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CAMBRIAN STRATIGRAPHY OF NORTHWESTERN WYOMING[1]

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ABSTRACT

The Flathead and Gros Ventre formations of the Teton, Gros Ventre, northwestern Wind River, and western Owl Creek Mountains gradually merge toward the east, forming the lower part of the Wyoming "Deadwood"; the Gallatin formation maintains its lithologic identity eastward into the Bridger Mountains, where it forms the upper part of the Wyoming "Deadwood." The Gallatin contains a number of faunal zones corresponding to zones in the type St. Croixian, the lowest zone containing an early Upper Cambrian fauna. Paleontologic and stratigraphic evidence indicates that the pre-Gallatin formations are largely Middle Cambrian.

The formational name, *Depass*, is proposed for beds lying below the Gallatin in the Wyoming "Deadwood." A persistent limestone member in the lower Gros Ventre and the lower limestone member of the Gallatin are designated by the names, *Death Canyon* and *Du Noir*, respectively. The lithology, faunal content, and stratigraphic relationships of the formations are described, and an interpretation of the Cambrian history and paleogeography of Wyoming is presented.

INTRODUCTION

The Cambrian rocks of northwestern Wyoming, in and to the west of the Wind River Mountains, attain a thickness of about 1,000 feet and are divided into the Flathead, Gros Ventre, and Gallatin formations. The lowest formation, the Flathead, consists of sandstone and quartzite; the overlying Gros Ventre formation consists largely of shale and contains a prominent limestone member in the

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lower part; the highest formation, the Gallatin, is composed almost wholly of limestone but has a persistent shaly member in the middle part. The Cambrian of the Owl Creek, Bridger, and Big Horn ranges, which lie to the northeast of the Wind River Mountains, has

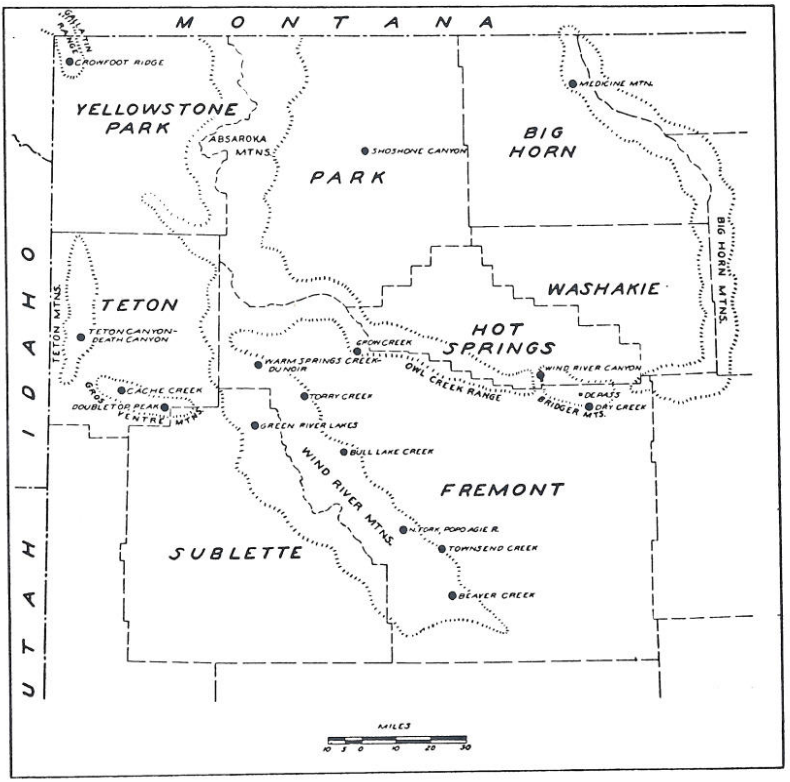

FIG. 1.—Index map of northwestern Wyoming

been described by N. H. Darton as averaging about 900 feet in thickness and consisting of a lower sandstone member, a middle shale member, and an upper limestone member. Darton referred these beds to the Deadwood formation.[2]

Although no systematic paleontologic study of these formations

[2] N. H. Darton, "Geology of the Big Horn Mountains," *U.S. Geol. Surv. Prof. Paper 51* (1906), pp. 23–26; "Geology of the Owl Creek Mountains," *U.S. 59th Cong. 1st Sess. Senate Doc. 219* (1906), pp. 14–15.

has been undertaken in the past, Cambrian fossils from various localities in northwestern Wyoming have been described by C. D. Walcott; and most authors, probably basing their conclusions largely on Walcott's work, have assigned the Flathead and Gros Ventre to the Middle Cambrian and the Gallatin to the Upper Cambrian. The most recent work indicates that the Deadwood, at its type section in the Black Hills, is of Upper Cambrian age.[3] The stratigraphic relationships and gradations in lithology between the Cambrian sections in the various mountain ranges of northwestern Wyoming have never been described, nor has there been any attempt to make accurate correlations between the Wyoming Cambrian and the standard Cambrian sections of other regions.

The field work here reported, which was carried out during the summers of 1933 and 1934, consisted primarily in tracing the Flathead, Gros Ventre, and Gallatin formations from the Teton Mountains through the Gros Ventre Mountains and northwestern part of the Wind River Mountains into the Wyoming Deadwood of the Owl Creek and Bridger ranges. In addition, detailed studies were carried out in the Wind River Mountains as far to the southeast as the Atlantic City district; and several days of reconnaissance work were spent in the Big Horn Mountains and in the Rattlesnake–Cedar Mountain uplift west of Cody.

EVOLUTION OF THE NOMENCLATURE

Flathead–Gros Ventre–Gallatin sequence.—In 1893, A. C. Peale divided the Cambrian of the Three Forks district, Montana, into two formations.[4] The lowest formation, the Flathead, was subdivided into the "Flathead quartzite" and "Flathead shales"; the Gallatin formation, overlying the Flathead, was subdivided into the "Trilobite limestones," "Obolella shales," "Mottled limestones," "Dry Creek shales," and "Pebbly limestones" (Fig. 2).

In 1899, Iddings and Weed also used the names "Flathead" and "Gallatin" in describing the Cambrian at Crowfoot Ridge in the

[3] Howard A. Meyerhoff and Christina Lochman, "*Crepicephalus* Horizon in the Deadwood Formation of South Dakota," *Geol. Soc. Amer. Proc. for 1933* (1934), p. 99.

[4] A. C. Peale, "The Paleozoic Section in the Vicinity of Three Forks, Montana," *U.S. Geol. Surv. Bull. 110* (1893), pp. 20–25.

Gallatin Mountains of Yellowstone Park.[5] However, they applied them in a different way, making the "Mottled limestone" the basal member of the Gallatin and expanding the use of the name "Flathead" to include all of the underlying Cambrian beds.

In 1918, Blackwelder restricted the name "Flathead," to the basal sandstones, and applied the name "Gros Ventre" to the shales and limestones intervening between the restricted Flathead and the Gallatin as redefined by Iddings and Weed.[6]

In 1900, W. H. Weed used the names "Flathead," "Wolsey," "Meagher," "Park," "Pilgrim," "Dry Creek," and "Yogo" for Peale's "Flathead quartzite," "Flathead shales," "Trilobite limestones," "Obolella shales," "Mottled limestones," "Dry Creek shales," and "Pebbly limestones," respectively.[7] At present Weed's names are being used in the Little Belt and Big Belt districts of Montana, although the names "Flathead," "Gros Ventre," and "Gallatin" are being used in the Three Forks district, as well as in northwestern Wyoming.[8]

In present usage, the name "Flathead" is applied to the basal sandstones and quartzites, even though they may vary in age from place to place; and that usage is continued in this paper. In Wyoming the name "Gallatin" is applied to the beds between the base of the massive, mottled, oölitic limestones and the Ordovician Big-Horn dolomite. The name "Gros Ventre" is applied to beds between the Flathead and Gallatin. The base of the Gros Ventre is drawn at the base of the first thick shales, and at places the Gros Ventre–Gallatin contact is disconformable.

So far as known to the writer, no one has systematically traced the Gallatin from the Three Forks district into Wyoming; and since the few fossils which have been described were not accurately listed as to

[5] J. P. Iddings and W. H. Weed, "Descriptive Geology of the Gallatin Mountains," *U.S. Geol. Surv. Mono. 32*, "Geology of Yellowstone Park," Part II (1899), p. 8.

[6] Eliot Blackwelder, "New Geological Formations in Western Wyoming," *Jour. Wash. Acad. Sci.*, Vol. VIII, No. 13 (1918), pp. 417–26.

[7] W. H. Weed, "Geology of the Little Belt Mountains, Montana," *U.S. Geol. Surv. 20th Ann. Rept.*, Part III (1900), pp. 284–87.

[8] M. Grace Wilmarth, *Tentative Correlation of the Named Geologic Units of Montana*, (U.S. Geol. Surv., July, 1932); *Tentative Correlation of the Named Geologic Units of Wyoming* (U.S. Geol. Surv., April, 1925).

their exact positions in the sections, there is no paleontologic proof that the base of the Gallatin is at precisely the same stratigraphic horizon from Montana to Wyoming (Fig. 2). In this paper the name

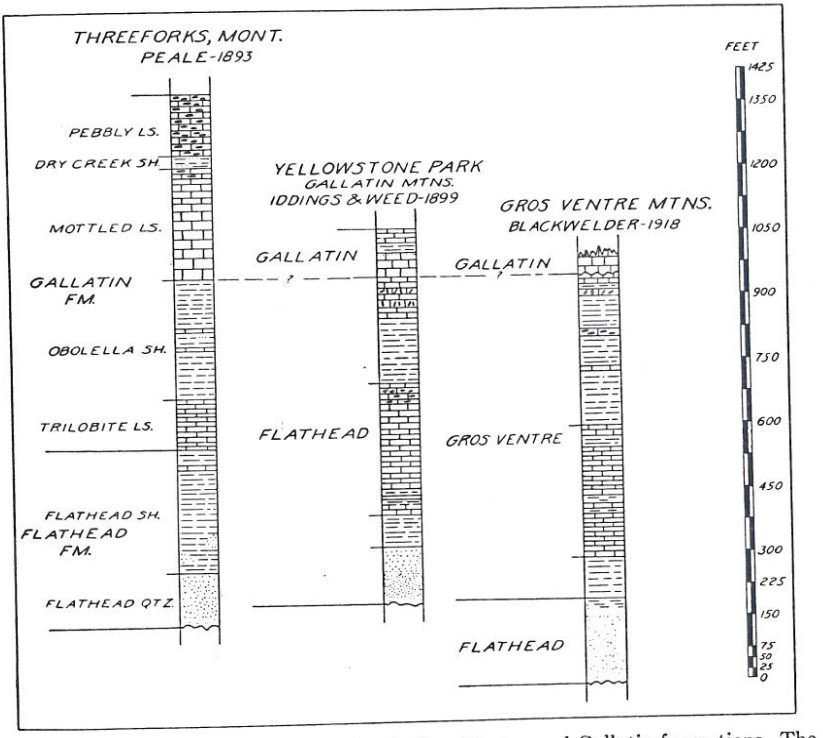

FIG. 2.—Type sections of the Flathead, Gros Ventre, and Gallatin formations. The columnar sections have been drafted by the writer from the text descriptions of the authors.

will be used in the same way as it has been used in the Wind River, Gros Ventre, and Teton Mountains.[9]

Wyoming Deadwood.—In 1901 Darton applied the name "Deadwood"[10] to the Cambrian rocks of the Black Hills and later applied

[9] D. Dale Condit, "Phosphate Deposits in the Wind River Mountains near Lander, Wyoming," *U.S. Geol. Surv. Bull. 764* (1924), pp. 7–8; Blackwelder, *op. cit.;* A. R. Schultz, "A Geologic Reconnaissance for Phosphate and Coal in Southeastern Idaho and Western Wyoming," *U.S. Geol. Surv. Bull. 680* (1918), pp. 17–19.

[10] N. H. Darton, "Description of the Geology and Water Resources of the Southern Half of the Black Hills and Adjoining Regions, South Dakota and Wyoming," *U.S. Geol. Surv., 21st Ann. Rept.*, Part IV (1901), pp. 505–8.

the same name in the Big Horn and Owl Creek Mountains.[11] The present writer does not apply "Deadwood" in the Owl Creek and Bridger Mountains, and questions whether it should be applied in the Big Horns.

STRATIGRAPHY OF THE FLATHEAD FORMATION

The Flathead formation averages about 175 feet in thickness and consists of quartz sandstones and quartzites which lie unconformably on the pre-Cambrian rocks, mostly granite, and conformably underlie the Gros Ventre shales. The basal beds of the formation as a rule are conglomeratic and arkosic; and in places the contact with the granite is more or less "blended," the Flathead arkose grading into weathered granite, which in turn gradually passes into unweathered granite. The upper beds of the formation usually contain thin layers of shale, and the boundary with the Gros Ventre is drawn at the base of the lowest thick shale series.

In sections studied by the writer the thickness of the Flathead varies from 225 to 60 feet. This variation is extremely irregular and does not appear to be consistent in any one direction. For example, at Du Noir, in the northwestern Wind River Mountains, the formation is 190 feet thick, whereas at Torry Creek, 15 miles to the southeast, it is only 60 feet thick, and in sections still farther to the southeast the thickness is comparable to that at Du Noir. These variations are believed by the writer to reflect the relief of the pre-Cambrian peneplain over which the Flathead sea advanced, the beds thinning by overlap against numerous elevations on the crystalline surface, rather than thickening because of local piling-up of sediment on the sea floor.

The formation is often referred to as the Flathead "quartzite," although in northwestern Wyoming the only quartzites seen are in the Teton and Gros Ventre Mountains, where they are restricted to about 85 feet in the middle part of the formation; in sections to the east of the Gros Ventres the Flathead is sandstone. The top of the Flathead commonly forms a terrace platform or dip slope projecting

[11] N. H. Darton, "Comparison of the Stratigraphy of the Black Hills, Big Horn Mountains, and Rocky Mountain Front Range," *Geol. Soc. Amer. Bull. 15* (1904), p. 395; "Geology of the Big Horn Mountains," *loc. cit.*; "Geology of the Owl Creek Mountains," *loc. cit.*

from beneath the shales of the Gros Ventre. The formation is in most cases poorly exposed.

The only fossil species found in the Flathead by the writer is *Lingulepis acuminatus*, which occurs in about 25 feet of beds at the top of the formation and ranges into the basal beds of the Gros Ventre.

STRATIGRAPHY OF THE GROS VENTRE FORMATION

The Gros Ventre formation, averaging about 675 feet in thickness, consists of shales and limestones which intervene between the Flathead and Gallatin formations. The lower shales of the Gros Ventre are arenaceous and contain thin beds of sandstone, and in places the boundary with the Flathead must be drawn arbitrarily. The top of the formation, in the Teton and Gros Ventre Mountains, is marked by a pronounced erosional contact with the Gallatin; in the northwestern Wind River Mountains evidence of erosion at the top of the Gros Ventre is not pronounced and is present only locally; and in the Owl Creek Range the Gros Ventre and Gallatin appear to be completely conformable.

Lower shale division.—The lowest division of the Gros Ventre consists largely of greenish-gray, soft, micaceous shales which average about 100 feet in thickness. The lower part of the shales contains layers of sandstone from a fraction of an inch to one foot thick; these sandstone beds are seen to increase in number and thickness as the formation is followed eastward. The upper part contains beds of calcareous sandstone and argillaceous limestone. The only fossils found in this division are *Lingulepis acuminatus*, which occurs in the sandstones in the lower part, and numerous, irregularly branching, tubular markings, which possibly represent worm borings. Complete exposures of this division are rare, the shales commonly weathering into a steep slope largely covered by talus from the limestones above.

Death Canyon member.[12]—The second division of the Gros Ventre is designated in this paper as the "Death Canyon" member, the type section being along the divide between Death and Teton canyons in the Teton Range. It consists largely of fine-grained, dark-gray and black limestone mottled with brown. The limestones are thin-

[12] "Death Canyon," new member name (type section, Table I).

bedded for the most part, occurring in layers from one-half to several inches thick, separated by argillaceous seams and partings. Trilobite fragments are present occasionally along the partings, although for the most part the specimens are too poorly preserved for identification. In the Teton Mountains, along the divide between Death and Teton canyons, a faunule consisting of *Glyphaspis* sp., *Bolaspis* (?) *resseri*, and *Marjumia* (?) *tetonensis* was found on talus blocks about 100 feet below the top of the member; in the Gros Ventre Mountains, about 2 miles east of Cache Creek, the same faunule occurs in place 75 feet below the top. Aff. *Kochaspis* sp. occurs in the upper 20 feet of the Death Canyon member at Crow Creek Canyon in the western Owl Creeks. "Worm borings" also occur, but are not so abundant as in the shale divisions.

The Death Canyon member attains a thickness of 285 feet in the Teton Range and gradually thins and interfingers with shale toward the east, disappearing in the middle parts of the Owl Creek and Wind River ranges. At Du Noir, in the northwestern Wind River Mountains, the Death Canyon is 219 feet thick and contains numerous shale beds in the lower part; at Torry Creek it is about 100 feet thick; at Bull Lake Creek only 40 feet of it are exposed, and it is probably not much thicker than the outcrop; along the North Fork of the Popo Agie River there is no evidence of the Death Canyon, nor was it seen in any sections farther to the southeast. In the Owl Creek Mountains the Cambrian is usually very poorly exposed, and it is not possible to trace the eastward thinning of the Death Canyon as easily as in the Wind Rivers. The greater part of the Death Canyon beds commonly outcrop in a prominent scarp in the Teton and Gros Ventre Mountains, the scarp becoming less prominent in the Wind Rivers and Owl Creeks because of thinning and interfingering of the limestones with shales.

Upper shale division.—The upper division of the Gros Ventre varies considerably in thickness, which is in the order of 200 to 300 feet. It consists largely of greenish-gray shales similar to the shales of the lower division. In places the shales are purplish and dark-green, owing to the presence of hematite and glauconite.

Limestone beds varying from an inch to several feet in thickness are common in the upper shale division. Some of the limestones are

dense, light-gray, brown, or greenish-gray, and are either laminated with micaceous seams or consist of thin layers and lenses separated by shaly partings, whereas others are of the type generally referred to as "intraformational conglomerate" (Fig. 3). In this paper these conglomerates are divided into "intraformational breccias" and "pebbly limestones." The breccias consist of thin limestone plates and lenses, of irregular outline and averaging 6 inches to 1 or 2 feet in diameter, which lie at all angles to the bedding, whereas the pebbly

FIG. 3.—Intraformational breccia in the upper part of the Gallatin formation in Shoshone Canyon.

limestones consist of small, flat-to-rounded pebbles which mostly lie parallel or nearly parallel to the bedding. In both types the pebbles or plates are cemented in a matrix which is usually coarse-grained, light-gray, glauconitic limestone, although in some cases the matrix is fine, argillaceous limestone. Beds consisting of thin layers and lenses of limestone with shaly partings are invariably associated with the breccias and in places can be seen to pass upward and laterally into thick breccia beds. In some cases the limestone plates in the breccias appear to be more or less bent; and since they show no evidence of having been rounded or washed by waves, it is considered possible that the breccias are autoclastic rocks produced by the slipping or slumping of the thin-layered limestones along their argil-

laceous partings while the sediment was still in a semiplastic condition. However, the pebbles of the pebbly limestones are more or less rounded and probably originated through waves breaking up beds of platy limestone or breccia.

The upper 50–100 feet of the upper division of the Gros Ventre, in the Owl Creek and Wind River Mountains, is composed largely of thin-bedded limestones, pebbly limestones, and intraformational breccias. These beds are absent for the most part in the Teton and

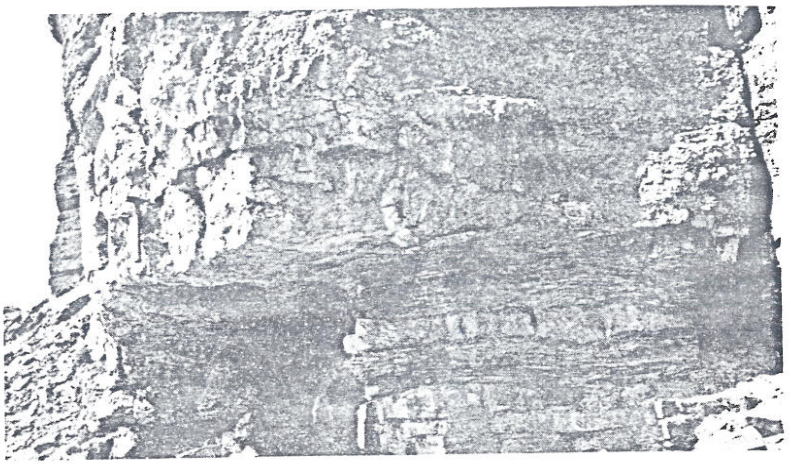

FIG. 4.—Disconformable contact (at hammer head) of the Gros Ventre and Gallatin in the South Fork of Teton Canyon. The beds on the lower right are thin-bedded, lenticular limestones which grade vertically and laterally into intraformational breccias lying above and to the left.

Gros Ventre Mountains, where the Gros Ventre is about 100 feet thinner than in sections to the east (Fig. 5); the missing limestones probably are represented by the pronounced disconformity at the top of the Gros Ventre. In the northwestern Wind River and western Owl Creek Mountains, the intraformational breccias always attain their maximum development just below the top of the Gros Ventre, where they form individual beds 4–5 feet thick.

Fragmentary trilobites are common in the limestones of the upper division of the Gros Ventre, as well as numerous "worm borings." At Crow Creek Canyon a fauna consisting of *Marjumia* (?) *tipperaryensis*, *Crepicephalus* (?) *wyomingensis*, several species of *Brachyaspis*, and *Dicellomus* sp. occur in lenticular limestones about 120

feet above the top of the Death Canyon member. In the Wind River and Owl Creek Mountains, oboloid brachiopods characterize the limestones in the upper part of this division.

The shales of the upper division are usually poorly exposed,

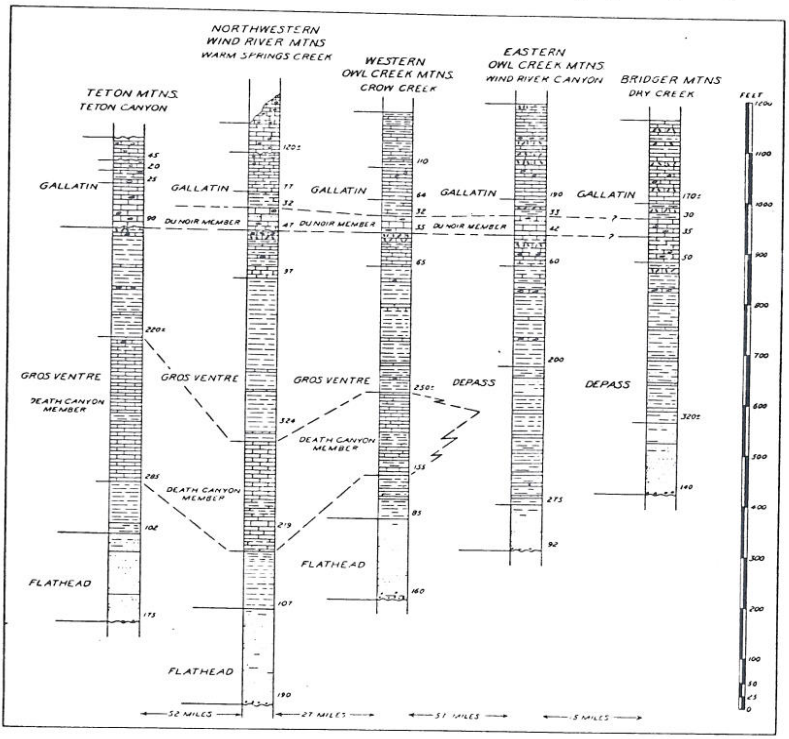

FIG. 5.—Correlated sections of the Cambrian formations from the Teton Range to the Bridger Range.

weathering back to form a steep slope. In the Wind River Mountains and in sections to the east, the limestones at the top of the Gros Ventre form a scarp in association with the massive limestones of the lower Gallatin.

STRATIGRAPHY OF THE DEPASS FORMATION[13]

As the Flathead and Gros Ventre formations are followed eastward through the Owl Creek and Wind River Mountains, the Flathead sandstone lithology is seen to rise gradually and invade the

[13] "Depass," new formational name (type section, Table IV).

lower part of the Gros Ventre, the sandstone and shale facies interfingering and finally becoming so greatly mixed that the two formations are not separable and are designated together as the "Depass" formation (Fig. 5). The type section is in the Wind River Canyon at the eastern end of the Owl Creek Range, where the Depass is defined as all the beds in the Wyoming "Deadwood" below the Gallatin. The name is taken from the "D" Pass (now spelled "Depass"), near the eastern end of the Bridger Range.

The name "Depass" will apply from about the middle of the Owl Creek Range at least as far to the east as the eastern end of the Bridger Range, and it is probable that it will apply in part of the Big Horns. In the Wind River Mountains it will apply from the southeastern end of the range at least as far to the northwest as the North Fork of the Popo Agie River, but not farther north than Bull Lake Creek. The Cambrian nomenclature to the southeast of the Wind River Mountains, in central Wyoming, must be considered as undetermined.

Well-exposed sections of the Depass formation are not common. The sandstones in the lower part generally outcrop as low ledges, the shales in the middle part form long slopes, and the limestones in the upper part usually form a scarp in association with the lower limestones of the Gallatin. The description of the type section (Table IV) and of the section at Dry Creek (Table V) present the character of the formation.

STRATIGRAPHY OF THE GALLATIN FORMATION

The Gallatin formation, in the area studied by the writer, attains its maximum thickness of about 300 feet in the northwestern part of the Wind River Mountains, thinning somewhat toward the southeastern end of the range. In the Gros Ventre and Teton Mountains it is about 180 feet thick; its average thickness in the upper part of the Wyoming "Deadwood" of the Owl Creek–Bridger uplift is about 225 feet. Although the Gallatin is somewhat variable in character, for purposes of description it can be divided into a lower limestone division, a middle shaly division, and an upper limestone division.

Du Noir member.[14]—The lower limestone division of the Gallatin,

[14] "Du Noir," a new member name (type section, Table II).

as it occurs in the Wind River Mountains and Owl Creek–Bridger uplift, is designated in this paper as the "Du Noir" member. The

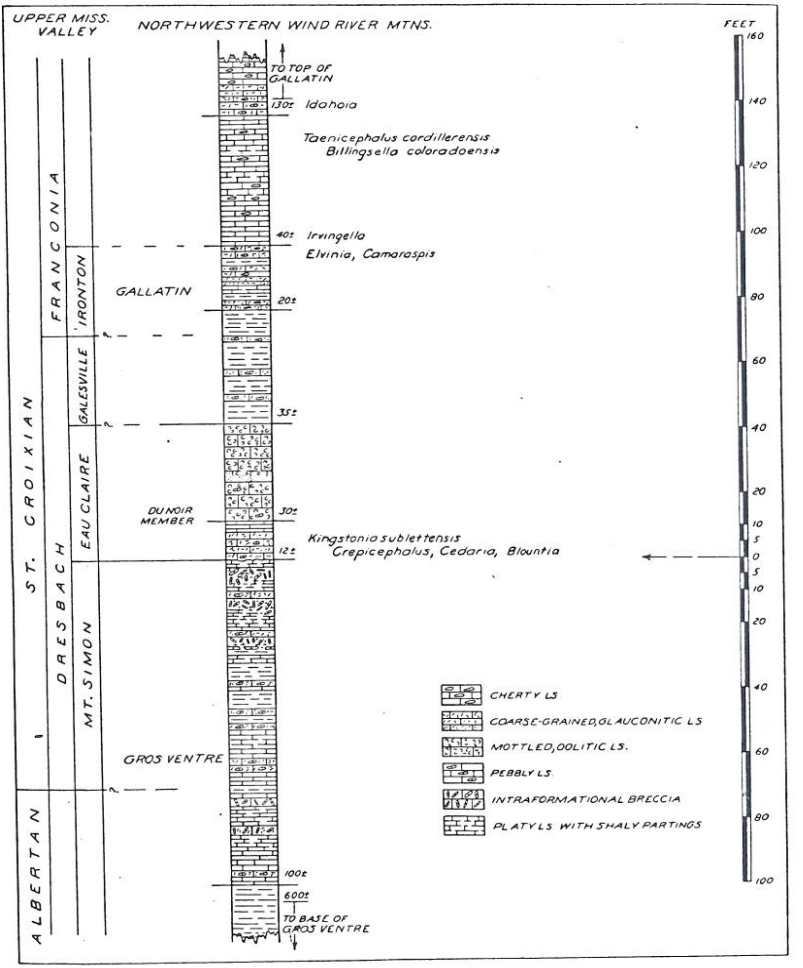

FIG. 6.—Generalized section of the upper Gros Ventre and lower Gallatin. The column on the left shows the correlation with the type St. Croixian.

type section is along Warm Springs Creek, 2 miles west of Du Noir, in the northwestern part of the Wind River Mountains. The Du Noir is composed largely of massive, dark-gray limestone mottled with yellowish-brown and filled with brown oölites. In most sections

it contains 1–3 feet of calcareous sandstone in the middle part and usually has about 10 feet of laminated limestone and glauconitic, pebbly limestone at the base. The average thickness is about 40 feet.

Trilobites are rather common in the Du Noir, although for the most part they are too fragmentary for identification. A fauna characterized by *Kingstonia sublettensis* and several species of *Crepicephalus* occurs in the basal glauconitic limestones at a number of localities in the Wind River Mountains; *Blountia* and *Cedaria* are other significant genera associated with this fauna.

In the Gros Ventre and Teton Mountains the Du Noir member is represented in the lower part of the lower limestone division of the Gallatin. However, the lower limestones are about twice as thick as in the Wind River Mountains, and the name "Du Noir" is not applied (Fig. 5).

The lower limestones of the Gallatin are massive and resistant for the most part, forming a prominent scarp.

Middle shaly member.—In the Wind River Mountains and Owl Creek–Bridger uplift, the Gallatin, for an interval of 30–35 feet above the Du Noir member, is composed largely of greenish-gray shale with beds of pebbly, glauconitic limestone and nodular, bluish-green, argillaceous limestone. Good exposures are rare, the beds generally weathering into a slope covered by talus from the limestone scarp above.

The middle shaly division in the Gros Ventre and Teton Mountains is 20–25 feet thick and does not contain as much shale as does the corresponding member in the Wind River Mountains. If this shaly facies is stratigraphically continuous from the Wind Rivers to the Gros Ventres and Tetons, it has risen 20 or 30 feet in the Gallatin, inasmuch as it contains the *Elvinia* fauna in the latter ranges; whereas in the Wind River Mountains that fauna characterizes the lower part of the limestone division overlying the middle shaly beds.

Upper limestone division.—The upper limestone division of the Gallatin attains its maximum thickness of about 195 feet in the northwestern part of the Wind River Range, thinning somewhat in the Owl Creek and Bridger ranges. To the west of the Wind River Range, in the Gros Ventre and Teton ranges, the thickness is only about 70 feet; this difference is due in part to the higher stratigraphic

position of the middle shaly member, as previously explained, and in part to erosion, the missing beds being represented by disconformities within, and at the top of, the Gallatin (Fig. 5).

The upper limestone division of the Gallatin contains a sequence of distinct faunal zones (Fig. 6). These zones appear to be more persistent in the Wind River Mountains than elsewhere. There the lower 20 feet are composed largely of glauconitic, pebbly limestones characterized by *Elvinia* and *Camaraspis*. Overlying the *Elvinia* beds are about 40 feet of dove-gray, thin-bedded limestones characterized by *Irvingella* in the lower part and by *Taenicephalus*, *Wilbernia*, and *Billingsella coloradoensis* in the upper part. The beds immediately overlying the *Taenicephalus* zone, for an interval of about 15 feet, are mostly coarse-grained, pebbly limestones characterized by *Idahoia*.

The remaining beds of the Gallatin above the *Idahoia* zone reach their maximum thickness in the northwestern part of the Wind River Range, where they are composed of gray, tan, and cream-colored limestones; their equivalents in the Owl Creek–Bridger uplift contain beds of shale and much pebbly limestone and intraformational breccia. Although no persistent faunal zones have been determined in these beds, several brachiopod and trilobite genera, including *Briscoia*, occur in the upper part.

CAMBRIAN SECTIONS IN NORTHWESTERN WYOMING

TETON MOUNTAINS

A well-exposed Cambrian section occurs along the divide between the South Fork of Teton Canyon and Death Canyon, about 2 miles south of Buck Mountain. The Cambrian is considerably thinner than in the Wind Rivers, the missing beds being represented largely by disconformities at the top of the Gros Ventre and at the top of the Gallatin. The type occurrence of the Death Canyon member is in this section, the limestones forming a prominent, double-rimmed scarp (Fig. 7). The massive lower limestones of the Gallatin are about twice as thick as in the Wind Rivers, and only in places do the beds exhibit the mottled appearance and brown oölites characteristic of the Du Noir member; beds equivalent to the *Kingstonia-Crepicephalus* zone are presumably present at the base of the lower Galla-

tin limestones, although the fauna has not been found. The *Elvinia* and *Irvingella* zones have been located and occur at about the same distance above the base of the Gallatin as in the Wind Rivers. The *Taenicephalus* and *Idahoia* zones have not been located and may be missing, inasmuch as there is a distinct disconformity within the Gallatin just above the *Irvingella* zone.

FIG. 7.—View in the South Fork of Teton Canyon. The double-rimmed scarp is the Death Canyon member of the Gros Ventre; the blocks in the foreground are at the top of the Flathead.

TABLE I

SECTION ALONG THE DIVIDE BETWEEN THE SOUTH FORK OF TETON CANYON AND DEATH CANYON, TETON COUNTY, WYOMING

Ordovician Big Horn formation: dolomite	
---------- Erosional disconformity ----------	
Cambrian	962 ft. (total)
Gallatin formation	180 ft. (total)
At base 3 ft. dove-gray limestone grading upward into light-gray to white limestone weathering to granular tan surface. "Worm-borings" and chert nodules common. Lower 20 ft. contain cystid (?) cups and abundant *Billingsella coloradoensis*	45 ft.
---------- Erosional disconformity ----------	
Dove-gray, fine-grained, thin-bedded limestone with "worm-borings." Top 5 ft.: *Irvingella gibba;* lower 15 ft.: *Eoorthis* (?) sp. cf. *E. iddingsi, Linarsonella* sp.	20 ft.

TABLE I—*Continued*

Largely covered. Gray, coarse, pebbly limestone with beds of soft, greenish-gray shale. *Elvinia roemeri, Pterocephalia* sp. cf. *P. sancti-sabae, Dunderbergia* (?) sp. cf. *D.* (?) *declivita*	25 ft.
Massive limestone. Mainly gray, mottled with greenish-yellow or brown; top 5 ft. yellow and yellowish-gray. In places pebbly, elsewhere with brown oölites. Trilobite fragments	90 ft.
---------- Erosional disconformity ----------	
Gros Ventre formation	607 ft. (total)
Largely covered. Greenish-gray shale with beds of pebbly limestone and intraformational breccia. Top 17 ft. is gray, thin-bedded limestone, pebbly limestone, and intraformational breccia	220 ft.
Death Canyon member (type)	285 ft. (total)
Black and dark-gray limestone mottled with brown; fine-grained, thin-bedded, with argillaceous seams and partings. Top 5 ft. is massive limestone weathering in spherical masses 3–5 ft. through. Top 15 ft.: *Glyphaspis* sp. cf. *G. perconcava;* talus slabs 100 ft. from top: *Marjumia* (?) *tetonensis Bolaspis* (?) *resseri, Glyphaspis* sp. und.	150 ft.
Greenish-gray shale and limestone similar to above	15 ft.
Limestone similar to above	112 ft.
Light-gray, fine-grained, thin-bedded limestone weathering light brown	8 ft.
Largely covered. Mainly greenish-gray, soft shale	80 ft.
Purplish and greenish, hard, arenaceous shales with a few thin beds of argillaceous sandstone containing *Lingulepis acuminatus*	22 ft.
Flathead formation	175 ft. (total)
Reddish and brownish, fine to medium-textured sandstone with beds of green, arenaceous shale	35 ft.
White and gray quartzite in beds up to 15 ft. thick	85 ft.
Red, purple, and gray, coarse, arkosic sandstone. Cross laminated in places	55 ft.
---------- Unconformity ----------	
Pre-Cambrian: Pink and gray granite containing xenoliths of gneiss and schist and cut by pegmatites and basic dikes.	

GROS VENTRE MOUNTAINS

The Cambrian is well exposed in the Gros Ventre Mountains about a mile east of Cache Creek and 9 miles southeast of Jackson. The section studied is located where the trail from Flat Creek to

Cache Creek crosses the divide between the two streams. The sequence is practically the same as at Teton and Death canyons.

Blackwelder has described the section at Doubletop Peak, about 18 miles southeast of the Cache Creek section.[15]

FIG. 8.—Section along Warm Springs Creek west of Du Noir. The blocks in the foreground are Flathead; the prominent lower cliff is the upper part of the Death Canyon. The Gros Ventre–Gallatin contact is just above the base of the second cliff above the Death Canyon; the Gallatin–Big Horn contact is in the middle part of the cliff capping the hill.

NORTHWESTERN WIND RIVER MOUNTAINS

The best Cambrian section in the northwestern part of the Wind River Range occurs along Warm Springs Creek. Most of the Cambrian is well exposed along the north side of the creek about 2 miles west of Du Noir, although there are fair exposures on Warm Spring

[15] *Loc. cit.*

Mountain about a mile east of Du Noir. At Warm Spring Mountain there are about 100 feet of limestones at the top of the Gallatin which are absent in the section west of Du Noir and apparently were eroded out prior to the deposition of the Big Horn.

TABLE II

SECTION ALONG WARM SPRINGS CREEK, NEAR DU NOIR, FREMONT COUNTY, WYOMING

Ordovician Big Horn formation: dolomite	
---------- Erosional disconformity ----------	
Cambrian	1,213 ft. (total)
Gallatin formation	276 ft. (total)
Light-gray and dark-gray, fine- to medium-grained limestone in layers a fraction to several inches thick. Chert nodules and "worm-borings" common. Contains a few beds of pebbly limestone. Top 5 ft.: *Briscoia schucherti;* at 40 ft. above base: *Synthrophia alata, Eoorthis* sp. cf. *E. iophon*	62 ft.
Partly covered. Mainly yellowish-gray to white, medium-grained limestone in layers from an inch to a foot thick. "Worm-borings" and cherty lenses common	58 ft.
---------- Local disconformity ----------	
Dove-gray, fine-grained, thin-bedded limestone marked by "worm-borings." Thin shaly layers common; in places pebbly. At 30–40 ft. above base: *Taenicephalus cordillerensis, Wilbernia* sp., *Billingsella coloradoensis, Billingsella* (?) sp. aff. *B. striata, Dicellomus* sp. und., *Lingulepis acuminatus* var. *meeki, Acrotreta microscopica* var. *tetonensis;* basal 5 ft.: *Irvingella gibba*	57 ft.
Gray limestone with shale partings. Some beds fine-grained, thin-layered; others coarse, glauconitic, pebbly. Top 5 ft.: *Elvinia roemeri, Burnetia* (?) sp. und., *Eoorthis* (?) sp. cf. *E. iddingsi*	20 ft.
Largely covered. Soft, greenish-gray shale with beds of bluish-green, soft, argillaceous limestone and pebbly limestone	32 ft.
Du Noir member (type)	47 ft. (total)
At base 2 ft. gray and yellow, fine-grained, calcareous sandstone grading upward into massive, dark-gray limestone mottled with yellow and filled with brown oölites. Trilobite fragments	18 ft.
Limestone similar to foregoing	16½ ft.

TABLE II—*Continued*

Brown, gray, and greenish, coarse-grained, pebbly limestone sprinkled with black and green glauconite grains. *Kingstonia sublettensis, Blountia globosa, B. dunoirensis, B.* sp. cf. *B. amage, Crepicephalus* sp., *Cedaria* sp. aff. *C. prolifica, Arapahoia levis, Maryvillia* sp., *Agnostus* sp. cf. *A. tumidosus*	12½ ft.
Gros Ventre formation	747 ft. (total)
Gray, fine-grained, laminated, and thin-bedded limestones with shaly partings; pebbly limestones and much intraformational breccia, the last-mentioned forming beds 5 ft. in thickness near the top. Upper 10 ft.: *Agnostus* sp., *Linnarsonella* sp. cf. *L. modesta, L. transversa, Obolus* (?) sp. cf. *O. zetus*	40 ft.
Largely covered. Mainly gray, laminated limestone and glauconitic pebbly limestone with beds of greenish-gray shale. Trilobite fragments	57 ft.
Largely covered. Mainly soft, greenish-gray, micaceous shale with beds of laminated limestone and pebbly limestone up to 4 ft. thick. "Worm-borings" common . .	324 ft.
Death Canyon member	219 ft. (total)
Thin-bedded, dark-gray limestone mottled with brown. Trilobite fragments	115 ft.
Greenish-gray shale and limestone similar to above .	20 ft.
Gray and pinkish limestone weathering rusty brown. Shale partings	46 ft.
Mainly gray and brown, arenaceous and micaceous limestone with thin shale beds	38 ft.
Greenish-gray and yellowish, micaceous shale with layers of gray and brown sandstone up to 10 in. thick . . .	107 ft.
Flathead formation	
White, gray, yellow, brown, red sandstones in beds up to 4 ft. thick. Conglomeratic and arkosic at base; in places rippled-marked, cross-laminated. Upper 20 ft.: *Linguleppis acuminatus*	190 ft. (total)

---------- Unconformity ----------

Pre-Cambrian: Pink and gray granite cut by pegmatites

OWL CREEK–BRIDGER UPLIFT

Crow Creek Canyon.—The section next described is located in Crow Creek Canyon about 3 miles north of Tipperary Post-Office, Fremont County, near the western end of the Owl Creek Range.

The Cambrian and Ordovician make up a fault block which is downdropped along the eastern side of the Canyon, the beds dipping northeast and abutting against the pre-Cambrian crystallines which almost entirely surround the block. The beds are largely covered by talus, and the section is difficult to measure because of rapid changes in dip and strike.

FIG. 9.—Crow Creek Canyon section. The triple-rimmed ledge in the middle foreground is the Death Canyon; the first cliff above the Death Canyon is the Du Noir member of the Gallatin.

TABLE III

SECTION IN CROW CREEK CANYON, FREMONT COUNTY, WYOMING

Ordovician Big Horn formation: At base 3 ft. of yellowish and pinkish quartzite grading upward into massive dolomite. Exact contact with Gallatin not exposed.	
Cambrian	965 ft. (total)
Gallatin formation	241 ft. (total)
Largely covered. Greenish-gray shale and limestones of various types: gray limestone mottled yellow and brown, fine-grained, in beds 1–3 ft. thick; gray and pinkish, fine-grained, thin-bedded limestone; glauconitic pebbly limestone. Some layers with trilobite fragments	110 ft.
Mainly dove-gray, fine-grained, thin-bedded limestone with some light-gray, glauconitic, pebbly limestone. Thin shale layers common throughout. Upper 15 ft.: *Idahoia* sp. cf. *I. serapio*, *I.* sp. und.; at 15–25 ft. above base:	

TABLE III—*Continued*

Taenicephalus cordillerensis, Billingsella coloradoensis, B. sp. cf. *B. plicatella*	36 ft.
Light-gray, pebbly limestone and dark-gray, fine-grained limestone splashed with brown. *Eoorthis* (?) sp. cf. E. *iddingsi*	28 ft.
Largely covered. Mainly greenish-gray shale	32 ft.
Du Noir member	
Mottled dark-gray and brown, massive limestone filled with brown oölites	35 ft. (total)
Contact apparently conformable	
Gros Ventre formation	555± ft. (total)
Greenish-gray, fine-grained, laminated limestones, pebbly limestones, and intraformational breccia. The breccias form beds 3–4 ft. thick in the upper part. *Obolus* (?) sp. cf. *Ozetus*	65 ft.
Largely covered. Mainly greenish-gray, purplish, and dark-green shale with beds of gray, fine-grained limestone and pebbly limestone. At about 120 ft. above the base *Brachyaspis rhynchina, B.* (?) sp., *Crepicephalus* (?) *wyomingensis, Marjumia* (?) *tipperaryensis, Dicellomus* sp. (Note: stated thickness approximate, possibly 25–50 ft. less than it should be)	250± ft.
Death Canyon member	155 ft. (total)
Dark-gray, thin-bedded limestone mottled yellow and brown. Green and red argillaceous partings. Lower 10 ft.: aff. *Kochaspis* sp.	20 ft.
Red and green shale with beds of limestone similar to foregoing and pebbly limestone	11 ft.
Dark-gray, thin-bedded limestone mottled yellow and brown	48 ft.
Largely covered. Greenish-gray shale and argillaceous limestone	28 ft.
Dark-gray limestone mottled with brown	24 ft.
Greenish-gray shale	12 ft.
At base gray, calcareous sandstone grading upward into gray and yellowish, argillaceous limestone	12 ft.
Greenish-gray shale with beds of gray, red, and yellow sandstone containing *Lingulepis acuminatus*	85 ft.
Flathead formation	
White, gray, yellow, brown, red sandstones. Conglomeratic and arkosic at base; in places cross-laminated and ripple-marked	160 ft. (total)
---------- Unconformity ----------	
Pre-Cambrian: Pink and gray granite.	

Wind River Canyon.—The Cambrian is exceptionally well exposed along both sides of Wind River Canyon, which is usually considered to be the boundary marking the eastern end of the Owl Creek Range

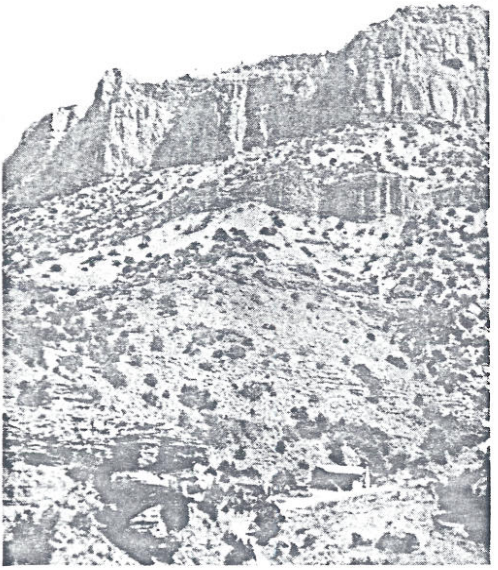

FIG. 10.—Section above Smith's cabin, Wind River Canyon. The cliff in the foreground is of lower Depass sandstone. The Big Horn–Gallatin contact is just above the base of the massive limestone cliff forming the canyon rim. The Gallatin-Depass contact is at the base of the dark limestones in the upper part of the first cliff below the Big Horn.

and the western end of the Bridger Range. Most of the section described below, from the base of the Depass to the top of the Du Noir member of the Gallatin, was measured on the east side of the Canyon, just above Smith's cabin; the beds from the top of the Du Noir to the base of the Big Horn were measured on the east side of the canyon about one-quarter mile east of Boysen Dam.

TABLE IV

SECTION IN WIND RIVER CANYON, FREMONT COUNTY, WYOMING

Ordovician Big Horn formation: At base 2 ft. of yellow sandstone grading upward into massive dolomite.	
Contact apparently conformable	
Cambrian	892 ft. (total)
Gallatin formation	265 ft. (total)
Red and pink, thin-bedded limestone and light-gray argillaceous limestone. Star-shaped echinoderm stems common in upper part	30 ft.
Mainly pebbly limestone and intraformational breccia. Purplish, thin-bedded argillaceous limestone prevails in the upper part	60 ft.
Mainly dove-gray, thin-bedded limestone. Contains several thick beds of intraformational breccia in the upper part. Talus slabs in lower part: *Taenicephalus cordillerensis*, *Saratogia* sp., *Billingsella coloradoensis*	100 ft.
Greenish-gray shale and intraformational breccia	33 ft.
Du Noir member	
Mainly massive limestone; some thin-bedded and some pebbly limestone. Contains several beds, 1–4 feet thick, of dark-gray limestone mottled with brown and filled with brown oölites. At 13–16 ft. below the top the beds vary from a light-gray, thin-bedded limestone to a gray calcareous sandstone. At 10–15 ft. below top: *Crepicephalus tripunctatus*, *Maryvillia* sp. cf. *M. ariston*, *Hyolithes* sp.	42 ft. (total)
Contact apparently conformable	
Depass formation (type)	627 ft. (total)
Mainly gray, fine-grained, thin-bedded limestone with shaly partings. Contains some pebbly limestone and intraformational breccia. Lower 10 ft.: *Arapahoia spatulata*, *A.* sp. cf. *A. typa*, *Dicellomus nana*, *Linnarsonella tennesseensis*, *L.* sp. cf. *L. modesta*	60 ft.
Largely covered. Mainly greenish-gray shale containing beds of gray, laminated limestone, pebbly limestone, and intraformational breccia	200 ft.
Dark-green and purple, hard, arenaceous sandstone containing a few layers of glauconitic limestone. Brachiopod fragments	10 ft.

TABLE IV—*Continued*

Gray and yellowish sandstone and green, hard, arenaceous shale. The sandstones carry fragments of linguloid brachiopods	34 ft.
Mainly dark-green and purplish shale with thin layers of gray, fine-grained sandstone carrying brachiopod fragments	136 ft.
Green shale with beds of light-gray sandstone from a fraction of an inch to 3 ft. in thickness. Cross-laminated in places; "worm-borings" common. The sandstones carry fragments of linguloid brachiopods	95 ft.
Green shale and sandstone alternating in beds about 6 in. thick. Cross-laminated in places; "worm-borings" common	25 ft.
Greenish and yellowish, massive sandstones marked by vertical, tubular structures resembling *Scolithus*	18 ft.
Gray and yellowish sandstone with a few thin layers of green and reddish shale. Cross-lamination common throughout. Conglomeratic and arkosic at base where the beds grade downward through decomposed granite into unweathered granite	49 ft.
---------- Unconformity ----------	
Pre-Cambrian: Pink and gray granite and pegmatites intruding black phyllites and slates.	

Dry Creek.—The section described in Table V is located near the eastern end of the Bridger Range, in the northwest quarter of T. 39 N., R. 92 W. The Cambrian forms part of an "island" of Paleozoic rocks which rises above the Eocene sediments along Dry Creek, a tributary of Badwater Creek. The beds are poorly exposed and difficult to measure because of faulting and rapid changes in dip.

Because of poor exposures, it has not been possible to determine accurately the boundaries of the Du Noir member of the Gallatin; and inasmuch as the writer did not observe any beds exhibiting the strongly mottled appearance and brown oölites which characterize the member in sections to the west, the name has not been applied (Fig. 5). However, the Du Noir is easily recognized in Wind River Canyon, 15 miles to the west; and it is probable that the name could be applied at Dry Creek if the section were well exposed.

TABLE V

SECTION ALONG DRY CREEK, FREMONT COUNTY, WYOMING

Ordovician Big Horn formation: At base 3–7 ft. of dense, white quartzite followed by massive dolomite.	
Contact apparently conformable	
Cambrian	745± ft. (total)
Gallatin formation	235± ft. (total)
Mainly gray intraformational breccia with beds of shale. Upper 30 ft. is reddish, thin-bedded limestone and intraformational breccia	125±ft.
Dove-gray, thin-bedded limestones and intraformational breccia. Some talus slabs from this division carry *Wilbernia* (?) sp.; other slabs carry *Eoorthis remnicha*	45 ft.
Greenish-gray and purplish shale with beds of intraformational breccia and greenish-gray limestone. Upper 10 ft.: *Kyphocephalus bridgerensis*, *Dunderbergia* (?) *declivita*	30 ft.
Gray limestone and intraformational breccia. Beds in general more massive than those below	35± ft.
Exact contact not determinable	
Depass formation	510± ft. (total)
Mainly gray, thin-bedded, argillaceous limestone. Talus slabs from the lower part contain *Arapahoia spatulata* and *Dicellomus nana*	50 ft.
Greenish-gray shale with a few beds of limestone, mainly intraformational breccia	85 ft.
Dark-green and purplish, hard arenaceous shale with beds of sandstone from a fraction of an inch to several feet thick. The sandstones contain *Lingulepis acuminatus*	235± ft.
Gray sandstone with thin beds of arenaceous shale. Vertical, tubular markings resembling *Scolithus* are common in the sandstones	40 ft.
Pink, yellow, and gray sandstone. Arkosic and conglomeratic at base; some beds cross-laminated	100± ft.
Contact covered	
Pre-Cambrian: Pink and gray granite containing xenoliths of gray and black schist and cut by pegmatites and basic dikes.	

BIG HORN MOUNTAINS

The Cambrian of the Big Horn Mountains has been described by Darton and referred by him to the Deadwood formation.[16] However,

[16] N. H. Darton, "Geology of the Big Horn Mountains," *loc. cit.*

the Wyoming "Deadwood," as pointed out elsewhere in this paper (p. 141), evidently includes beds considerably older than the type Deadwood in the Black Hills; and since the writer has not applied the name, "Deadwood," in the Owl Creek–Bridger uplift, it is questionable whether it should be applied in the Big Horns.

Although the writer spent several days of reconnaissance study in the Big Horn Range, the work did not progress to the point where conclusions relative to the Cambrian nomenclature can be considered well established; additional study is necessary before details of the stratigraphy are available. The Cambrian in the Big Horn Mountains appears to be of the same general character as the sequence in the Bridger Mountains, is roughly equivalent to the Depass and Gallatin formations, and it is probable that these formational names can be applied in at least part of the range. However, in most of the Cambrian areas in the Big Horns, by far the greater part of the beds is covered by mantle and glacial deposits, and it will be difficult to separate the sequence into formations.

RATTLESNAKE–CEDAR MOUNTAIN UPLIFT

The Cambrian sequence in the Shoshone Canyon, 7 miles west of Cody, is divisible into the Flathead, Gros Ventre, and Gallatin formations. The section is similar to the section at Crow Creek Canyon, in the western part of the Owl Creek Mountains; and the Teton Canyon and Du Noir members both are present. The upper part of the Gallatin contains black and gray shales carrying graptolites, some of which have been described by Ruedemann.[17] The writer has not found these graptolite shales in any other section.

AGE AND CORRELATION OF THE FORMATIONS

The correlation of the Cambrian formations of northwestern Wyoming with the Cambrian of other regions must be based on evidence that is far from complete. The faunal lists given in the preceding section of this paper represent only a small part of the fauna that ultimately will be listed from the beds, inasmuch as the collections include species unidentified because of their fragmentary condition. Many of the species and genera found were undescribed;

[17] Rudolf Ruedemann, "The Cambrian of the Upper Mississippi Valley," Part III, "Graptolitoidea," *Public Mus. of the City of Milwaukee Bull. 12*, No. 3 (1933), p. 323.

and although the writer is publishing some of them in connection with this study, only those which can be closely compared to described forms are of value in correlation. Furthermore, many of the forms which were described from the Cambrian of other regions and which also occur in Wyoming have never been accurately tabulated as to their precise stratigraphic position; thus their use in correlation is impaired. In addition, there is difficulty in that the Cambrian of the Pacific Province has not been adequately subdivided into standard faunal zones, and this is accentuated by the fact that the type regions for the Waucobian, Albertan, and St. Croixian series, representing Lower, Middle, and Upper Cambrian, respectively, are in widely separated parts of the continent. For these reasons the correlations proposed in this paper are considered to be only approximate.

The correlations are based on an evaluation of the trilobite faunas occurring in the formations, together with a consideration of the sequence of the faunas and their positions in the sections. The only other organisms represented in any abundance are the brachiopods, and these are simple in type and apparently not diagnostic. The correlations are based only on those genera and species whose range in Cambrian rocks outside of Wyoming appears to be well established; the associated forms are listed in the tables in the preceding section of this paper.

Correlation of the Gallatin formation.—The most reliable correlations which can be made between the Cambrian formations of northwestern Wyoming and the Cambrian of other regions are afforded by a comparison of the faunal zones of the Gallatin with zones in the type St. Croixian of the upper Mississippi Valley (Fig. 6).

The Du Noir member of the Gallatin contains a fauna characterized by *Kingstonia,* several species of *Crepicephalus* belonging to the *C. texanus* group, *Blountia,* and *Cedaria.* So far as known to the writer, all the described species belonging to these genera occur in beds of early St. Croixian age. In the upper Mississippi Valley, *Crepicephalus* and *Cedaria* characterize the Eau Claire member of the Dresbach; and the Du Noir is thus believed to be approximately of Eau Claire age. In the Black Hills, *Crepicephalus* and *Kingstonia*

occur in a zone near the base of the type Deadwood;[18] for this reason, the base of the Gallatin and the base of the Deadwood appear to be approximately of the same age and the Wyoming "Deadwood" evidently includes beds considerably older than the type Deadwood.

The succeeding faunal zone of the Gallatin is characterized by *Elvinia*, *Camaraspis*, and *Pterocephalia*. In the type St. Croixian, *Elvinia* and *Camaraspis* occur in the Ironton member of the Franconia. The beds immediately overlying the *Elvinia* zone of the Gallatin contain *Irvingella gibba* and *I. major;* the latter species characterizes the transition beds between the Ironton and upper Franconia.[19] Therefore, it is thought that the part of the Gallatin between the Du Noir member and the *Irvingella* zone corresponds approximately to the Galesville (upper Dresbach) and the Ironton.

The *Taenicephalus* zone of the Gallatin (Fig. 6) contains *Taenicephalus cordillerensis* and *Wilbernia* sp. aff. *W. diademata,* both of which are closely related to species occurring in the *Conaspis* beds of the Franconia. The beds immediately succeeding the *Taenicephalus* zone contain *Idahoia*, which was first described from the Ovid formation, of Oneida County, Idaho; Resser has recently referred several species occurring in the Franconia to *Idahoia.*[20]

The correlation of the beds overlying the *Idahoia* zone is uncertain. The only significant trilobite found is *Briscoia schucherti,* which occurs 22 feet below the top at Du Noir; this species was originally described from the "Mazomanie," the uppermost member of the Franconia.

Correlation of the pre-Gallatin formations.—The writer has found few well-preserved, useful fossils in the pre-Gallatin formations. None of these seems to occur in persistent faunal zones, a number of them were undescribed, and it is impossible at present to correlate accurately the pre-Gallatin formations with the Cambrian formations of other regions.

No diagnostic species have been found in the Flathead formation

[18] Meyerhoff and Lochman, *loc. cit.*

[19] J. M. Wanemacher, W. H. Twenhofel, and G. O. Raasch, "The Paleozoic Strata of the Baraboo Area, Wisconsin," *Amer. Jour. Sci.*, 5th ser., Vol. XXVIII (1934), p. 6.

[20] C. E. Resser, "Nomenclature of Some Cambrian Trilobites," *Smith. Inst. Misc. Coll.*, Vol. XCIII, No. 5 (1935), pp. 35–36.

or in the lower shales of the Gros Ventre below the Death Canyon member. The total fauna identified by the writer from the Death Canyon is composed of *Bolaspis* (?) *resseri*, *Marjumia* (?) *tetonensis*, *Glyphaspis* sp. cf. *G. perconcava*, *G.* sp. und., and aff. *Kochaspis* sp. und. All of these species, except the questionable *Marjumia*, are sufficiently similar to known forms to admit of no doubt of their Middle Cambrian (Albertan) age; *Marjumia* (?) *tetonensis* possibly represents a previously unknown genus. All of the species occur in the upper part of the Death Canyon; and all were found in the Teton and Gros Ventre Mountains except the questionable *Kochaspis*, which was found in the western part of the Owl Creek Range.

A small trilobite fauna was found in the upper shales of the Gros Ventre, about 120 feet above the Death Canyon member, in the western Owl Creek Mountains. The fauna includes *Marjumia* (?) *tipperaryensis*, representing the same genus as the questionable *Marjumia* from the Death Canyon member in the Teton Mountains, and *Crepicephalus* (?) *wyomingensis;* the latter species is referred to *Crepicephalus* because of its similarity to *C. coosensis* Walcott, which occurs in the Middle Cambrian of Alabama and probably is not a *Crepicephalus*. The writer has found no other diagnostic fossils in the upper Gros Ventre shales, although in the collections at the United States National Museum there are Middle Cambrian trilobites which came from the upper shales of the Gros Ventre, between the Death Canyon member and the Gallatin, in the Teton Mountains.[21]

The paleontologic evidence indicates that the Gros Ventre and Flathead are largely, if not wholly, of Middle Cambrian age; and although no diagnostic fossils have been found in the Depass, its stratigraphic relations with the Gallatin and Gros Ventre indicate that it is largely Middle Cambrian (Fig. 5). It seems also that the pre-Gallatin beds must include late Middle Cambrian, inasmuch as through most of the Wind River Mountains and the Owl Creek–Bridger uplift they appear to be conformable below the Gallatin, which has an early Upper Cambrian fauna at its base. However, as previously pointed out (p. 122), there are about 75–100 feet of beds, mainly limestones, which are present in the upper part of the Gros

[21] C. E. Resser, personal communication.

Ventre in the northwestern Wind River Mountains and in sections to the east, but which are largely absent in the Gros Ventre and Teton ranges, where they seem to be represented by a disconformity. Furthermore, the Du Noir member of the Gallatin contains an Eau Claire fauna; and therefore it is assumed that equivalents of the Mount Simon, which underlies the Eau Claire and contains no fauna, are represented in the Wind River, Owl Creek, and Bridger ranges by approximately the upper 75 or 100 feet of the pre-Gallatin beds (Fig. 6).

CAMBRIAN HISTORY AND PALEOGEOGRAPHY OF WYOMING

During early Cambrian time most, if not all, of Wyoming was undergoing peneplanation. No one, to the writer's knowledge, has demonstrated the presence of Lower Cambrian rocks in Wyoming, although it is known that the early Cambrian sea was present in Utah, and it is considered possible by the writer that this sea extended into southwestern Wyoming, as indicated by Schuchert on a recent paleogeographic map.[22]

In northwestern Wyoming the record begins with the advance of a sea which reached the western border of the state in later Middle Cambrian time and spread slowly eastward. In this sea were deposited the Flathead sandstones and the greater part of the shales and limestones which compose the Gros Ventre and Depass formations, the beds overlapping toward the east (Fig. 5). Toward the close of Middle Cambrian time an uplift took place along the northwestern boundary of the state, the seas retreating from the area west of the Wind River Mountains but remaining over the greater part of the area to the east, where deposition appears to have continued into the later Cambrian with little or no interruption.

During later Cambrian time the sea returned to the area that had previously emerged and spread farther toward the east, extending across Wyoming at least as far as the Black Hills and probably connecting eastward with the upper Mississippi Valley sea. The sea remained in Wyoming through the greater part of later Cambrian time, although there were irregular withdrawals, as indicated by disconformities in the upper part of the Gallatin formation; and it is

[22] Charles Schuchert and Carl O. Dunbar, *Textbook of Geology*, Part II, *Historical Geology* (New York: John Wiley & Sons, 1933), p. 125.

probable that the sea retreated completely before the close of the period.

The history of central Wyoming during the Cambrian period is uncertain. The Cambrian rocks are known to thin and become increasingly clastic from the Wind River Mountains southeast to central Wyoming, where the beds have been referred by various writers to the "Deadwood" formation; they disappear in the northern part of the Laramie Range between the Casper and Douglas districts.[23] In the Rattlesnake Mountains in the eastern part of Natrona County, the Cambrian consists of 800 feet of sandstone, shale, and impure limestone; at Alcova, 25 miles southeast of Casper, there are 200 feet of sandstone, quartzite, and conglomerate; and at Rawlins, 65 miles south of the Rattlesnake Mountains, 395 feet of quartzite and conglomerate.[24] At all of these localities the Cambrian is overlain by the Madison limestone (Mississippian), the Big Horn formation terminating at the southeastern end of the Wind River Range.[25]

The character of the Cambrian of central Wyoming suggests nearshore deposition, from which it is inferred that the Cambrian sea did not extend to southeastern Wyoming, where Cambrian rocks are absent. It is the writer's opinion that the thinning of the beds is due in large part to overlap, although it is probable that the thickness has been somewhat reduced by erosion prior to the deposition of the Madison. If this interpretation is correct, southeastern Wyoming was a part of the land mass, Siouxia, which acted as the dominant source of the Cambrian sediments which were deposited to the northwest.

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The field studies were carried out as part of the program of the Wyoming Geological Survey, and the writer is indebted to Dr. S. H. Knight for making available the resources of that organization.

[23] Willis T. Lee, "Correlation of Geologic Formations between East-Central Colorado, Central Wyoming, and Southern Montana," *U.S. Geol. Surv. Prof. Paper 149* (1927), p. 46.

[24] *Ibid.*, pp. 45, 51, 73.

[25] N. H. Darton, "Paleozoic and Mesozoic of Central Wyoming," *Geol. Soc. Amer. Bull. 19* (1908), p. 410.