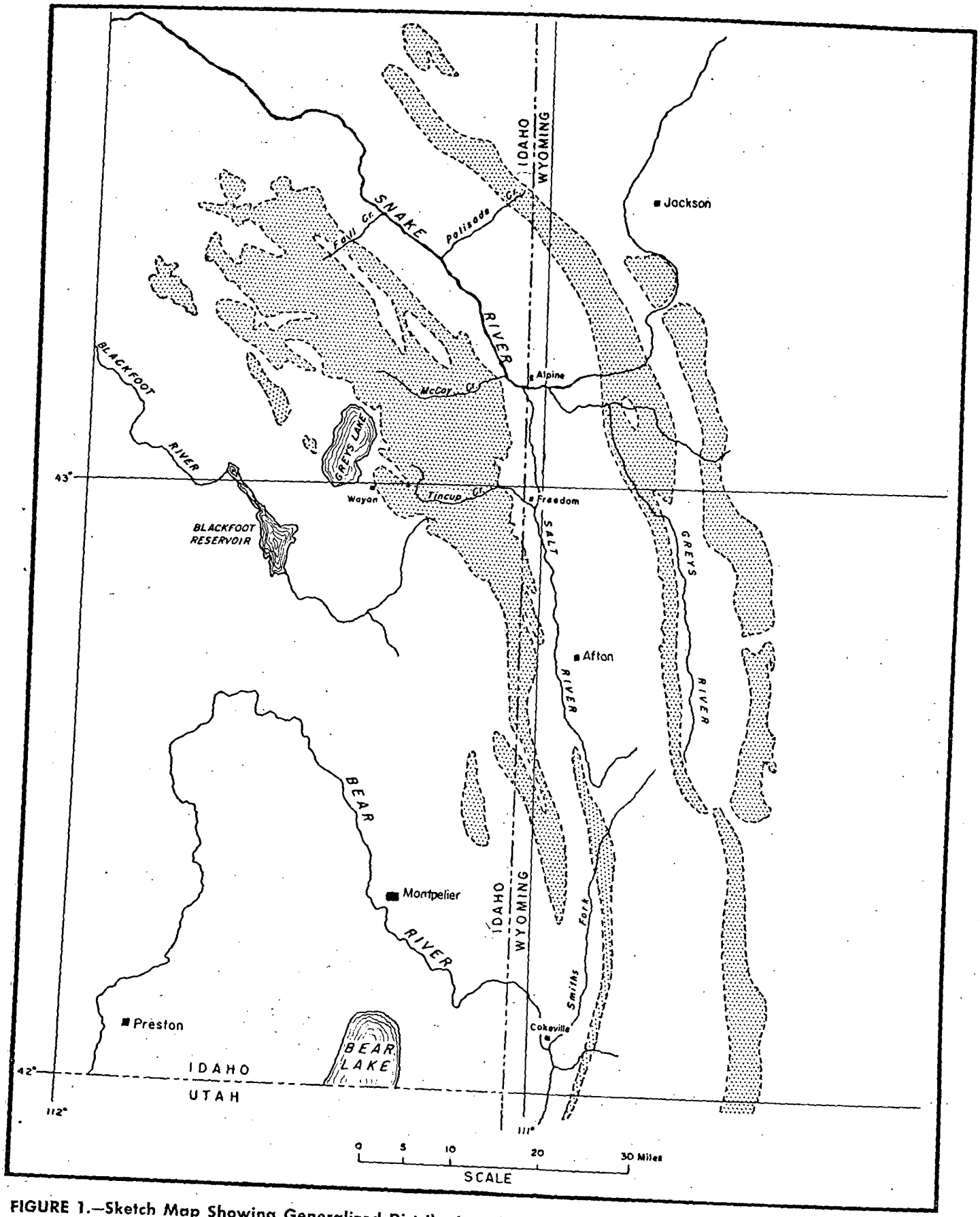

FIGURE 1.—Sketch Map Showing Generalized Distribution of Cretaceous Outcrops in Region of Field Conference.

medium- to dark-gray, sub-lithographic limestone, with a thin bed of light-gray, crystalline limestone at the top.

On the basis of stratigraphic position and a few non-marine mollusks Mansfield and Roundy (1916, p. 77; Mansfield, 1927, p. 104) assigned the Peterson limestone to the Lower Cretaceous (?). Peck (1941, p. 287) collected and identified Lower Cretaceous charophytes and ostracods from the Peterson limestone at various localities. Reeside (personal communication) has called the writer's attention to the fact that Yen has identified mollusks from the Peterson limestone as a Kootenai-Cloverly fauna of the Lower Cretaceous.

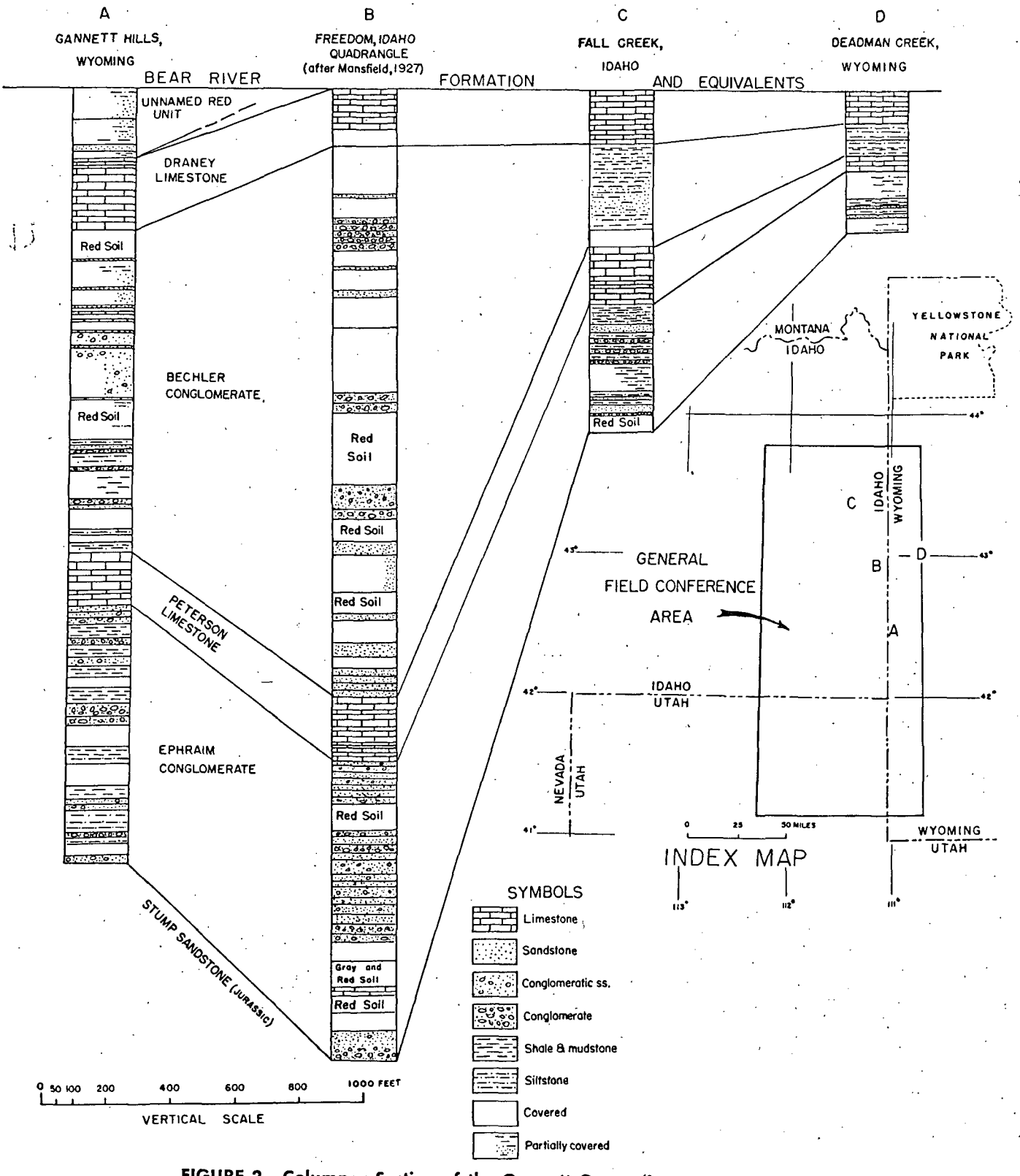

FIGURE 2.—Columnar Section of the Gannett Group (Lower Cretaceous).

apparent conformity upon the Jurassic Stump sandstone. Mansfield and Roundy (1916, p. 82) subdivided the Gannett group into five formations, from bottom to top, Ephraim conglomerate, Peterson limestone, Bechler conglomerate, Draney limestone, and Tygee sandstone.

Ephraim Conglomerate—The Ephraim conglomerate was named for exposures in Ephraim Valley in the Crow Creek, Idaho, Quadrangle and at the type locality consists of about 1,000 feet of reddish conglomerate with minor amounts of sandstone and a few thin beds of limestone (Mansfield and Roundy, 1916, p. 82). North and east of the type locality the formation thins rapidly and becomes finer-grained (see Figure 2). The pebbles of the conglomerates are made up of a wide variety of materials, including quartzite, sandstone, chert, and limestone, which were apparently derived from the Paleozoic and pre-Cretaceous Mesozoic rocks of the region. In general the pebbles are well rounded and moderately to highly spherical, although some of the larger fragments in the thicker, coarser sections near the type locality are distinctly angular. The source of these sediments apparently lay a short distance to the west of the Gannett Hills region in southeastern Idaho, as shown by the marked increase in thickness and grain size in this area. Rubey (in a discussion of the Gannett group at the 5th Annual Field Conference of the Wyoming Geological Association in Kemmerer, Wyoming, in 1950) stated that the rate of increase in grain size indicates that the source of the sediments must have been very close to the type locality, perhaps 25 miles or less to the west.

One of the relatively well exposed and readily accessible sections of the Ephraim conglomerate is found along U. S. Highway 89 in T. 28 N., R. 119 W., Lincoln County, Wyoming. Here the formation consists of conglomerates, sandstones, siltstones, and mudstones that have a characteristically reddish and purplish color. In this area the formation is about 400 to 800 feet thick; however, it appears to be somewhat thicker in other parts of the Gannett Hills. North of this locality in the Freedom, Idaho-Wyoming, Quadrangle Roundy (see Mansfield, 1927, pp. 102, 103) reported the Ephraim conglomerate to be slightly more than 1,000 feet thick. South of the Snake River, along Fall Creek in the Fall Creek, Idaho, Quadrangle, the writer assigned slightly more than 400 feet of conglomerate, sandstone, and shale with minor amounts of limestone to the Ephraim. A section in this same general area has been previously published by Kirkham (1924, p. 24), who reported it to be 359 feet thick. North of the Snake River in the highlands southwest of Teton Basin the formation has thinned to 268 feet, and only the lower 40 to 50 feet are conglomeratic. East and northeast of the type locality the formation thins even more rapidly. Along Deadman Creek (T. 35 N., R. 116 W., Lincoln Co., Wyo.) it has a maximum thickness of about 175 feet and contains practically no conglomerate.

Mansfield and Roundy (1916) originally assigned the Ephraim conglomerate to the Lower Cretaceous (?) on the basis of its stratigraphic position, and because the fossils are apparently younger than Jurassic. Cobban and Reeside (1952a, p. 1030) state that the Ephraim conglomerate has not yet yielded significant fossils and is arbitrarily placed in the Lower Cretaceous although it may contain beds of Upper Jurassic age in the lower part. The writer believes that certain of the shaly and calcareous zones of the Ephraim conglomerate may yield diagnostic charophytes or ostracods similar to those that have been described by Peck (1941 and 1951) from other non-marine Lower Cretaceous formations in the Rocky Mountain region. It is suggested that workers interested in these organisms should examine certain argillaceous and calcareous zones in the Ephraim conglomerate in the Fall Creek, Idaho, Quadrangle, where cursory examination of the outcrop samples suggests that these forms may be present.

Peterson Limestone—The Peterson limestone was named for the Peterson Ranch in Bannock County, Idaho, and at the type locality consists of about 200 feet of gray limestone (Mansfield and Roundy, 1916, p. 82). In the Gannett Hills section along U. S. Highway 89 the Peterson limestone consists of about 125 feet of gray, compact, sublithographic limestone with a few conglomeratic and brecciated zones. In the Freedom, Idaho-Wyoming, Quadrangle the Peterson limestone is somewhat thicker. Here Roundy (Mansfield, 1927, p. 102) assigned 205 feet of light-gray, fine-grained limestone to this unit. In the Fall Creek section the Peterson limestone was found to be about 180 feet thick. The lower 80 feet of the formation consist of thin-bedded, fractured, somewhat shaly, gray limestone which weathers to form white soil, whereas the upper 100 feet is made up of medium-bedded, slate-gray to light-gray limestone with a distinct conchoidal fracture. Near the northeast corner of the Irwin, Idaho, Quadrangle the Peterson limestone is made up of 125 feet of dark-gray, massive- to thin-bedded, resistant limestone (Gardner, 1944, p. 7). North of this locality the formation thins rapidly, for on the north side of Holter Creek in T. 4 N., R. 44 E., Teton County, Idaho the unit consists of only 20 feet of gray and mottled gray and pinkish-gray, massive, resistant limestone. East of the type area, in the Wyoming Range along Deadman Creek, the Peterson limestone thins to about 43 feet, where it is represented by

Cobban and Reeside (1952a, plate 1) also place the Peterson in the Lower Cretaceous.

Bechler Conglomerate—The Bechler conglomerate was named for Bechler Creek in Bannock County, Idaho, and at the type locality consists of about 1,700 feet of gray and reddish "salt and pepper" sandstones and conglomerates; the conglomerates are approximately twice as abundant as the sandstones (Mansfield and Roundy, 1916, p. 82). Elsewhere, particularly to the north and east of the type area, sandstones, shales, and mudstones are much more abundant than conglomerates. As a result, Cobban and Reeside (1952a, Plate 1, column 63) refer to the formation as the Bechler shale, and the writer has used the term Bechler formation in unpublished reports.

The Bechler formation (or shale or conglomerate) is usually easy to recognize in the field, for it is a clastic unit that is overlain and underlain by the two limestone units of the Gannett group. In the Gannett Hills (T. 28 N., R. 119 E., Lincoln County, Wyoming) the formation is about 1,000 feet thick and consists of sandstones, siltstones, conglomerates, a few thin, coarsely-crystalline limestones, poorly exposed shales, and mudstones. In the Freedom, Idaho-Wyoming, Quadrangle Roundy (Mansfield, 1927, p. 102) assigned about 1,700 feet of beds to this unit. North and east of the type area the Bechler formation thins rapidly and becomes finer-grained (see Figure 2). No fossils have been reported from this unit, but on the basis of its stratigraphic position it is assigned to the Lower Cretaceous.

Draney Limestone—The Draney limestone was named for exposures on the Draney Ranch along Tygee Creek in southeastern Idaho, where it consists of about 200 feet of gray, compact, fairly massive limestone (Mansfield and Roundy, 1916, p. 83). This unit is very similar to the Peterson limestone and certain limestones of the Wayan formation, but it is differentiated from these on the basis of its stratigraphic position. The variation in thickness throughout the region is shown in Figure 2. The Draney limestone, as well as the Peterson, forms ledges and ridges in most places where it is exposed. Yen has identified a fairly large molluscan fauna of Kootenai-Cloverly age from these beds, and Reeside (personal communication) had previously assigned these forms to the Lower Cretaceous. Peck (1941, p. 287) has described a Lower Cretaceous non-marine microfauna from material collected from the Draney limestone at several localities in southeastern Idaho and western Wyoming.

Unnamed Red Bed Unit—Mansfield and Roundy (1916, p. 83) included a fifth formation in the Gannett group, which they named the Tygee sandstone for exposures along Tygee Creek in southeastern Idaho. It is now clear that these beds belong to the Bear River formation and that the uppermost unit of the Gannett group is a discontinuous red bed unit (see Cobban and Reeside, 1952a, p. 1030, annotation no. 40). In most of the sections of the Gannett group studied by the writer this unit did not appear to be present, and beds assigned to the Bear River formation were found to be resting disconformably on the Draney limestone. The writer was able to identify this unit in a single area (the Gannett Hills locality), where it is made up chiefly of poorly exposed red siltstones, sandstones, and mudstones that are approximately 200 feet thick (see Figure 2). Although the unit is not well exposed, it does constitute a mappable unit which lies between the Draney limestone, and the Bear River formation or equivalent beds. As a result of its stratigraphic position it must be assigned to the Lower Cretaceous.

BEAR RIVER FORMATION

The Bear River formation was named by Hayden (1869, pp. 91, 92) for exposures near Old Bear River City, Wyoming. In southwestern and western Wyoming Veatch (1907, Plate III) and Schultz (1914, Plate I) have mapped the Bear River formation over an extensive area. In southeastern Idaho (Freedom and Crow Creek, Idaho-Wyoming, Quadrangles) Mansfield (1927, Plates V and VII) mapped the Bear River formation as the "Tygee sandstone". Kirkham (1924, pp. 26-28), following Mansfield and Roundy (1916), assigned 1,020 feet of beds to the "Tygee sandstone" along Fall Creek in Bonneville County, Idaho, and mapped it over large areas in the Hell Creek, Palisade Creek, McCoy Creek, Grays Lake, and Fall Creek, Idaho, Quadrangles. The writer re-measured these beds in the Fall Creek area and assigned approximately 980 feet of beds to the Bear River formation, but the section is not complete.

North of the Snake River, on a ridge between Corral Creek and Red Creek in T. 3 N., R. 44 E., Teton County, Idaho, a relatively good section of the Bear River formation may be observed. The upper and lower contacts, however, are not well defined. The lower contact has been placed at the base of a covered interval that lies above the uppermost limestones of the Draney limestone, and the upper contact has been arbitrarily placed at the base of a covered interval, above which the siliceous shales of the Aspen shale become prominent. Approximately 1,500 feet of beds were assigned to the Bear River formation at this locality, but the indefinite contacts may exaggerate the thickness.

The formation is somewhat thinner near the northeast corner of the Irwin, Idaho, Quadrangle in sec. 18, T. 2 N., R. 46 E., on a ridge between the forks of Palisade Creek. The lower portion of the formation is