SMITHSONIAN MISCELLANEOUS COLLECTIONS

PART OF VOLUME LIII

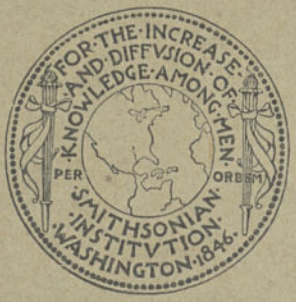
CAMBRIAN GEOLOGY AND PALEONTOLOGY

No. 5.—CAMBRIAN SECTIONS OF THE CORDILLERAN AREA

With Ten Plates

BY

CHARLES D. WALCOTT



No. 1812

CITY OF WASHINGTON

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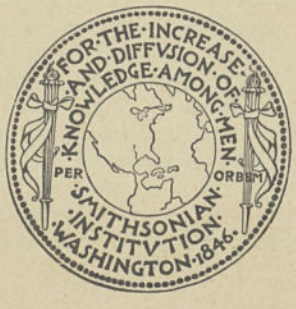

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INTRODUCTION

My first study of a great section of Paleozoic rocks of the western side of North America was that of the Grand Canyon of the Colorado River, Arizona. In this section the Cambrian strata extend down to the horizon of the central portion of the Middle Cambrian (Acadian) where the Cambrian rests unconformably on the pre-Cambrian formations.[1]

[1] See American Jour. Sci., 3d ser., xxvi, 1883, pp. 437–442.

The second section studied was that of the Eureka District of central Nevada in 1880–1881, the results of which were incorporated in Monographs VIII and XX of the U. S. Geological Survey. This section includes the upper portion of the Lower Cambrian (Georgian), the Middle Cambrian (Acadian), and the Upper Cambrian (Saratogan). The studies of the Cambrian strata were afterward continued in the Cordilleran area from time to time as opportunity offered. These included the Highland Range section of Nevada and the Big Cottonwood section of the Wasatch Mountains (see Bulletin U. S. Geol. Survey, No. 30, 1886, pp. 33 and 38). The great House Range section of central western Utah was studied and measured in 1905, the Blacksmith Fork section of the Wasatch Mountains in 1906, and the Mount Bosworth section of British Columbia in 1907. The last three sections are included in this paper.

The strata of the Lower Cambrian (Georgian) are apparently well developed in the Big Cottonwood section of Utah, and the upper portion in the House Range, Eureka, and Highland Range sections, but it was not until the sections of the Lower Cambrian (Georgian) formations of western Nevada and southeastern California were examined that the fauna was found well developed. These sections are incorporated in this paper.

ILLUSTRATIONS.—In order that geologists and paleontologists who have not had an opportunity to see the sections may get an idea of the completeness of the exposures of the strata in the Cordilleran area, photographs are introduced in connection with the House Range and Mount Bosworth sections.

The map of the House Range gives the localities and names used in the section.

CORRELATION OF SECTIONS

The object of this preliminary correlation is to show in a broad way the interrelations of the strata and faunas in the North American Cordilleran area west of the great continental land area of Lower and much of Middle Cambrian time. The margin of this area was as far westward as the present position of the main range of the Wasatch Mountains in the vicinity of Salt Lake, Utah; from this point the shoreline trended gradually south-southwest to southwestern Utah and into southeastern Nevada. To the north of Salt Lake the trend of the early Cambrian shoreline was north-northeast to western Wyoming, and thence north into Montana (see Dearborn River section). It passed westward of the Belt Mountain

uplift, and thence north into Alberta, east of the Rocky Mountain front, where all traces of it are lost beneath the covering of Tertiary and Cretaceous rocks. In the vicinity of the international boundary (49th parallel) an uplift of pre-Cambrian (Beltian) strata appears to have largely prevented Cambrian sedimentation in northwestern Montana and northern Idaho. The faunas of the sections to the north in British Columbia and to the south in Utah clearly prove that the seas in which they lived were connected, but how or where we do not know.

In the following diagram the general relations of the sections are shown:

Table Showing Stratigraphic Position in the Cambrian System of Five of the Sections Described

Ordovician	285+			+		+
Upper Cambrian (Saratogan)	Utah, 3,315 feet.	300		Utah, 1,227 feet.		3,590 feet.
Middle Cambrian (Acadian)	House Range, 4,417 feet.	(?) (?)	225	Blacksmith Fork, 5,420 feet.		British Columbia, 4,963 feet.
Lower Cambrian (Georgian)	Total, 9,232+ 1,500 feet.	+ Waucoba, California, 5,670+	Big Cottonwood, Utah, 12,000 feet.			Mount Bosworth, 3,800 feet.

The House Range section, supplemented by the Lower Cambrian sections of western Nevada and southeastern California, 230 miles (370.07 km.) west-southwest, gives a total of over 13,000 feet (3962 m.) of strata with Cambrian faunas throughout. If the Big Cottonwood section, 140 miles (225.26 km.) to the northeast of the

House Range, is found to have Cambrian fossils to its base, there will be over 19,000 feet of Cambrian strata in Utah. I think it quite probable that the quartzitic sandstones and siliceous shales of the Big Cottonwood section were being deposited as near-shore sediments while the calcareous, argillaceous, and arenaceous muds were accumulating at the same time 350 miles (563.15 km.) to the southwest.

The Upper and Middle Cambrian formations of the House Range section are much like those of the Blacksmith Fork and Mount Bosworth sections. From the top down the correlation of the various sections is as follows:

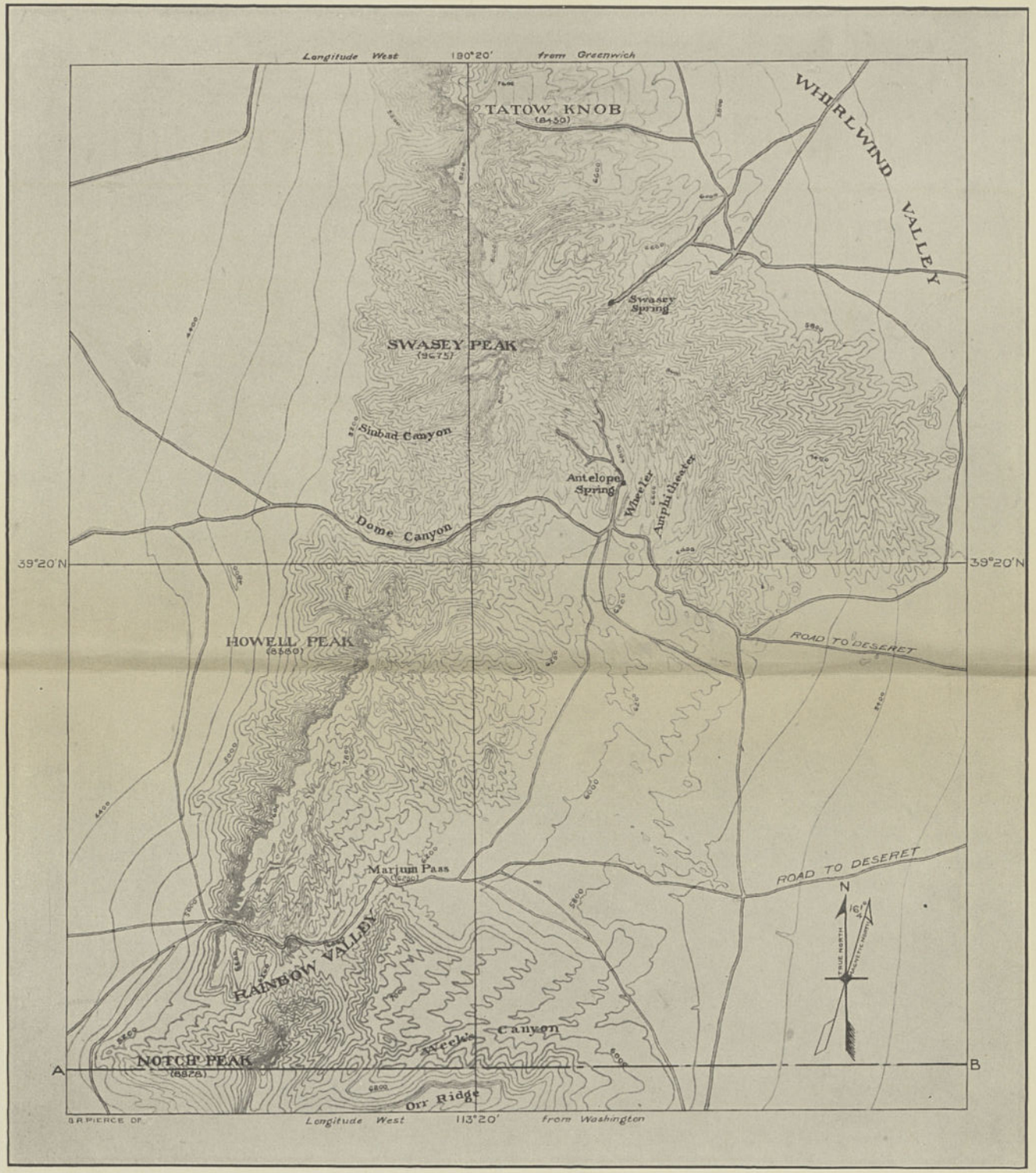
Correlation Table of Stratigraphic Sections

	House Range	Silver Peak	Big Cottonwood	Blacksmith Fork	Dearborn River	Mount Bosworth
Upper Cambrian (Saratogan)	Notch Peak, 1,490	Emigrant, 300	No Upper Cambrian	St. Charles, 1,227	(?)	Sherbrooke, 1,375
	Orr, 1,825					Paget, 360
						Bosworth, 1,855
Middle Cambrian (Acadian)	Weeks, 1,390	(?)		Nounan, 1,041	Limestone, 1,320	Eldon, 2,728
	Marjum, 1,102			Bloomington, 1,320		
	Wheeler, 570					
	Swasey, 340			Blacksmith, 570	Shale, 150	Stephen, 640
	Dome, 355	(?)	(?)	Ute, 729	Limestone, 130	
	Howell, 435			Spence, 30	Shale, 210	Cathedral, 1,595
	Spence, 20		Limestone, 75	Langston, 498		
	Langston(?), 205		Shale, 150		Limestone, 55	
Lower Cambrian (Georgian)	Pioche, 125	Silver Peak, 5,670 +	Shale, 100	Brigham, 1,232 +	Shale, 190	Mt. Whyte, 390
	Prospect Mountain, 1,375 +		Prospect Mountain, 11,750 +		Sandstone, 150	St. Piran, 2,705
					The sandstone rests unconformably on the pre-Cambrian	Lake Louise, 105
						Fairview, 600 +

The numerals indicate the thickness of each formation in feet. The only horizons definitely correlated by strongly marked and similar faunas are the Pioche and Mount Whyte; Spence and Stephen; Notch Peak, St. Charles, and Sherbrooke.

There are many partial sections that supplement various portions of the three great sections. These I wish to utilize in connection with the study of the Cambrian trilobites of the Cordilleran area, as our present knowledge of the vertical range and distribution of the trilobites is too limited and inaccurate to be more than of value in general and broad correlations. It is also true that many of the great limestone beds now considered as almost without fossils will be found in their extension away from the three great sections to contain a well-marked fauna.

In closing this brief review, I wish to call attention to the close relationship between the great Cambrian section of the Province of Shantung, China, and the Cordilleran sections. The thickness of the strata is very much less, but the general character and stratigraphic succession of the Cambrian faunas is very much the same. This will be discussed in the introduction to a paper on the Cambrian faunas of China, upon which I am now at work.



HOUSE RANGE, MILLARD COUNTY, UTAH

CENTRAL PORTION

Scale

1 ½ 0 1 2 3 4 5 Miles

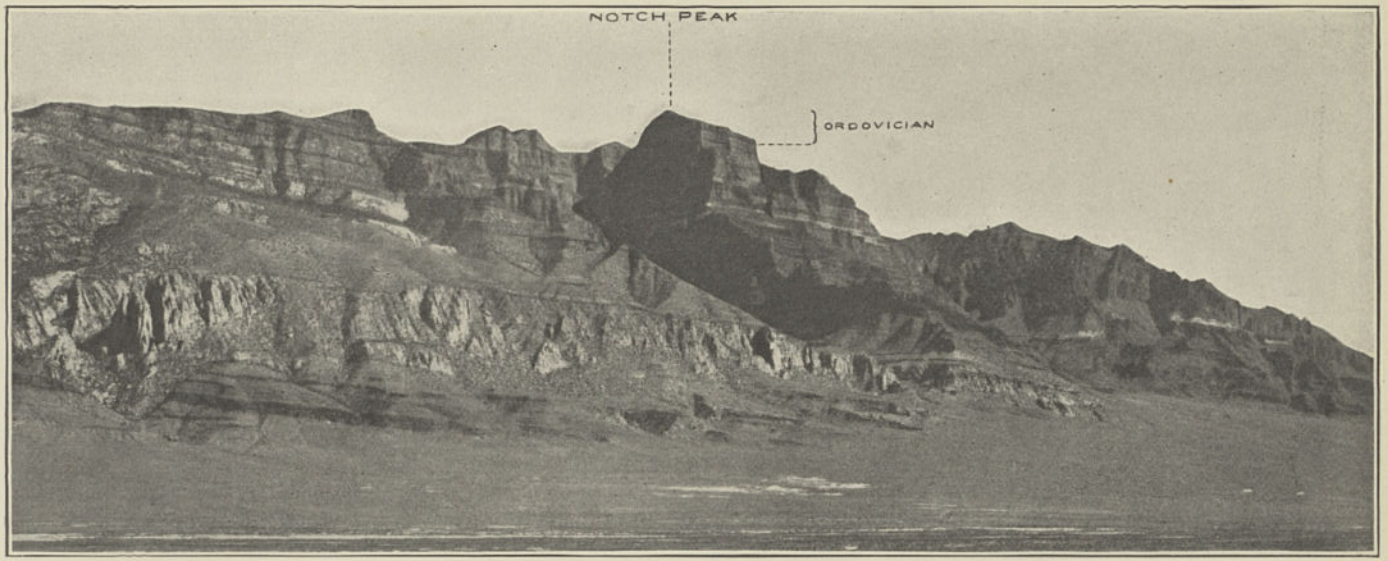
1 ½ 0 1 2 3 4 5 Kilometers

Contour interval 200ft

Datum is mean sea level

Contours below "A-B" have been added to Map to show approximate relations of Notch Peak and Orr Ridge to the rest of the range

TOPOGRAPHY BY W. D. JOHNSON, 1901



WEST FACE OF NOTCH PEAK, HOUSE RANGE, SOUTH OF MARJUM PASS, UTAH

The summit of Notch Peak is capped with Ordovician limestone, and an intrusive mass of granite porphyry is intruded into the Cambrian beds on the north slope of the peak (left side). The Notch Peak formation is beautifully shown in the 1,400-foot cliff exposed in the dark canyon just beneath the peak. (See Plate 15, Figure 1, for opposite side of Notch Peak.)

HOUSE RANGE SECTION

In order to locate the various points referred to, the accompanying map has been prepared, under the direction of Mr. L. D. Burling, from a manuscript topographic map made by Mr. W. D. Johnson of the U. S. Geological Survey (see plate 13).

LOCALITY.—West and east of Antelope Springs and east-southeast and south of Marjum Pass, House Range, Millard County, Utah. Sawtooth Range is a name given locally to the House Range south of Marjum Pass.

The section begins at the top, 285 feet below the summit of Notch Peak, the highest point (8,828 feet) on the House Range south of Marjum Pass.

The top of the peak is formed of 285 feet of Ordovician limestone, which is a banded, thin-bedded, bluish gray and purplish limestone containing near the top a distinct fauna:

Obolus (*Westonia*) *notchensis* Walcott [1908*d*, p. 69].
Eoorthis coloradoensis (Meek) [1870, p. 425].
Raphistoma sp., etc.

The strike of the upper beds is north 20° east (magnetic); dip, 12° south.

The line of the section extends down the northeast slope of Notch Peak and thence to a high ridge east of the area of eruptive granite on the northwest slope of Notch Peak; thence north to Marjum Pass. It is then carried on the line of the upper beds of the Wheeler formation to a point southeast of Antelope Springs; thence west to Dome Pass and (on the north side of Dome Canyon) to the Lower Cambrian quartzitic sandstones that pass beneath the quaternary of the White Valley at the western foot of the House Range.

ORDOVICIAN

	Feet
Limestone resting conformably on the Cambrian.....	285

UPPER CAMBRIAN

NOTCH PEAK FORMATION:

The Notch Peak formation [Walcott, 1908*a*, p. 9] is exposed on the east and southeast slopes and ridges of Notch Peak.

	Feet
1*a*. Gray, arenaceous limestone in thick layers and bands of thin layers. Irregular nodules and thin layers of dark gray chert, weathering dark brown, occur at irregular intervals for 350 feet below the summit. Thin, cherty layers, one-half to one-eighth inch thick, also occur occasionally below.....	640

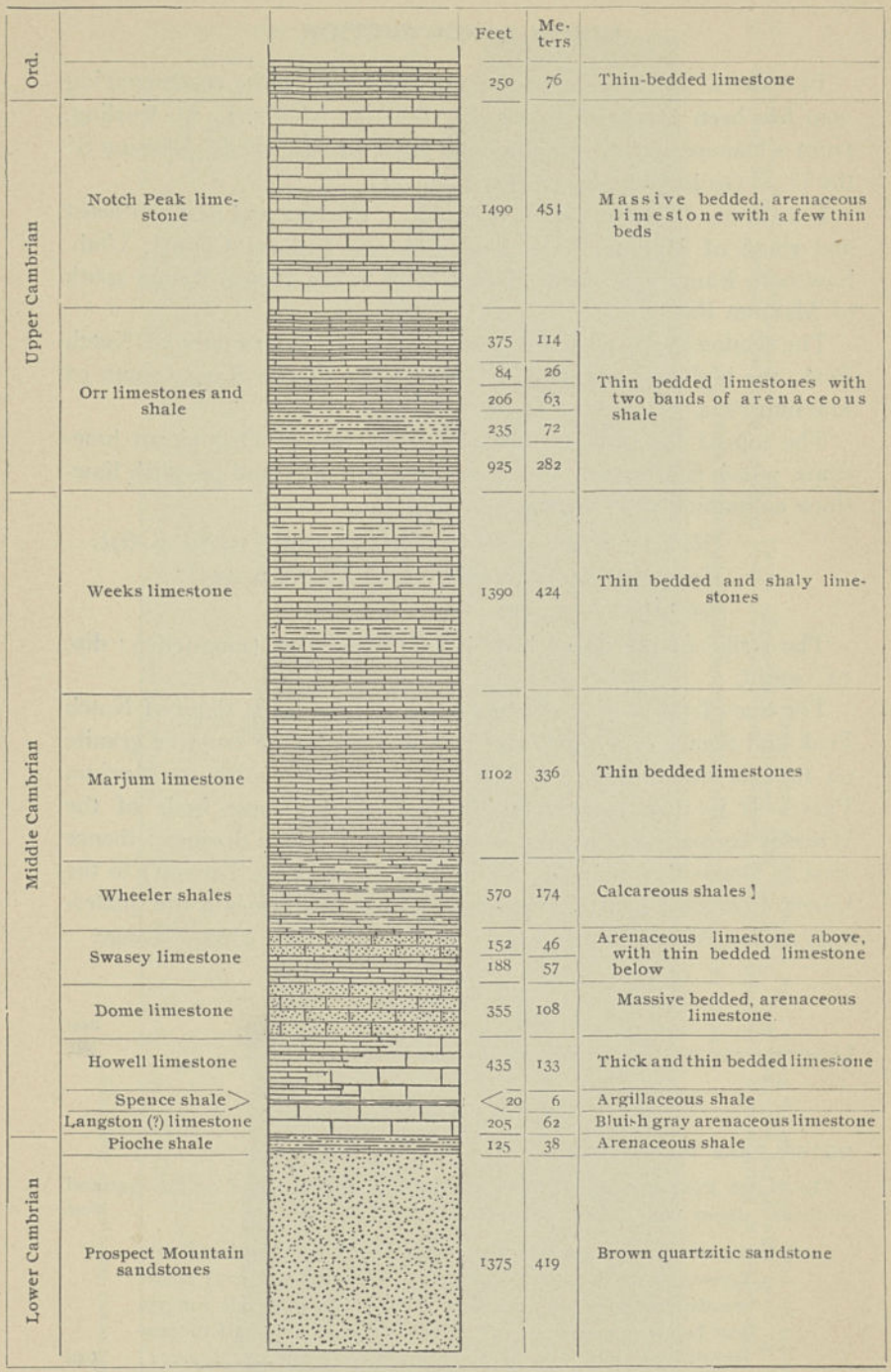


FIG. 6.—House Range Section.

NOTCH PEAK FORMATION (continued):

1*a* (continued): Feet

Fauna:
Lingulella isse (Walcott) [1905, p. 330].
Dicellocephalus ? sp. ?

A drift boulder found 2.5 miles from the peak, and on its eastern drainage slope, and similar in its lithological appearance to the gray, arenaceous limestone of this horizon, contained the following fossils:

Eoorthis coloradoensis (Meek) [1870, p. 425].
Schizambon typicalis Walcott [1884, p. 70].
Agraulos.
Solenopleura.
Illænurus.

Another drift boulder was found near this with slightly different fauna.
Crepicephalus.
Ptychoparia.

1*b*. Shaly, dark gray to bluish gray, arenaceous limestone, with small dark concretions in some layers..... 90
No fossils observed.

1*c*. Gray, siliceous limestone in layers of varying thickness, 4 inches to 2 feet, banded with dark cherty layers and purer arenaceous limestone. The chert takes the form of flattened nodules and very thin irregular layers..... 340

1*d*. Shaly and thin-bedded, bluish gray, arenaceous limestone..... 65

1*e*. Gray, siliceous limestone in layers 2 inches to 2 feet thick. In the lower part of this limestone, where it is not metamorphosed, it is dove-colored and in layers 6 inches to 3 feet thick. There are occasional occurrences of gray, cherty matter, as flattened nodules, and thin layers that weather a dark brown 355

Fauna (about 120 to 150 feet from the base):
Obolus tetonensis leda Walcott [1908*d*, p. 63].
Fragments of the free cheek of a trilobite.

Total of Notch Peak formation..... 1,490

ORR FORMATION:

The section is carried along the strike of the exposed strata two miles east to the west side of Orr Ridge, where the rocks of the Orr formation [Walcott, 1908*a*, p. 10] are unmetamorphosed and present the following characters:

Feet

1*a*. Bluish gray to gray, compact limestone in layers 1 inch to 2 feet thick. On weathering the thicker layers break down into thin, irregular layers, which form a talus of angular fragments 375

ORR FORMATION (continued):

1*a* (continued): Feet

Fauna:
Fragments of trilobites.

1*b*. Sandy and siliceous, bluish and drab-colored shales, with interbedded bands of dark, bluish gray limestone 6 inches to 2 feet thick 84

Fauna:
Section of crinoid column.
Lingulella manticula (White) [1874, p. 9].
Lingulella isse (Walcott) [1905, p. 330].
Obolus rotundatus (Walcott) [1898, p. 415].
Ptychaspis.
Anomocare.

1*c*. Lead-colored, finely oölitic, and arenaceous limestone in layers 4 inches to 2 feet thick that are obscurely banded by thin strips of light and dark gray color..... 91

Fauna:
Fragments of trilobites.

1*d*. Bluish gray, compact limestone in layers 2 inches to 4 feet thick that break down into irregular, thin layers on weathering... 115

Fauna (near base):
Fragments of trilobites.
Linnarssonella modesta Walcott [1908*d*, p. 90].
Linnarssonella nitens Walcott [1908*d*, p. 91].
Solenopleura.

1*e*. Dirty brown and bluish black, arenaceous shales, with thin nodules of gray, fossiliferous limestone in some horizons; also a few layers of bluish gray limestone 4 inches to 8 inches thick 235

Fauna (near the top):
Linnarssonella modesta Walcott [1908*d*, p. 90].
Lingulella isse (Walcott) [1905, p. 330].
Ptychoparia?
Solenopleura.

Fauna (near the base):
Micromitra (*Paterina*) *crenistria ?* (Walcott) [1897, p. 713].
Obolus mcconnelli pelias (Walcott) [1905, p. 330].
Lingulella desiderata (Walcott) [1898, p. 399].
Lingulella isse (Walcott) [1905, p. 330].
Linnarsonella transversa Walcott [1908*d*, p. 92].
Agnostus.
Crepicephalus.

2*a*. Gray, slightly arenaceous limestone in layers 2 to 6 feet thick, weathering lead gray. (Cliff-forming beds.)..... 590

ORR FORMATION (continued):

	Feet
2*a* (continued):	
Fauna (at base): *Lingulella desiderata* (Walcott) [1898, p. 399]. *Acrotreta idahoensis* Walcott [1902, p. 587]. *Crepicephalus texanus* (Shumard) [1861, p. 218]. *Bathyuriscus.* *Illænurus ??*	
Fauna (275 feet above base): *Agraulos.* *Crepicephalus texanus* (Shumard) [1861, p. 218]. *Illænurus.*	
2*b*. Gray limestone and dark gray chert in alternating layers, one-half to 2 inches thick. The irregular cherty layers weather in relief as dark brown bands and the limestone as lead-colored bands, which give a very characteristic banded appearance to the cliff	170
2*c*. Gray, arenaceous limestone in massive beds that usually break up, on weathering, into irregular layers one-fourth to 4 inches thick. The upper 20 feet form a more massive, solid bed than the layers below	165
Fauna: Traces of trilobites and brachiopods.	
Total of Orr formation	1,825
Total Upper Cambrian	3,315

MIDDLE CAMBRIAN

WEEKS FORMATION:

The Weeks formation [Walcott, 1908*a*, p. 10] is exposed at Weeks Canyon (see pl. 13) from beneath the massive limestone on the south side of the canyon to the top of the cliffs on the south side of Marjum Pass. Average dip, 12°; strike, north 20° east (magnetic).

	Feet
1*a*. Thin-bedded limestones in layers 1 to 4 inches thick. The limestone is mainly fine-grained, dark gray, weathering lead-colored, except on bedding planes, where it is usually more or less pinkish colored	245
Fauna: Fragments of trilobites and brachiopods of the fauna in shaly limestone in 1*b*.	
1*b*. Shaly limestone, usually dark gray, with pinkish tinge in some layers and on the surfaces; sometimes buff yellow on weathering. The shales vary from one-eighth to 1 inch thick. This is a marked band in some sections and is arbitrarily separated from the shaly beds below	285

WEEKS FORMATION (continued):

	Feet
1*b* (continued):	
Fauna:	
The fauna ranges through about 100 feet of the lower portion of this division.	
Obolus (*Fordinia*) *perfectus* Walcott [1908*d*, p. 65].	
Agnostus (2 species).	
Ptychoparia.	
Crepicephalus texanus (Shumard) [1861, p. 218].	
Anomocare.	
Bathyuriscus.	
Asaphiscus minor, new species.	
The fauna is much like that of 1*c*. Its most characteristic trilobite is *Asaphiscus minor,* new species.	
1*c*. Shaly, bluish gray to dark gray limestone in layers one-eighth to 1 inch thick, with occasional layers 2 to 6 inches thick; 25 feet from the top a band of layers of arenaceous, dirty gray, finely oölitic limestone, 3 feet thick, occurs, and a second similar band 38 feet below.....	170
Fauna:	
The fauna is rich in numbers of specimens and quite varied. The best specimens occur on the surface of the shaly layers in the lower portion of the division.	
Lingulella isse (Walcott) [1905, p. 330].	
Obolus (*Fordinia*) *perfectus* Walcott [1908*d*, p. 65].	
Acrotreta ophirensis Walcott [1902, p. 591].	
Acrotreta ophirensis descendens Walcott [1908*d*, p. 94].	
Hyolithes.	
Agnostus (several species).	
Ptychoparia (several species).	
Crepicephalus texanus (Shumard) [1861, p. 218].	
Solenopleura.	
Asaphiscus minor, new species.	
1*d*. Reddish tinted, more or less arenaceous, shaly limestone.....	30
Fauna:	
Same as 1*c*, but not abundant.	
1*e*. Shaly, bluish gray to dark gray limestone, similar to 1*c*.....	270
Fauna:	
Same as that of 1*c*.	
1*f*. Evenly bedded, bluish gray to dark gray, fine-grained limestone, in layers 2 to 16 inches thick, with shaly limestone partings	330
Fauna:	
A few traces of *Agnostus* and *Ptychoparia* similar to those above.	
1*g*. Calcareous shales with thin layers of limestone.....	60
Total thickness of Weeks formation.....	1,390

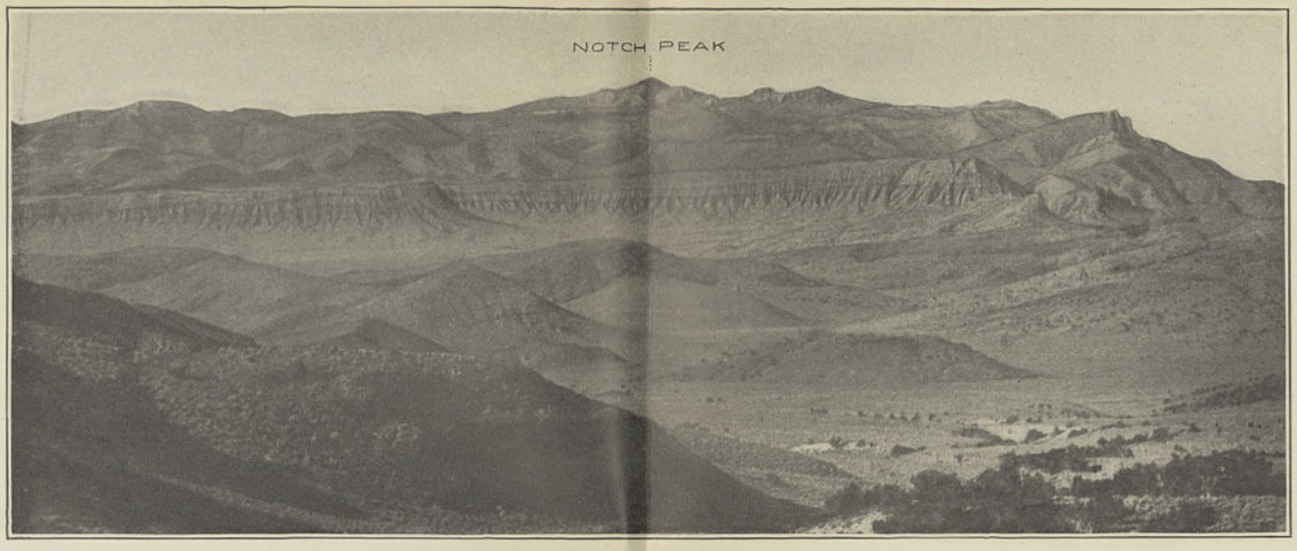


Fig. 1. VIEW FROM THE NORTHEAST OF THE EASTERN SIDE OF THE HOUSE RANGE SOUTH OF MARJUM PASS, UTAH

The rounded hills of the foreground are eroded in the Wheeler shales. The Marjum limestone forms the long horizontal cliff, and back of this the Cambrian limestones of the Weeks, Orr, and Notch Peak formations, 4,700 feet thick, continue on up to near the summit of Notch Peak, which is capped by 285 feet of Ordovician limestone.

Fig. 2. PANORAMIC VIEW OF RIDGE EAST AND SOUTHEAST OF ANTELOPE SPRINGS

Looking across Wheeler Amphitheater, House Range. The Wheeler shale extends to the base of the low foothills and the Marjum formation to the summit of the ridge. The best known fossil localities in the Marjum formation are on the slopes of the mountain on the left side of the illustration.

MARJUM FORMATION:

The Marjum formation [Walcott, 1908*a*, p. 10] is exposed in the cliffs southeast of Marjum Pass and in the ridge east of Wheeler Amphitheater.

Feet

1*a*. Gray, more or less thin-bedded limestone that weathers to a dark lead-gray color and breaks down into angular fragments one-half to 2 inches thick.
Flattened cherty nodules and thin, irregular cherty layers occur at intervals 305

Fauna (in upper 100 feet):
Obolus mcconnelli pelias (Walcott) [1905, p. 330].
Obolus (Fordinia) gilberti Walcott [1908*d*, p. 65].
Obolus (Fordinia) perfectus Walcott [1908*d*, p. 65].
Acrotreta bellatula Walcott [1908*d*, p. 93].
Acrotreta marjumensis Walcott [1908*d*, p. 94].
Acrotreta cf. *sagittalis* Salter [1866, p. 285].
Agnostus (4 species).

Fauna (central portion):
Micromitra sculptilis Meek [1873, p. 479].
Lingulella arguta (Walcott) [1898, p. 396].
Dicellomus prolificus Walcott [1908*d*, p. 77].
Acrotreta attenuata Meek [1873, p. 463].
Acrotreta bellatula Walcott [1908*d*, p. 93].
Agnostus.
Ptychoparia.
Anomocare.

Fauna (near base):
Micromitra (Iphidella) pannula ophirensis (Walcott) [1905, p. 306].
Obolus mcconnelli pelias (Walcott) [1905, p. 330].
Obolus rotundatus (Walcott) [1898, p. 415].
Hyolithes.
Ptychoparia.
Anomocare.

1*b*. Alternating bands of dark, blue-gray, compact limestone in massive layers that break up into thin irregular layers; and gray arenaceous limestone in layers 1 to 8 inches thick.

	Feet
1. Gray limestone	35
2. Blue-gray limestone	7
3. Gray arenaceous limestone.....	95
4. Blue-gray limestone	12
5. Gray arenaceous limestone.....	90
6. Blue-gray limestone	8
	247

Fauna:
Ptychoparia, sp. undt.

1*c*. Dark and light-gray, thin-bedded limestone, more or less arenaceous 250

MARJUM FORMATION (continued):

1*c* (continued): Feet

Fauna (near top):
Acrotreta pyxidicula White [1874, p. 9].
Agnostus.
Ptychoparia like *P. kingi* (Meek) [1870, p. 63].

Fauna (in central portion, though ranging through 100 to 150 feet of the thin-bedded shaly limestone):
Obolus mcconnelli pelias (Walcott) [1905, p. 330].
Lingulella arguta (Walcott) [1898, p. 396].
Acrothele subsidua (White) [1874, p. 6].
Acrotreta ophirensis ? Walcott [1902, p. 591].
Eoorthis thyone Walcott [1908*d*, p. 105].
Nisusia (Jamesella) nautes (Walcott) [1905, p. 283].
Nisusia (Jamesella) spencei (Walcott) [1905, p. 285].
Hyolithes.
Agnostus (2 species).
Ptychoparia (3 species).
Solenopleura.
Owenella typa, new genus and new species.
Neolenus inflatus Walcott [1908*b*, p. 30].
Neolenus intermedius Walcott [1908*b*, p. 34].
Neolenus intermedius pugio Walcott [1908*b*, p. 35].
Neolenus superbus Walcott [1908*b*, p. 36].
Ogygopsis?

1*d*. Gray, shaly limestone, passing below into shales, interbedded in the shaly limestone, and at 75 feet from the top into drab argillaceous shales 105

Fauna:
Micromitra (Iphidella) pannula ophirensis (Walcott) [1905, p. 306].
Micromitra sculptilis Meek [1873, p. 479].
Obolus mcconnelli pelias (Walcott) [1905, p. 330].
Obolus rotundatus (Walcott) [1898, p. 415].
Lingulella arguta (Walcott) [1898, p. 396].
Acrotreta attenuata Meek [1873, p. 463].
Acrotreta ophirensis Walcott [1902, p. 591].
Acrothele subsidua (White) [1874, p. 6].
Acrothele subsidua lævis, new variety.
Eoorthis remnicha (N. H. Winchell) [1886, p. 317].
Eoorthis thyone Walcott [1908*d*, p. 105].
Syntrophia unxia Walcott [1908*d*, p. 105].
Agnostus (3 species).
Ptychoparia.
Owenella typa, new genus and new species.
Neolenus inflatus Walcott [1908*b*, p. 30].
Neolenus intermedius Walcott [1908*b*, p. 34].
Neolenus superbus Walcott [1908*b*, p. 36].
Ogygopsis?

MARJUM FORMATION (continued):

Feet

1*e*. Dark, bluish gray limestone in thick beds that break up on weathering into thin, irregular layers one-half to 2 inches thick 195

Fauna:
Linnarssonella sp.
Agnostus.
Ptychoparia.
Ogygopsis.

Total thickness of Marjum formation..... 1,102

WHEELER FORMATION:

The Wheeler formation [Walcott, 1908*a*, p. 10] is exposed at Marjum Pass, but the type locality is in Wheeler Amphitheater, southeast of Antelope Springs. The section was measured south from the ridge south of the lower springs of Antelope Springs.

Feet

1. Alternating bands of thin, shaly limestone and calcareous shale, with shale gradually increasing and predominating toward the lower portion. At 405 feet from top a band of blue-gray, hard limestone, in layers one-eighth to 2 inches thick, occurs. At 473 feet another band, and below an occasional thin layer..... 570

Fauna:
Acrothele subsidua (White) [1874, p. 6].
Agnostus bidens Meek [1873, p. 463].
Asaphiscus wheeleri Meek [1873, p. 485].
Ptychoparia kingi (Meek) [1870, p. 63].

These species occur in great numbers at 230 feet to 350 feet from the base. Many hundred trilobites, entire and backed by "cone-in-cone," have been picked up on the surface of the clay, resulting from the disintegration of the shales.

Obolus mcconnelli pelias Walcott and *Acrotreta attenuata* Meek occur more rarely.

SWASEY FORMATION:

The section of the Swasey formation [Walcott, 1908*a*, p. 11] is exposed on the southwest ridge of Swasey Peak.

Feet

1*a*. Oölitic and arenaceous limestone in massive layers near the top. Below, dark bluish gray limestone is occasionally interbedded, and gradually it becomes the principal rock; it breaks up on weathering into irregular, shaly layers one-half to 3 inches thick..... 152

Fauna (near the top):
Platyceras.
Zacanthoides.
Fauna (near the base):
Scenella.
Zacanthoides.
Ptychoparia.
Dorypyge.

SWASEY FORMATION (continued):

	Feet
1*b*. Drab and reddish argillaceous shales, with interbedded, thin layers of fossiliferous limestone	63
1*c*. Dark, bluish gray limestone in massive layers that break up into irregular, shaly layers one-fourth to 2 inches thick	17
1*d*. Calcareous and argillaceous shales with thin layers of gray limestone	102

Fauna:
Micromitra (*Paterina*) *labradorica utahensis* (Walcott) [1905, p. 306].
Lingulella arguta (Walcott) [1898, p. 396].
Ptychoparia (2 species).

1*e*. Bluish gray limestone in layers 4 to 10 inches thick, with numerous concretions from one-eighth to 1 inch in diameter, in a few layers	6

Fauna:
Obolus (*Westonia*) *ella* (Hall and Whitfield) [1877, p. 232].
Ptychoparia (3 species).

Total of Swasey formation	340

DOME LIMESTONE:

The section of the Dome limestone [Walcott, 1908*a*, p. 11] is exposed in the central portion of Dome Canyon and adjoining cliffs.

	Feet
Massive bedded, cliff-forming, gray, siliceous limestone, with small specks of calcite. One hundred feet from the top, and for 50 feet below, occasional layers 15 inches to 2 feet thick, of brownish yellow, arenaceous limestone, occur	355

HOWELL FORMATION:

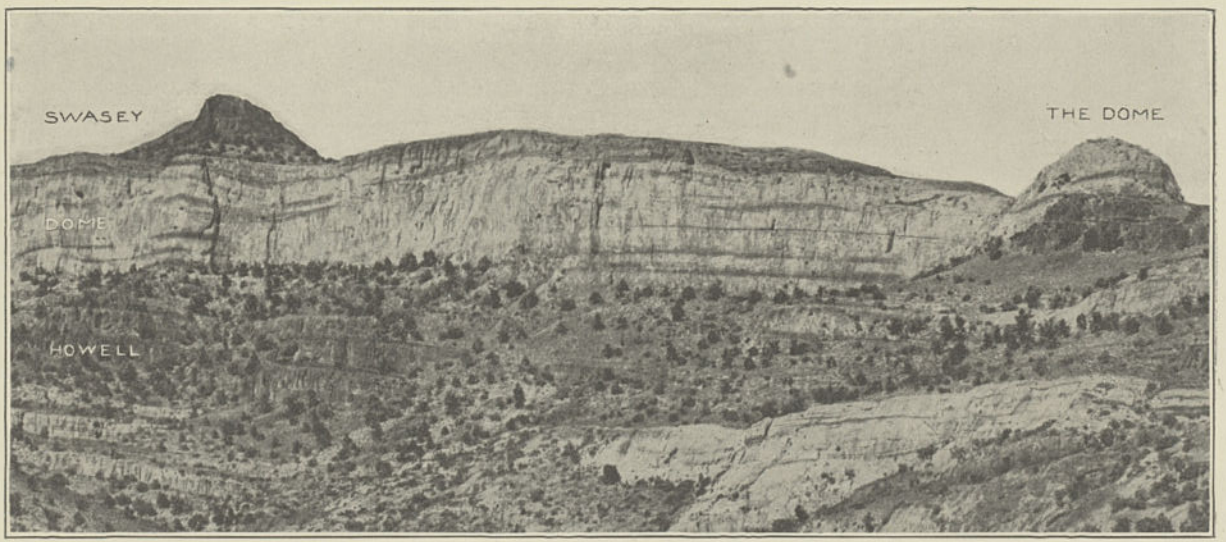
The section of the Howell formation [Walcott, 1908*a*, p. 11] is exposed on the west face of the House Range at Howell Mountain.

	Feet
1*a*. Bluish black limestone in massive layers that break up on weathering into irregular, thin layers	50

Fauna (in shaly bed at top of 1*a*):
Micromitra (*Iphidella*) *pannula* (White) [1874, p. 6].
Acrotreta cf. *ophirensis* Walcott [1902, p. 591].
Ptychoparia.

1*b*. Gray, siliceous limestone	8
1*c*. Bluish black limestone, similar to 1*a*	105
1*d*. Pinkish colored, argillaceous shale with interbedded, thin layers of limestone	10

Fauna:
Micromitra (*Iphidella*) *pannula* (White) [1874, p. 6].
Obolus (*Westonia*) *ella* (Hall and Whitfield) [1877, p. 232].
Acrotreta cf. *ophirensis* Walcott [1902, p. 591].
Scenella.
Hyolithes.
Zacanthoides.
Bathyuriscus.



VIEW OF THE NORTH SIDE OF DOME CANYON BELOW DOME PASS, HOUSE RANGE

The dark Swasey limestone forms the dark peak at the left. This rests on the light gray cliff of Dome limestone, below which the Howell formation breaks down. A mass of the Dome limestone has been displaced in the foreground by a fault between it and the cliff. The dome from which the canyon formation takes its name is shown at the right.

HOWELL FORMATION (continued):

	Feet
1*e*. Gray, siliceous limestone in layers 2 to 10 inches thick	70
1*f*. Bluish black limestone in massive layers, breaking up into thin layers on weathering	102

Fauna:
Ptychoparia.
Bathyuriscus.

1*g*. Gray, siliceous limestone in thick beds	90
Total of Howell formation	435

Spence shale:

The Spence shale [Walcott, 1908*a*, p. 8] is exposed on the east side of Dome Canyon a little above where it bends to the westward.

	Feet
1. Pinkish, argillaceous shale	20

Fauna:
Micromitra (*Iphidella*) *pannula* (White) [1874, p. 6].
Obolus (*Westonia*) *ella* (Hall and Whitfield) [1877, p. 232].
Lingulella dubia (Walcott) [1898, p. 401].
Acrothele subsidua (White) [1874, p. 6].
Hyolithes billingsi Walcott [1886, p. 134].
Ptychoparia piochensis Walcott [1886, p. 201].
Ptychoparia sp.
Zacanthoides typicalis (Walcott) [1886, p. 183].
Bathyuriscus productus (Hall and Whitfield) [1877, p. 244].

LANGSTON (?) FORMATION:

The section of the beds which are doubtfully placed in the Langston formation [Walcott, 1908*a*, p. 8] was measured at the same locality as the Spence shale.

	Feet
1*a*. Massive bedded, bluish gray, arenaceous limestone, with irregular partings of buff-colored arenaceous limestone. The latter penetrates the layers of limestone in the most irregular manner and frequently surrounds small, irregular nodules of the bluish gray limestone	170

Fauna:
Billingsella, sp. undt.
Platyceras.
Hyolithes.
Leperditia.
Ptychoparia.
Zacanthoides.
Dorypyge?

1*b*. Brown, buff weathering, arenaceous limestone in thick layers; almost sandstone in places	35
Total of Langston (?) formation	205
Total Middle Cambrian	4,417

LOWER CAMBRIAN

PIOCHE FORMATION:

The Pioche formation [Walcott, 1908*a*, p. 11] is exposed at the westward bend of Dome Canyon.

	Feet
1. Arenaceous and siliceous shaly layers, with some thicker layers of quartzitic sandstone	125

Fauna:
Annelid trails.
Trilobite tracks (*Cruziana*).

Southwest of Pioche, Nevada, on the Panaca Road, this formation contains the following fauna:

Eocystites ? longidactylus Walcott [1886, p. 94].
Obolus (*Westonia*) *ella* (Hall and Whitefield) [1877, p. 232].
Micromitra (*Iphidella*) *pannula* (White) [1874, p. 6].
Acrothele subsidua (White) [1874, p. 6].
Acrothele subsidua hera Walcott [1908*d*, p. 87].
Acrothele spurri Walcott [1908*d*, p. 86].
Acrotreta primæva Walcott [1902, p. 593].
Billingsella highlandensis (Walcott) [1886, p. 119].
Hyolithes billingsi Walcott [1886, p. 134].
Olenellus gilberti Meek [1874, p. 7].
Zacanthoides levis (Walcott) [1886, p. 187].
Crepicephalus augusta Walcott [1886, p. 208].
Crepicephalus liliana Walcott [1886, p. 207].

PROSPECT MOUNTAIN FORMATION:[1]

The Prospect Mountain formation [see Walcott, 1908*a*, p. 12] is exposed on the west slope and foothills of the House Range north and south of Dome Canyon.

	Feet
1. Gray and brownish quartzitic sandstone in layers 4 inches to three feet in thickness	1,375+
Total Lower Cambrian	1,500+

RÉSUMÉ, HOUSE RANGE SECTION

	Feet	Feet
UPPER CAMBRIAN:		
Notch Peak formation	1,490	
Orr formation	1,825	
Total		3,315

[1] As the result of conference with Mr. Arnold Hague, the following formation names are given for formations in the Eureka section (see Walcott, 1884, p. 284): Eldorado limestone replaces Prospect Mountain limestone; Dunderberg shale replaces Hamburgh shale, the name Hamburgh being retained for the Hamburgh limestone.

TATOW KNOB

WEST FACE OF HOUSE RANGE BENEATH TATOW KNOB

The Prospect Mountain formation forms the lowest beds, and above, the Pioche shale of the Lower Cambrian, then in turn the limestones of the Langston and Howell formations separated by a narrow band of Spence shale, and above, the Dome and Swasey limestones. Tatow is a word of Indian derivation signifying "nipple", and the topographic feature to which it refers is locally known as "Mollie's Nipple."

RÉSUMÉ, HOUSE RANGE SECTION (continued):

	Feet
MIDDLE CAMBRIAN:	
Weeks formation	1,390
Marjum formation	1,102
Wheeler formation	570
Swasey formation	340
Dome formation	355
Howell formation	435
Spence shale	20
Langston (?) formation	205
Total	4,417
LOWER CAMBRIAN:	
Pioche formation	125
Prospect Mountain formation (estimated)	1,375+
Total	1,500+
Total section	9,232+

WAUCOBA SPRINGS SECTION

LOCALITY.—East of Waucoba Springs, on the Saline Valley road, east of the Inyo Range, Inyo County, California.

LOWER CAMBRIAN

SILVER PEAK GROUP:[1]

	Feet
1*a*. Bluish gray, compact limestone with irregular, inosculating threads and stringers of yellowish to buff magnesian limestone. Immense numbers of dark concretions one-fourth to one inch in diameter occur in the greater proportion of the layers. The latter vary from 6 inches to 2 feet in thickness..	525
Fauna: Sections of a calcareous brachiopod and a large *Orthotheca*-like shell occur about 50 feet from the base.	
1*b*. Light bluish gray limestone	115
1*c*. Massive bedded, dark bluish gray limestone	60
1*d*. Lead-colored, arenaceous limestone, with layers of sandstone 1 to 2 inches thick in bands in lower portion, with a band of cross-bedded buff calcareous sandstone about 50 feet from the base. Layers of bluish gray limestone, banded dark and light gray limestone, and a few layers of brown, quartzitic sandstone occur at irregular intervals	340

[1] The name Silver Peak was first used by Mr. H. W. Turner in describing the Cambrian rocks of Esmeralda County, Nevada. American Geologist, XXIX, 1902, pp. 264–265.

SILVER PEAK GROUP (continued):

	Feet
1d (continued):	
Fauna (105 feet from the base): *Salterella.* *Holmia weeksi,* new species. Total of 1	1,040
2a. Dark, siliceous, indurated shales, shaly sandstone and quartzitic sandstone in alternating layers	35
Fauna: Annelid trails. *Cruziana.*	
2b. Buff, drab, and bluish gray arenaceous limestone alternating in layers and bands	120
2c. Gray and dirty brown sandstones, with bands of light gray quartzitic sandstones	125
2d. Gray limestone, becoming arenaceous and passing into gray and dirty brown sandstone	105
Fauna: Traces of fragments of trilobites on the surface of the sandstone.	
2e. Gray and dirty brown, compact sandstone in layers from 2 inches to 2 or 3 feet in thickness. In the lower portion of the strata are layers of massive bedded, gray quartzitic sandstone. Small concretions 1 to 2 millimeters in diameter are very abundant in many of the upper layers	365
2f. Hard, brown and gray, shaly sandstones, with an occasional irregular, thin layer of bluish gray limestone	155
2g. Bluish gray arenaceous limestone in thick layers	25
2h. Greenish-colored arenaceous shale	120
2i. Alternating bands of arenaceous shale and massive bedded, gray, quartzitic sandstones	430
Fauna: *Scolithus* occurs abundantly in many of the quartzitic sandstones.	
Fauna (50 feet from the top): *Salterella.* *Olenellus* (fragments).	
2j. Gray quartzitic sandstones in layers 8 inches to 3 feet in thickness, passing below 35 feet into buff to yellowish shale with greenish buff bands, with some interbedded, gray, quartzitic sandstones	485
Fauna (in quartzitic layers): *Scolithus* like *S. linearis* Haldeman [see Walcott, 1891, p. 603].	
Fauna (in lower portion): *Obolella,* sp. undt. *Holmia rowei,* new species.	

LOWER CAMBRIAN QUARTZITES

Showing vertical cleavage in massive layers and interbedded thin layers without cleavage. Soldiers Canyon, above Deep Spring Valley, White Mountain range, Inyo County, California.

SILVER PEAK GROUP (continued):

	Feet
2j (continued):	
Near Resting Springs, in the Kingston Range, and at about this horizon, Mr. R. B. Rowe collected the following: *Billingsella highlandensis* (Walcott) [1886, p. 119]. *Holmia weeksi,* new species. *Olenellus frêmonti,* new species.	
2k. Gray and brownish gray quartzitic sandstones in layers 6 inches to 3 feet in thickness	790
Fauna: Annelid trails on the surface of the layers.	
Total of 2	2,755
3a. At summit a band of bluish gray limestone, with sandstones and occasional layers of thin-bedded limestone below. At 290 feet down a band of arenaceous limestone 50 feet thick occurs. Below this, brown sandstone and sandy shales, with interbedded thin layers of limestone in the lower 100 feet	650
Fauna (430 feet from the base): Numerous fragments of *Olenellus.*	
3b. Argillaceous and sandy shale, with a few thin beds of limestone	200
Fauna (160 feet from base): *Obolella,* sp. undt. *Trematobolus excelsis* Walcott [1908*d,* p. 80].	
3c. Alternating arenaceous limestones, shales, and dirty brown sandstones that break into angular blocks and fragments...	575
Fauna (275 feet from base): *Archæocyathus* is very abundant.	
3d. Shaly indurated sandstones, with a few thicker layers of almost quartzitic sandstone	450+
Fauna (on west slope of hill just east of the summit, where the Saline Valley wagon road passes down the slope toward Waucoba Springs): Annelid trails. *Cruziana.* *Trematobolus excelsis* Walcott [1908*d,* p. 80]. *Holmia rowei,* new species.	
Fauna (on the east side of the hill and in lower portion of *3d*): *Archæocyathus.* *Ethmophyllum gracile* Meek [1868, p. 62]. *Mickwitzia occidens* Walcott [1908*d,* p. 54]. *Obolella,* sp. undt.	

SILVER PEAK GROUP (continued):

	Feet
3d (continued):	
Trematobolus excelsis Walcott [1908*d*, p. 80].	
Hyolithes sp.	
Holmia rowei, new species.	
Total of 3	1,875+
Total of section	5,670+

In this section the genus *Olenellus* is found extending through 4,900 feet of strata and its lower limit is unknown.

RÉSUMÉ, WAUCOBA SPRINGS SECTION

	Feet	Feet
1*a*. Limestone	525	
1*b*. Limestone	115	
1*c*. Limestone	60	
1*d*. Arenaceous limestone	340	
		1,040
2*a*. Shales	35	
2*b*. Arenaceous limestone	120	
2*c*. Sandstone	125	
2*d*. Arenaceous limestone	105	
2*e*. Sandstone	365	
2*f*. Sandstone	155	
2*g*. Arenaceous limestone	25	
2*h*. Shale	120	
2*i*. Shale and sandstone	430	
2*j*. Sandstone and shale	485	
2*k*. Quartzitic sandstone	790	
		2,755
3*a*. Shales, limestone, and sandstone	650	
3*b*. Shaly sandstone	200	
3*c*. Arenaceous limestone and shaly sandstone	575	
3*d*. Hard sandstones	450+	
		1,875+
Total		5,670+

BARREL SPRING SECTION

A section of Lower Cambrian strata studied by Mr. F. B. Weeks near Barrel Spring, 16 miles south of the town of Silver Peak, Nevada, is much like that east of Waucoba Springs, and has about the same fauna at various horizons in it.

	Feet
1. Massive blue mottled limestone, with 50 feet of sandy limestone in the middle of the series	737
Fauna:	
Archæocyathus and allied forms occur throughout this limestone.	

		Feet
2.	Sandy shales succeeded by coarse, thin, fine sandstone, with buff limestones at top	206
	Fauna (in limestone):	
	Micromitra (*Paterina*) *prospectensis* (Walcott) [1884, p. 19].	
	Nisusia (*Jamesella*) *amii* Walcott [1905, p. 252].	
	Scenella, sp.	
	Agraulos?	
	Olenellus gilberti Meek [1874, p. 7].	
3.	Green calcareous shale, arenaceous at top	390
	Fauna:	
	Archæocyathus ?	
	Kutorgina cingulata (Billings) [1861, p. 8].	
	Kutorgina perugata Walcott [1905, p. 310].	
	Siphonotreta ? dubia, new species.	
	Acrotreta claytoni Walcott [1902, p. 583].	
	Acrothele spurri ? Walcott [1908*d*, p. 86].	
	Swantonia weeksi Walcott [1905, p. 297].	
	Swantonia ? sp.	
	Stenotheca cf. *elongata* Walcott [1884, p. 23].	
	Stenotheca cf. *rugosa* (Hall) [1847, p. 306].	
	Salterella.	
	Ptychoparia sp.	
	Holmia rowei, new species.	
	Holmia weeksi, new species.	
4.	Massive blue mottled limestone	49
5.	Mainly green shales, some quartzitic shale, bands of limestone at top	580
6.	Green calcareous shale, with bands of limestone at top	564
	Fauna:	
	Salterella sp.	
	Holmia weeksi, new species.	
	Olenellus claytoni, new species.	
7.	Andesite mass	750
8.	Massive blue mottled limestone	81
9.	Green calcareous shales	238
10.	Mostly thin-bedded blue and gray shaly quartzites	904
11.	Siliceous limestones at base, then blue coral limestones	1,349
	Holmia weeksi, new species.	
	Olenellus, sp.	
12.	Massive quartzites, shaly in places	222
	Fauna:	
	Holmia rowei, new species.	
	Holmia weeksi, new species.	
13.	Siliceous buff limestones	180
	Total	6,250

Base unknown.

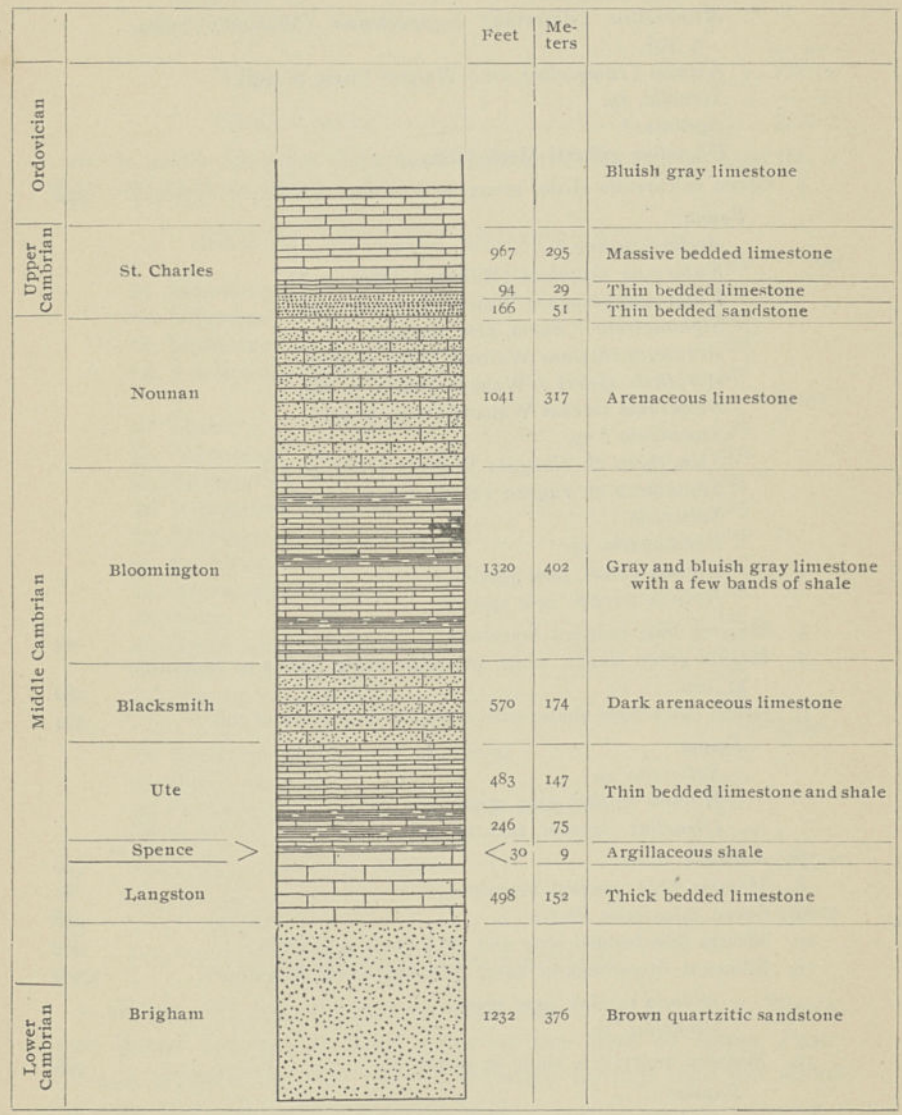


FIG. 7.—Blacksmith Fork Section

BLACKSMITH FORK SECTION

LOCALITY.—Wasatch Mountains, between Ute and Logan Peaks, in Blacksmith Fork Canyon, east side of Cache Valley, and 12 to 16 miles east of Hyrum, in northern Utah.

This section is 230 miles northeast of the House Range section and north of the greater effect of the pre-Cambrian Uinta Mountain uplift and island. The character of the sediments derived from the Uinta area is shown by the continuation of the arenaceous deposits up to the middle of the Middle Cambrian (Acadian) time, whereas in the House Range section the arenaceous deposits cease before the Middle Cambrian fauna appears. It is not until after the Belt Mountain and Kintla (of the 49th parallel) uplifts to the north are passed that the order of sedimentation, as shown in the Mount Bosworth section, is again of the type of that of the House Range section.

ORDOVICIAN

Feet

1. Dark, bluish black and gray limestone. In the basal bed immediately above the Cambrian a fine fauna occurs. The limestone is of the same character as that of the Upper Cambrian for 190 feet below and, except for the change in the fauna, there is no break in the section. One of the characters common to the Cambrian and the superjacent Ordovician is the presence in most layers of flattened concretionary nodules and stringers from a minute size up to 6 or 8 cm. or more in diameter; the large ones rarely exceed 3 to 10 mm. in thickness.

   Fauna:
   Eoorthis coloradoensis (Meek) [1870, p. 425].
   Syntrophia nundina Walcott [1905, p. 292].
   Orthoceras.
   Endoceras.
   Fragments of trilobites.

UPPER CAMBRIAN

ST. CHARLES FORMATION [Walcott, 1908*a*, p. 6]:

1. Dark bluish gray and gray limestone in layers varying from 1 to 20 inches in thickness. Many of the layers are almost made up of flattened concretions varying from a minute size to 6 or 8 cm..... 190

   Fauna (25 feet below the top):
   Lingulella manticula (White) [1874, p. 9].
   Eoorthis coloradoensis (Meek) [1870, p. 425].
   Syntrophia nundina Walcott [1905, p. 292].
   Dicellocephalus.

ST. CHARLES FORMATION (continued):

1 (continued): Feet

Fauna (105 to 125 feet below the top):
Schizambon typicalis Walcott [1884, p. 70].
Eoorthis coloradoensis (Meek) [1870, p. 425].
Eoorthis newberryi Walcott [1908*d*, p. 105].
Syntrophia nundina Walcott [1905, p. 292].
Solenopleura.
Menocephalus.
Illænurus.

Fauna (20 to 30 feet above base):
Lingulella (*Lingulepis*) *acuminata* (Conrad) [1839, p. 64].
Eoorthis coloradoensis (Meek) [1870, p. 425].
Eoorthis newberryi Walcott [1908*d*, p. 105].
Agnostus.
Solenopleura.
Menocephalus.
Asaphus?
Fragments of fossils occur throughout.

2*a*. Massive bedded, dark lead-gray, arenaceous, cliff-forming limestone, becoming thinner bedded in the lower 50 feet..... 195

2*b*. Massive bedded, gray, arenaceous limestone with occasional irregular cherty layers which extend down 85 feet, and just below this the dark, arenaceous limestone is almost made up of round concretions 2 to 4 mm. in diameter for a thickness of about 15 feet..... 100

2*c*. Gray, siliceous, and arenaceous limestone in layers one-half inch to 6 inches thick, occurring in massive bands. Light gray chert fills large and small annelid borings, and it also occurs as flattened stringers in the line of the bedding and in the layers..... 85

Fauna (34 feet from the base):
Obolus (*Westonia*) *iphis*, new species.
Lingulella desiderata (Walcott) [1898, p. 399].

2*d*. Massive bedded, arenaceous limestone, forming broken cliffs. A few cherty nodules occur near the top and the lower 50 feet has many irregular, oval cherty nodules and stringers of chert coincident with the bedding..... 397

Total of 2..... 777

3. Bedded, bluish gray fossiliferous limestone..... 94

Fauna (upper part):
Acrotreta sp.
Anomocare.

Fauna (near base):
Obolus, sp. undt.
Lingulella manticula (White) [1874, p. 9].
Billingsella coloradoensis (Shumard) [1860, p. 627].
Agnostus.
Ptychoparia.

ST. CHARLES FORMATION (continued):

	Feet
3 (continued):	
Fauna (a mixture of the faunas at the base and at the top):	
Obolus discoideus (Hall and Whitfield) [1877, p. 205].	
Obolus ? sp. undt.	
Lingulella manticula (White) [1874, p. 9].	
Billingsella coloradoensis (Shumard) [1860, p. 627].	
Huenella lesleyi Walcott [1908*d*, p. 110].	
Hyolithes.	
Cyrtolites.	
Agnostus.	
Ptychoparia.	
Anomocare.	
4. Bedded, light gray sandstone, followed below by dirty brown sandstone, and toward the base shaly and thin-bedded sandstone	166
Strike, north 20° east (magnetic); dip, 25° west.	
Fauna (in upper 20 feet):	
Obolus discoideus (Hall and Whitfield) [1877, p. 205].	
Obolus (*Fordinia*) *bellulus* (Walcott) [1905, p. 323].	
Acrotreta idahoensis alta Walcott [1902, p. 588].	
Billingsella coloradoensis (Shumard) [1860, p. 627].	
Fauna (near the base):	
Lingulella (*Lingulepis*) *acuminata* (Conrad) [1839, p. 64].	
Total Upper Cambrian	1,227

MIDDLE CAMBRIAN

NOUNAN FORMATION [Walcott, 1908*a*, p. 6]:

1*a*. Light-gray, arenaceous limestone	12
1*b*. Lead-colored, arenaceous limestone	40
1*c*. Light-gray, arenaceous limestone	85
1*d*. Dark lead-gray, arenaceous limestone	87
1*e*. Shaly and thin-bedded arenaceous limestone with intercalated reddish brown sandy layers	15
1*f*. Light-gray, arenaceous limestone	18
1*g*. Dark lead-gray, arenaceous limestone	198
1*h*. Light-gray, arenaceous limestone	494
1*i*. Dark lead-gray, arenaceous limestone, with numerous irregular annelid borings filled with light-gray, arenaceous limestone	56
1*j*. Massive bedded, arenaceous, cherty limestone	8
1*k*. Bluish gray, cherty, more or less arenaceous limestone in thick bands that break up into thin layers on weathering	28
Total of 1	1,041

Fauna:

A few traces of fossils occur in the lower 28 feet and large annelid borings occur in many of the arenaceous limestones. If in a dark rock, the irregular borings are filled with lighter-colored rock, and in the light-gray rock by darker rock.

BLOOMINGTON FORMATION [Walcott, 1908*a*, p. 7]:

	Feet
1*a*. Thin-bedded, bluish gray, compact limestone with interbedded thick layers of gray limestone	22
Fauna: *Protospongia* (spicules). *Obolus mcconnelli pelias* (Walcott) [1905, p. 330]. *Obolus* (*Westonia*) *wasatchensis* Walcott [1908*d*, p. 69]. *Lingulella desiderata* (Walcott) [1898, p. 399]. *Hyolithes.* *Agnostus.* *Ptychoparia.*	
1*b*. Greenish argillaceous shale	12
1*c*. Gray, coarse-grained limestone. Strike, north 20° east; dip, 20° west (magnetic).	13
Fauna: *Hyolithes.* *Ptychoparia.*	
1*d*. Greenish argillaceous and sandy shale	147
Fauna (at base): *Hyolithes* (fragments). *Agnostus.* *Ptychoparia.*	
1*e*. Gray, coarse-grained limestone	4
Fauna: *Micromitra sculptilis* (Meek) [1873, p. 479]. *Hyolithes* (abundant). *Ptychoparia.* *Agraulos.*	
1*f*. Greenish argillaceous and sandy shale	22
Total of 1	220
2*a*. Bluish gray limestones, with small concretions and small nodules of calcite scattered through the layers, which range from an inch to 6 inches or more in thickness	380
Fauna: Fragments of fossils.	
2*b*. Massive bedded, gray limestone that forms a low cliff and breaks down readily on gentle slopes	132
Fauna: *Ptychoparia.* *Agraulos.* } Same as in 1*e*.	
2*c*. Bluish gray limestone, with small concretions and small nodules of calcite scattered through the layers; a limestone similar to 2*a*	290

BLOOMINGTON FORMATION (continued):

	Feet
2c (continued):	
Fauna:	
Hyolithes.	
Agraulos.	
2d. Greenish argillaceous shale	39
Fauna:	
Obolus (*Westonia*) *wasatchensis* Walcott [1908*d*, p. 69].	
Agraulos.	
Ptychoparia.	
At this horizon in Wasatch Canyon, 5 miles north of Brigham, *Acrothele subsidua* (White) [1874, p. 6] occurs.	
2e. Bluish gray, thin-bedded limestone	182
2f. Arenaceous, steel-gray limestone	22
2g. Bluish gray limestone, with small concretions and small nodules of calcite scattered irregularly through the layers	55
Fauna:	
Micromitra sculptilis (Meek) [1873, p. 479].	
Ptychoparia.	
Dorypyge.	
Total of 2	1,100
Total of Bloomington formation	1,320

BLACKSMITH FORMATION [Walcott, 1908*a*, p. 7]:

1a. Dark lead-gray, arenaceous limestone	195
1b. Arenaceous, steel gray, cliff-forming limestone, in the lower portion passing gradually into a dove-gray, compact limestone that weathers to a light-gray color. The layers vary in thickness from 4 inches to 2.5 feet	375
Fauna:	
Fragments of a small trilobite (*Ptychoparia ?*).	
Annelid borings.	
Total of Blacksmith formation	570

UTE FORMATION [Walcott, 1908*a*, p. 7]:

1a. Bluish gray, compact, thin-bedded limestone, with large irregular annelid borings in the upper part filled with steel-gray, arenaceous limestone similar to the beds above. Below the limestone is purer and more uniformly gray and in layers that tend to form low cliffs on the steeper slopes	290
Fauna (in upper part):	
Micromitra (*Paterina*) *labradorica utahensis* (Walcott) [1905, p. 306].	
Billingsella, sp. undt.	
Hyolithes.	
Agraulos.	

UTE FORMATION (continued):

1*a* (continued): Feet

Ptychoparia subcoronata (Hall and Whitfield) [1877, p. 237].
Dorypyge ? quadriceps (Hall and Whitfield) [1877, p. 240].

130 feet below the top of 1*a* a large trilobite is indicated by a head and tail.

1*b*. Gray, arenaceous limestone in thin layers, with occasional bands of layers 4 to 10 inches thick, often oölitic, and with interformational conglomerate and flattened concretions.... 135

Fauna (in the upper 5 feet):
Scenella.
Ptychoparia subcoronata (Hall and Whitfield) [1877, p. 237].
Dorypyge ? quadriceps (Hall and Whitfield) [1877, p. 240].

Fauna (in layers 70 to 80 feet below the top):
Micromitra (*Paterina*) *labradorica utahensis* (Walcott) [1905, p. 306].
Obolus mcconnelli (Walcott) [1889, p. 441].
Billingsella coloradoensis (Shumard) [1860, p. 627].
Nisusia (*Jamesella*) *nautes* (Walcott) [1905, p. 283].
Eoorthis zeno Walcott [1908*d*, p. 106].
Syntrophia cambria Walcott [1908*d*, p. 106].
Hyolithes.
Scenella.
Zacanthoides.
Ptychoparia subcoronata (Hall and Whitfield) [1877, p. 237].
Dorypyge ? quadriceps (Hall and Whitfield) [1877, p. 240].

1*c*. Gray limestone, with numerous concretions one-fourth to one-half inches in diameter. A few thin layers of interformational conglomerate and some shaly limestone..... 58

Total of 1..... 483

2*a*. Gray, fine-grained, calcareous and argillaceous shaly beds..... 38

Fauna:
Micromitra (*Paterina*) *labradorica utahensis* (Walcott) [1905, p. 306].
Obolus (*Westonia*) *ella* (Hall and Whitfield) [1877, p. 232].
Acrothele cf. *turneri* Walcott [1908*d*, p. 87].
Isoxys cf. *argentea* (Walcott) [1886, p. 146].
Ptychoparia.

2*b*. Bluish gray to blue-black, fine-grained, thin-bedded limestone. 57

Fauna:
Obolus ?
Ptychoparia.

UTE FORMATION (continued): Feet

2c. Greenish argillaceous and calcareous shale, weathering buff... 51
2d. Thin-bedded, grayish-blue limestone..... 36
2e. Gray, oölitic limestone in layers 3 to 14 inches thick..... 24

Fauna:
Micromitra (Paterina) stuarti Walcott [1908d, p. 58].
Micromitra (Paterina) superba (Walcott) [1897, p. 711].
Hyolithes.
Ptychoparia a.
Ptychoparia b.
Dorypyge (fragment).

2f. Greenish argillaceous and sandy shale..... 18

Fauna:
Obolus mcconnelli (Walcott) [1889, p. 441].
Micromitra (Paterina) superba (Walcott) [1897, p. 711].
Ptychoparia, sp. undt.

2g. Bluish gray, thin-bedded limestone..... 22

Strike, north 30° (magnetic); dip, 12° northwest.

Fauna (near base):
Micromitra (Paterina) superba (Walcott) [1897, p. 711].
Hyolithes.
Ptychoparia (small heads).

Total of 2..... 246

Spence shale [Walcott, 1908a, p. 8]:

1. Greenish argillaceous and sandy shale..... 30

Fauna:
Micromitra (Iphidella) pannula (White) [1874, p. 6].
Obolus (Westonia) ella (Hall and Whitfield) [1877, p. 232].
Hyolithes.
Orthotheca major Walcott [1908c, p. 246, pl. I, fig. 11].
Leperditia.
Ptychoparia.
Bathyuriscus productus (Hall and Whitfield) [1877, p. 244].

At Wasatch Canyon, 5 miles north of Brigham, Utah, the following were found at this horizon:

Eocystites ? longidactylus Walcott [1886, p. 94].
Micromitra (Iphidella) pannula (White) [1874, p. 6].
Obolus (Westonia) ella (Hall and Whitfield) [1877, p. 232].
Lingulella desiderata (Walcott) [1898, p. 399].
Acrothele subsidua (White) [1874, p. 6].
Agnostus.
Ptychoparia piochensis Walcott [1886, p. 201].
Zacanthoides idahoensis Walcott [1908b, p. 26].

Spence shale (continued):

1 (continued):

Neolenus a.
Neolenus b.
Bathyuriscus howelli Walcott [1886, p. 216].
Bathyuriscus productus (Hall and Whitfield) [1877, p. 244].
Ogygopsis.

LANGSTON FORMATION [Walcott, 1908*a*, p. 8]:

	Feet
1*a*. Massive bedded, bluish gray limestone, passing downward into gray, arenaceous limestone with many round concretions, one-fourth to three-fourths of an inch in diameter.....	64

Fauna:
Obolus (*Westonia*) *ella* (Hall and Whitfield) [1877, p. 232].
Zacanthoides sp.
Bathyuriscus productus (Hall and Whitfield) [1877, p. 244]?
Neolenus?

1*b*. Massive bedded, bluish gray limestone that breaks up into layers 2 to 8 inches thick on weathering and with many round concretions	44

Fauna:
Ptychoparia.
Bathyuriscus productus (Hall and Whitfield) [1877, p. 244].

In the section two miles southeast of Malade, Idaho, a section which is 60 miles northwest of Blacksmith Fork, the fauna at this horizon is large and finely preserved in compact, bluish gray limestones. It includes:

Micromitra haydeni Walcott [1908*d*, p. 55].
Micromitra (*Iphidella*) *pannula* (White) [1874, p. 6].
Micromitra (*Iphidella*) *pannula ophirensis* (Walcott) [1905, p. 306].
Lingulella desiderata (Walcott) [1898, p. 399].
Lingulella helena (Walcott) [1898, p. 406].
Lingulella isse (Walcott) [1905, p. 330].
Acrotreta idahoensis sulcata Walcott [1902, p. 588].
Acrotreta pyxidicula White [1874, p. 9].
Acrotreta?
Acrothele artemis Walcott [1908*d*, p. 82].
Acrothele subsidua (White) [1874, p. 6].
Acrothele subsidua, var.
Acrothyra minor Walcott [1905, p. 303].
Billingsella coloradoensis (Shumard) [1860, p. 627].
Hyolithes.

LANGSTON FORMATION (continued):	Feet
Orthotheca.	
Stenotheca.	
Platyceras.	
Agnostus.	
Microdiscus.	
Solenopleura.	
Ptychoparia (2 species).	
Oryctocephalus.	
Dorypyge (2 species).	
Neolenus (2 species).	
Asaphiscus.	
Ogygopsis?	
2. Massive bedded, dark, arenaceous limestone, passing at about 150 feet down into a calcareous sandstone, and then a gray sandstone	390
Total of Langston formation	498

BRIGHAM FORMATION [Walcott, 1908*a*, p. 8]:

1*a*. Quartzitic sandstone, gray, greenish, gray brownish, dirty gray, all weathering reddish dirty brown in layers 3 inches to 3 feet in thickness	28
1*b*. Greenish, hard, sandy shale	4
Fauna:	
Annelid trails.	
Trilobite tracks.	
1*c*. Same as 1*a* (estimated)	1,200+
Total of Brigham formation	1,232
Total of Middle Cambrian[1]	5,420+

RÉSUMÉ, BLACKSMITH FORK SECTION

	Feet	Feet
UPPER CAMBRIAN:		
ST. CHARLES FORMATION:		
1. Fossiliferous limestone	190	
2. Arenaceous limestone	777	
3. Fossiliferous limestone	94	
4. Shaly and thin-bedded sandstones	166	
		1,227
MIDDLE CAMBRIAN:		
NOUNAN FORMATION:		
1. Arenaceous limestone		1,041
BLOOMINGTON FORMATION:		
1. Limestone and shales	220	
2. Thin-bedded limestone	1,100	
		1,320

[1] The line of separation between the Middle and Lower Cambrian occurs somewhere in the Brigham formation, and this thickness (5,420 feet) likely includes several hundred feet of Lower Cambrian beds.

RÉSUMÉ, BLACKSMITH FORK SECTION (continued):

		Feet
BLACKSMITH FORMATION:		
1. Arenaceous limestone		570
UTE FORMATION:		
1. Thin-bedded limestone	483	
2. Limestone and shales	246	
		729
Spence shale		30
LANGSTON FORMATION:		
1. Massive limestone	108	
2. Arenaceous limestone	390	
		498
BRIGHAM FORMATION:		
1. Quartzitic sandstones (estimated)		1,232+
Total Middle Cambrian[1]		5,420+
Total section		6,647+

DEARBORN RIVER SECTION

LOCALITY.—North fork of the Dearborn River, south-southeast and south of Mount Dearborn, Lewis and Clark Forest Reserve, Montana.

The base of the section is 4 miles above Walker's ranch at the mouth of the canyon. The summit is the top of Mount Dearborn.

CARBONIFEROUS

	Feet
1. Brown, thin-bedded sandstone	135
2*a*. Massive bedded, light gray, siliceous limestone, forming a high cliff and breaking into talus slopes of small angular fragments	1,970
Fossils: Noted *Zaphrentis* and *Syringopora* in abundance.	
2*b*. Massive bedded dark gray, siliceous limestone breaking into fragments; 275 feet from the top there is a thin bed of shaly limestone	425
2*c*. Thin-bedded, steel-gray, buff, and gray weathering limestone..	725
Very few fossils were observed. A large *Spirifer* and specimens of a large *Productus* were noted about 400 feet from the top.	
Total Carboniferous	3,255

SILURIAN (?)

The strata referred to the Silurian are arenaceous limestones in which no fossils were observed. It is not improbable that the upper portion of them may be of Devonian age, or possibly Lower Carboniferous.

[1] See footnote on page 199.

	Feet
3*a*. Massive bedded, gray, arenaceous cliff-forming limestones.....	675
3*b*. Thin-bedded, gray limestone and sandstone, with small lentiles of light-gray limestone. The irregular arenaceous portions weather buff and form a buff band where the rock is in the cliffs	75
3*c*. Massive bedded, light gray, arenaceous limestone, with thinner bedded, purer limestones at intervals. On the mountain slopes the massive beds form cliffs, and the thin-bedded more shaly portion forms slopes.....	245
3*d*. Massive bedded, light gray, arenaceous limestone, with somewhat purer, slightly banded limestones toward the top.....	175
3*e*. Massive bedded light gray, banded limestones, that break up into thin and often shaly layers on exposure to the weather.	51
3*f*. Massive bedded, light gray, arenaceous limestones.....	164
Total of Silurian ?.....	1,385

The line drawn between the Cambrian and the Silurian is based largely on the change in the character of the limestone, from the coarse, gray, arenaceous limestone to a much purer, gray limestone, and the occurrence, about 150 feet from the top, of fragments of a species of *Ptychoparia*.

CAMBRIAN

LIMESTONE:

	Feet
1*a*. Massive bedded, hard, gray and bluish gray limestones that break up into thin, irregular layers on exposure to the weather. The color of many thin layers and the thick layers on their bedding planes is yellow to buff. The upper 100 feet contain massive dove-colored limestones and near the top a few feet of siliceous limestone.....	550
Fragments of a species of *Ptychoparia* were noted about 150 feet below the summit.	
1*b*. Greenish and gray, thin-bedded limestone, with some arenaceous shale and thin layers of greenish sandstone in the shale	90
Numerous annelid trails and fragments of trilobites occur throughout.	
1*c*. Massive bedded, gray limestone that breaks up into thin, irregular layers, in very much the same manner as the Pilgrim limestone, but is usually more massive. It is quite arenaceous near the central portions, where it is more massive bedded for a short distance.....	680
One hundred and seventy feet from the top there is a band of thin-bedded oölitic limestone, in which fragments of trilobites are numerous; also a small *Obolus*-like shell. Oölitic limestone, interbedded with irregular, thin-bedded, bluish gray limestones, occurs in the lower 170 feet.	
Total of limestone.....	1,320

SHALE:

	Feet
2. Thin-bedded limestones, with partings of greenish, argillaceous, and arenaceous shale. Sometimes the shale and at other times the limestone predominates	150

LIMESTONE:

3. Massive bedded, gray limestone, similar to the Meagher limestone, except that it is of a lighter gray color near the top.. Annelid trails are abundant and fragments of tribolites.	130

SHALE:

4. Thin-bedded limestones, with partings of greenish, argillaceous, and arenaceous shale, the limestones predominating. It breaks down readily on the slopes and forms a sloping terrace	210

LIMESTONE:

5. Massive bedded, fine-grained, gray limestone that breaks up on weathering into thin layers from a quarter of an inch to two inches in thickness. They have a very irregular surface, marked by a thin, buff-colored deposit that fills the annelid burrows and trails, and also occurs as irregular blotches on the surface. This belt of limestone is divided into five thick beds that may be distinguished for miles in the cliffs. The two lower are usually broken down. Annelid trails are abundant and numerous fragments of trilobites.	55

SHALE:

6. Greenish purple and dark gray, argillaceous shales, with thin layers of sandstone and arenaceous shale at irregular intervals	190

Shale No. 6 is in the same stratigraphic position as the Wolsey shale [Weed, 1900, p. 285] of the Little Belt Mountains section, and the sandstone beneath corresponds stratigraphically to the Flathead sandstone [Peale, 1893, p. 20] in the same section. The fauna of shale No. 6 on Scapegoat and Gordon mountains, localities west of the Dearborn River section, is, however, entirely unlike that of the Middle Cambrian Wolsey shale, and includes the following species:

Micromitra (*Iphidella*) *pannula* (White) [1874, p. 6].
Obolus (*Westonia*) *ella* (Hall and Whitfield) [1877, p. 232].
Acrothele colleni, new species.
Acrothele panderi, new species.
Wimanella simplex Walcott [1908*d*, p. 101].
Olenopsis ? sp.
Ptychoparia, sp.
Albertella helena Walcott [1908*b*, p. 19].

Vanuxemella contracta, new genus and new species.
Bathyuriscus productus ? (Hall and Whitfield) [1877, p. 244].
Bathyuriscus ?

This fauna is strikingly similar to that occurring in the drift blocks which are believed to have come from the lower portion of the Mount Whyte formation of the Mount Bosworth section [see page 214]. At the localities in question neither fauna contains *Olenellus,* but that genus occurs so generally in the Mount Whyte formation, both above and below the Albertella horizon, that the entire formation is placed in the Lower Cambrian. This correlation places shale No. 6 and sandstone No. 7 in the Lower Cambrian.

SANDSTONE:

	Feet
7*a*. Thin-bedded sandstones, with partings of dark arenaceous shale Many varieties of annelid trails and tracks of trilobites occur on the surface of the sandstone.	70
7*b*. Massive bedded, coarse, more or less cross-bedded, light gray sandstone, with a few thin layers of fine quartzitic conglomerate	80
Total of sandstone	150

RÉSUMÉ, DEARBORN RIVER SECTION

	Feet
1. Limestone	1,320
2. Shale	150
3. Limestone	130
4. Shale	210
5. Limestone	55
6. Shale	190
7. Sandstone	150
Total of Cambrian	2,205

Beneath the Cambrian sandstone the Empire shales of the Belt Terrane of the Algonkian occur with apparently the same strike and dip as the base of the sandstone. Traced on the strike, however, they appear to be unconformably beneath the sandstone.

MOUNT BOSWORTH SECTION

Mount Bosworth section, north of Hector, British Columbia, on the Continental Divide, north of the Canadian Pacific Railway.

The summit of the section is on the west spur (Sherbrooke ridge) of Mount Bosworth overlooking Sherbrooke Lake. The highest beds are on the south summit of the ridge, and from their lithologic character and the finding of obscure fossils that suggest *Ophileta* of the Lower Ordovician the upper 110 feet of strata are tentatively referred to the Ordovician system. The strata near the summit are much broken up owing to a fault line that crosses the ridge.

ORDOVICIAN

		Feet
1.	Massive bedded gray and bluish gray arenaceous limestone, with thin layers, irregular stringers, and nodules of dark chert	110

UPPER CAMBRIAN

SHERBROOKE FORMATION [Walcott, 1908*a*, p. 2]:

1.	Massive bedded, bluish gray limestone, with some cherty matter in the form of small nodules and stringers; also irregular partings and fillings of annelid borings by gray dolomitic limestone weathering buff	175

Fauna:
Annelid borings and trails.
Fragments of undeterminable trilobites.

2*a*.	Gray oölitic limestone in thick layers, with bluish banded limestone intercalated at irregular intervals. The banded appearance of the nonoölitic layers is owing to the buff weathering of the thin dolomitic layers	190

Fauna (Upper Cambrian facies):
Crepicephalus.
Pterocephalus?
Ptychoparia.

2*b*.	Greenish drab and gray siliceous shales with interbedded oölitic limestone in bands of layers from 6 inches to 4 feet thick; also a few bands of thick-bedded, bluish gray limestone that breaks up into shaly limestone on weathering	335

Fauna (in green shales near summit):
Lingulella isse (Walcott) [1905, p. 330].

Fauna (in oölitic layers):
Agnostus, sp. undt.
Illænurus.
Ptychoparia.

SHERBROOKE FORMATION (continued):

	Feet
2c. Gray oölitic limestone, with thin bands of interbedded shaly, blue gray limestone. Gray, dolomitic, buff-weathering, flattened nodules, stringers, and thin layers of limestone occur in a very irregular manner	65

Fauna:
Illænurus.
Agnostus.
Ptychoparia.
Bathyurus-like pygidia.

Total of 2	590
3. Arenaceous, dolomitic, steel gray limestone weathering light gray and buff gray	610

The line of demarcation between 3 and the bluish gray limestones below is irregular. The gray beds of 3 extend along the cliff and abruptly change to bluish gray. In the upper 100 feet of 3 irregular masses of bluish gray limestone occur like great lentiles, as though they were cores left in the general alteration (dolomitization) of the strata.

Total of Sherbrooke formation	1,375

PAGET FORMATION [Walcott, 1908a, p.3]:

1. Massive bedded, dark bluish gray limestone forming base of cliff on the west side of the amphitheater on the west slope of Mount Bosworth and, with 3 of Sherbrooke formation, the upper cliffs of Paget Peak and Mount Daly	60
2. Massive beds of oölitic limestone, with irregular, interbedded bands of green siliceous shale. Thin layers, irregular stringers, and nodules of gray buff weathering dolomite occur in the oölitic limestones	300+

The base of 2 is covered by talus slope on line of the section. It is well exposed on the southeast face of Mount Daly and Paget Peak. The thickness is placed at 300 feet, which I think is less than the total thickness. Over 200 feet was measured.

Fauna:
Hyolithes.
Agnostus.
Crepicephalus.

Total of Paget formation	360+

BOSWORTH FORMATION [Walcott, 1908a, p.3]:

1. Massive bedded, gray, and bluish gray arenaceous dolomitic limestone. Several bands of steel gray, yellowish buff weathering bands of strata occur in the lower half of 1	600+

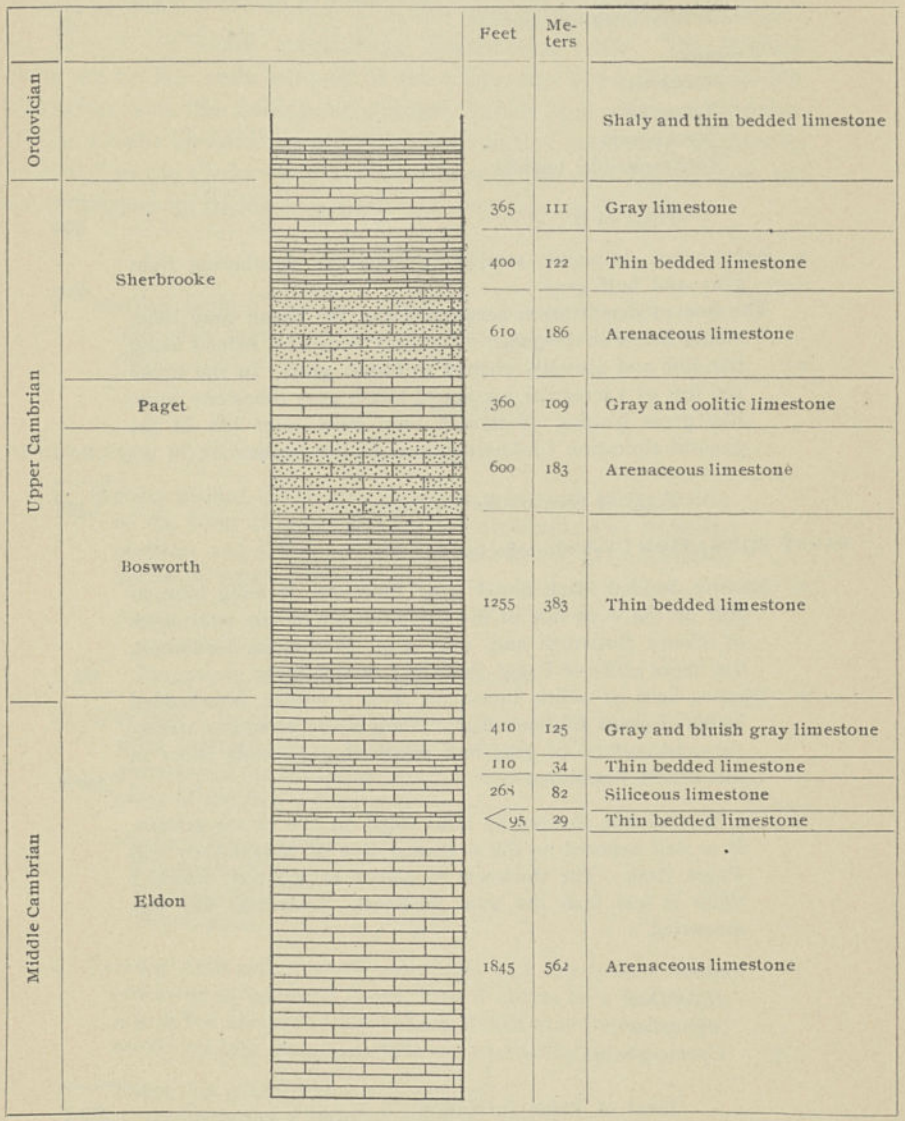


FIG. 8.—Mt. Bosworth Section (continued on following page)

EASTERN SIDE OF SHERBROOKE RIDGE

The summit of the ridge at (*a*) is formed of strata tentatively referred to the Ordovician. Below, the Sherbrooke and Paget formations extend down to the foot of the cliffs. Buff Point and Red Knob expose the Bosworth formation nearly down to the great Eldon siliceous limestone. A fault brings the base of the Paget formation up about 500 feet.

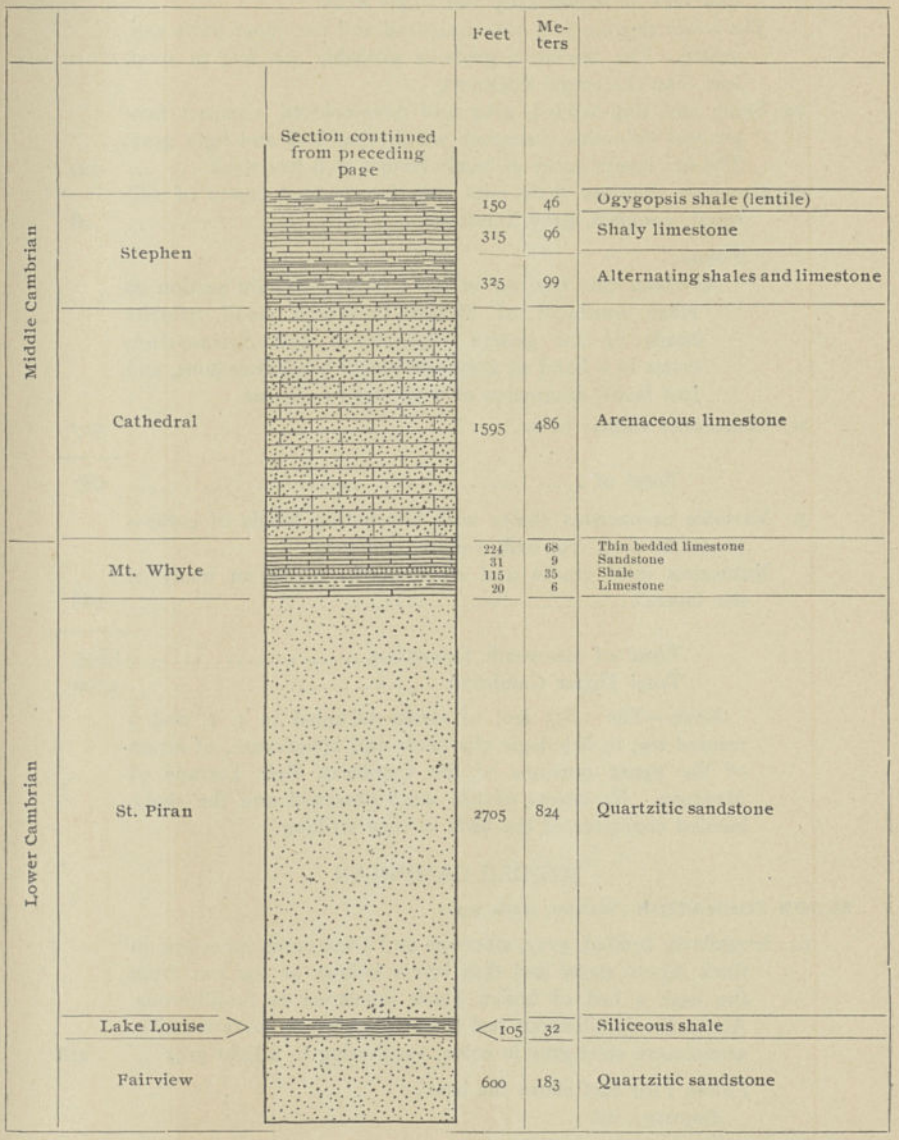


FIG. 9.—Mt. Bosworth Section (continued)

NOTE.—The thickness of the St. Piran, Lake Louise, and Fairview formations is taken from the Lake Louise section.

BOSWORTH FORMATION (continued):

1 (continued): Feet

This formation forms the base of the high cliffs on the southeast face of Mount Daly and Paget Peak.

The lower portion of 1 was measured and the upper parts estimated. The thickness given is probably 100 feet or more less than the actual thickness.

2a. Shaly and thin-bedded, gray and dove-colored, compact fine-grained dolomitic limestone weathering buff and light gray. Thicker layers occur in bands from 1 to 6 feet thick..... 422

2b. Greenish siliceous shale with thin interbedded layers of siliceous, compact, gray limestone..... 48

Fauna:

At about this horizon in the Castle Mountain section 20 miles southeast of Mount Bosworth small trilobite heads of the genera *Ptychoparia* and *Solenopleura* occur in a band of gray and bluish black limestone, and just below fragments of a species of *Obolus*.

2c. Limestones similar to *2a*..... 517

Total of 2..... 987

3. Variable arenaceous shales with alternating bands of color—greenish, deep red, buff, yellow, and gray.

Numerous mud cracks and ripple-marks occur on many of the layers..... 268

Total of Bosworth formation..... 1,855

Total Upper Cambrian..... 3,590

NOTE.—The 1,855 feet of strata included in 1, 2, and 3 remind me, in lithologic character and appearance, of strata of the upper portions of the Cambrian Belt Terrane of Montana. No traces of life were observed and the shaly, banded character of the beds is very striking.

MIDDLE CAMBRIAN

ELDON FORMATION [Walcott, 1908*a*, p.3]:

1a. Irregularly bedded, gray, siliceous and arenaceous limestone in thick layers above and thin layers below; at 192 feet from the base a bed of bluish black limestone is fossiliferous. Above the fossiliferous bed the strata become more massive, arenaceous, steel gray in color, weathering to a light gray... 410

Fauna (192 feet above the base):

Agnostus, sp.

Ptychoparia, 2 species.

Bathyuriscus-like pygidium.

1b. Light and dark gray, thin-bedded, arenaceous limestone, weathering to a light-gray color..... 110

1c. Massive bedded, siliceous, fine-grained, compact, dark bluish gray limestone..... 197

Fig. 1. NORTH RIDGE OF CASTLE MOUNTAIN

Showing the Eldon formation in the cliffs above the lake and the Bosworth formation in the snow-covered points above the cliff line.

Fig. 2. PROFILE OF SOUTHEAST FRONT OF CASTLE MOUNTAIN, OPPOSITE ELDON

The upper cliff is formed of the siliceous limestone of the Eldon formation; the terrace with snow on it the Stephen formation, and the lower cliff and slope the Cathedral formation. These formations are finely exposed on Mount Bosworth, but not so as to get good photographs of them.

ELDON FORMATION (continued):

		Feet
1*c* (continued):		
	Two yellowish buff weathering bands of limestone 2 to 3 feet thick stand out in color on the face of cliffs.	
	Fauna (near the summit): *Billingsella ?* *Neolenus*-like pygidium.	
1*d*.	Massive bedded limestone much like that of 1*c*.....	71
	Total of 1.....	788
2.	Thin-bedded, bluish gray limestone with irregular layers and stringers of gray, buff weathering, dolomitic limestone.....	95
	At 24 feet from the base a shaly, bluish gray, siliceous limestone about two feet thick is interbedded.	
	Fauna (in shaly limestone): *Obolus membranaceous* Walcott [1908*d*, p. 61]. *Lingulella* sp. *Isoxys argentea* (Walcott) [1886, p. 146]. *Ptychoparia*, 2 species.	
3.	Massive bedded dark gray arenaceous limestone.....	190
4.	Massive bedded, cliff-forming, light gray arenaceous limestone. At several horizons bands of thinner layers from a few feet up to 30 feet in thickness occur. One of these 480 feet from the base forms a slight terrace.....	1,655
	Fauna:	
	In the Mount Stephen section seven miles southwest of Mount Bosworth, at a horizon about 700 feet above the base of this limestone, the following fossils have been recognized: *Protospongia* (spicules). *Lingulella* cf. *isse* (Walcott) [1905, p. 330]. *Hyolithes* sp. *Agnostus* cf. *montis* Matthew [1899, p. 43]. *Zacanthoides spinosus* Walcott [1884, p. 63]. *Ptychoparia* sp. *Bathyuriscus* sp. *Ogygopsis* sp.	
	Total of Eldon formation.....	2,728

STEPHEN FORMATION [Walcott, 1908*a*, p. 3]:

1.	Thin-bedded, dark gray and bluish black limestone.....	315
	Fauna: *Micromitra* (*Paterina*) *stissingensis* (Dwight) [1889, p. 145]. *Obolus mcconnelli* (Walcott) [1889, p. 441].	

STEPHEN FORMATION (continued):

1 (continued):

Nisusia alberta (Walcott) [1889, p. 442], var.
Hyolithes carinatus Matthew [1899, p. 42].
Agnostus sp.
Agraulos sp.
Menocephalus sp.
Ptychoparia, 3 species.
Neolenus sp.
Bathyuriscus sp.

At Mount Stephen, about seven miles southwest of Mount Bosworth, a siliceous shale occurs at the summit of the Stephen formation in which an unusually rich fauna occurs. This shale is not well developed on Mount Bosworth.

Ogygopsis Shale.—This term is applied to the local development of arenaceous and calcareous shale at the summit of the Stephen formation on the northwest slope of Mount Stephen. The shale band (lentile) has a maximum thickness of about 150 feet. It thins out to the northeast and is faulted out to the southwest. At its maximum thickness, 2,800 feet above Field, it carries immense numbers of trilobites, especially *Ogygopsis klotzi* (Rominger), *Bathyuriscus rotundatus* (Rominger), *Neolenus serratus* (Rominger), *Zacanthoides spinosus* (Walcott), and, in addition, sponges, cystids, brachiopods, pteropods, and gasteropods. The shale is less rich in fossils one-fourth of a mile northeast on the strike; also to the northwest. Lentiles of gray quartzitic sandstone and siliceous, gray limestone occur in the shale, and the entire shale band appears to be a lentile between the thin-bedded blue limestones and the superjacent massive, arenaceous limestone formation. There is no trace of the *Ogygopsis* shale on Mount Bosworth 6 miles northeast, at the same horizon, or at Castle Mountain, 20 miles east-southeast.

There is a sharp anticline, with a northeast-southwest axis, in the shale and the thin-bedded limestones beneath, on the northwest slope of Mount Stephen. The southeast limb is crushed and the beds are largely faulted out against the massive arenaceous limestone before reaching the amphitheater at the head of Field Brook. On the northwest limb the shales are unaltered and slope down the side of the mountain for 1,800 feet, thus affording a great exposure of the shale and contained fossils.

Fauna:

1. *Hyolithellus flagellum* (Matthew) [1899, p. 40].
2. *Hyolithellus annulatus* (Matthew) [1899, p. 42].
3. *Orthotheca corrugata* Matthew [1899, p. 42].
4. *Orthotheca major* Walcott [1908*c*, p. 246, pl. I, fig. 11].
5. *Hyolithes*, sp.
6. *Hyolithes carinatus* Matthew [1899, p. 42].
7. *Stenotheca wheeleri* Walcott [1908*c*, p. 245, pl I, fig. 7].
8. *Platyceras romingeri* Walcott [1889, p. 442].
9. *Platyceras bellianus* Walcott [1908*c*, p. 246, pl. I, fig. 13].
10. *Acrotreta depressa* (Walcott) [1889, p. 441].
11. *Micromitra (Iphidella) pannula* (White) [1874, p. 6].
12. *Obolus mcconnelli* (Walcott) [1889, p. 441].
13. *Nisusia alberta* Walcott [1889, p. 442].
14. *Philhedra columbiana* (Walcott) [1889, p. 441].

MOUNT STEPHEN, BRITISH COLUMBIA, FROM THE NORTH

Near the base at (*a*) the Mount Whyte formation rests on the St. Piran quartzitic sandstones. The great Cathedral arenaceous limestone forms the north shoulder of the mountain up to (*b*), where the 800 feet of the Stephen formation breaks the profile. Above this the massive beds of the Eldon formation extend to the summit of the peak. The section shown in the profile is over 5,800 feet in thickness. At *xx* on the slope the great fossil beds of the Stephen formation are finely exposed.

STEPHEN FORMATION (continued):

Ogygopsis shale (continued): Feet

15. *Scenella varians* Walcott [1886, p. 127].
16. *Anomalocaris canadensis* Whiteaves [1892, p. 207].
17. *Anomalocaris? whiteavesi* Walcott [1908*c*, p. 246, pl. II, figs. 2, 2*a*, 4, 6, and 6*a*[.
18. *Anomalocaris?? acutangula* Walcott [1908*c*, p. 247, pl. II, fig. 5].
19. *Agnostus montis* Matthew [1899, p. 43].
20. *Dorypyge* (*Kootenia*) *dawsoni* (Walcott) [1889, p. 446].
21. *Bathyuriscus rotundatus* (Rominger) [1887, p. 16].
22. *Bathyuriscus pupa* Matthew [1899, p. 51] probably = 23.
23. *Bathyuriscus occidentalis* (Matthew) [1899, p. 49].
24. *Bathyuriscus ornatus* Walcott [1908*b*, p. 39].
25. *Karlia stephenensis* Walcott [1889, p. 445].
Corynexochus romingeri Matthew [1899, p. 47] = 25.
26. *Neolenus serratus* (Rominger) [1887, p. 13].
Neolenus granulatus Matthew [1899, p. 55]=26.
27. *Ogygopsis klotzi* (Rominger) [1887, p. 12].
28. *Oryctocephalus reynoldsi* Reed [1899, p. 359].
Oryctocephalus walkeri Matthew [1899] = 28.
29. *Burlingia hectori* Walcott [1908*b*, p. 15].
30. *Ptychoparia cordillerœ* (Rominger) [1887, p. 17].
Conocephalites cf. *perseus* Hall, Matthew [1899, p. 46] = 30.
31. *Ptychoparia palliseri* Walcott [1908*c*, p. 247, pl. III, fig. 6].
32. *Zacanthoides spinosus* (Walcott) [1884, p. 63].

2*a*. Greenish siliceous shale 23

Fauna:
Obolus (*Westonia*) *ella* ? (Hall and Whitfield) [1877, p. 232].

2*b*. Thick-bedded, bluish gray limestone, breaking up into thin layers one-half to 3 inches thick on weathering..... 22

Fauna:
Micromitra (*Paterina*) *stissingensis* (Dwight) [1889, p. 145].
Nisusia alberta Walcott [1889, p. 442], var.

2*c*. Greenish siliceous shale..... 70
2*d*. Alternating bluish gray, bedded, compact limestone, siliceous and arenaceous shale, mostly shale below..... 210

Total 2..... 325

Fauna:
Cruziana.
Micromitra (*Iphidella*) *pannula* (White) [1874, p. 6].
Obolus (*Westonia*) *ella* (Hall and Whitfield) [1877, p. 232].
Hyolithes.
Leperditia.
Ptychoparia.
Bathyuriscus.

STEPHEN FORMATION (continued):

2d (continued): Feet

On Mount Stephen, at a horizon 150 feet from the base of this limestone, the fauna includes:

Micromitra (*Iphidella*) *pannula* (White) [1874, p. 6].
Billingsella marion Walcott [1908*d*, p. 102].
Hyolithes.
Microdiscus.
Ptychoparia.

CATHEDRAL FORMATION [Walcott, 1908*a*, p. 4]:

1*a*. Thin-bedded gray to lead-gray, arenaceous limestones, weathering buff gray to dull light gray	404
1*b*. Massive bedded, steel-gray weathering, light gray, arenaceous limestone. In some localities thinner layers appear at various horizons and large lentiles of dark lead-gray-colored beds occur very irregularly	682
1*c*. Similar to 1*a*. Annelid borings and trails occur in and on some of the layers	126
1*d*. Similar to 1*b*	83
1*e*. Thin-bedded, lead-gray to blue-gray, thin-bedded (layers 1 inch to 4 inches thick) arenaceous limestone	25
1*f*. Alternating thin and massive bedded, arenaceous, steel-gray limestone weathering light gray	275
Total of 1	1,595

LOWER CAMBRIAN

MOUNT WHYTE FORMATION [Walcott, 1908*a*, p. 4]:

The line between the Middle and Lower Cambrian is placed at this horizon on account of the presence in the Mount Stephen section of *Olenellus* in the limestone 116 feet below the massive arenaceous limestone belt represented by 1*f* in the Cathedral formation of the Mount Bosworth section.

1*a*. Thin-bedded, bluish gray, slightly arenaceous limestone	120

Fauna:
Numerous annelid trails and borings.

1*b*. Gray oölitic limestone in layers 3 to 6 inches thick	44

Fauna (4 feet from base):
Nisusia (*Jamesella*) *lowi* Walcott [1908*d*, p. 98].
Microdiscus, sp. undt.
Agraulos sp.
Ptychoparia sp.

At Castle Mountain fragments of a species of *Bornemannia* (new genus allied to *Zacanthoides*) occur at about this horizon.

MOUNT WHYTE FORMATION (continued):

Feet

1*b* (continued):

In the Mount Stephen section the following species occur at a horizon near the top of this limestone:

Nisusia (*Jamesella*) *lowi* Walcott [1908*d*, p. 98].
Stenotheca elongata Walcott [1884, p. 23], var.
Scenella varians Walcott [1886, p. 127].
Platyceras, new species.
Hyolithes billingsi Walcott [1886, p. 134].
Ptychoparia sp.
Crepicephalus, new species.
Protypus, new species.
Albertella, sp. undt.

About 50 feet down in the Mount Stephen section in a gray, siliceous shale the following species occur:

Cystid plates.
Micromitra (*Paterina*), sp. undt.
Acrotreta sagittalis taconica (Walcott) [1887, p. 189].
Nisusia (*Jamesella*) *lowi* Walcott [1908*d*, p. 98].
Hyolithes (fragment).
Hyolithellus cf. *micans* Billings [1872, p. 215].
Scenella varians Walcott [1886, p. 127].
Olenellus (fragments of thoracic segments).

1*c*. Massive layers made up of banded bluish gray limestone and sandstone in layers one-half inch to 2 inches thick..... 60

Fauna:
Agraulos, sp. undt.

Total of 1..... 224

On Mount Stephen, at a horizon near the top of this bed of limestone, there was found:
Acrothele colleni, new species.
Acrotreta sagittalis taconica (Walcott) [1887, p. 189].
Scenella varians Walcott [1886, p. 127].
Stenotheca elongata Walcott [1884, p. 23], var.
Albertella, sp. undt.
Olenellus (fragments).
Bathyuriscus, sp. undt.

Near the base on Mount Stephen:
Micromitra (*Paterina*) *labradorica* (Billings) [1861, p. 6], var.
Micromitra (*Iphidella*) *pannula* (White) [1874, p. 6].
Acrotreta sagittalis taconica (Walcott) [1887, p. 189].
Bornemannia prima, new genus and new species.
Ptychoparia, 3 species.

2. Gray and brownish gray sandstone in thin and massive layers. 31

MOUNT WHYTE FORMATION (continued):

2 (continued): Feet

Fauna:
Hyolithes.
Agraulos.

On Mount Stephen, at this horizon, there were found:
Microdiscus, sp. undt.
Olenellus, sp. undt. (fragments).
Ptychoparia, sp. undt.
Protypus, sp. undt.

3. Siliceous shale with a few interbedded thin layers of compact, hard, gray sandstone..... 115

In the Lake Agnes section 5 miles southeast of Mount Bosworth, the fauna of about this horizon includes:
Micromitra (Paterina) wapta Walcott [1908*d*, p. 59].
Obolus parvus Walcott [1908*d*, p. 61].
Hyolithes billingsi Walcott [1886, p. 134].
Olenopsis agnes, new species.
Ptychoparia, 3 species.
Albertella, sp. undt.
Bathyuriscus.

On the south slope of Mount Bosworth two drift blocks of siliceous shale, supposed to be from this horizon, were found, from which the following species were collected:
Micromitra (Paterina) wapta Walcott [1908*d*, p. 59].
Obolus parvus Walcott [1908*d*, p. 61].
Acrothele colleni, new species.
Wimanella simplex Walcott [1908*d*, p. 101].
Agraulos, sp.
Ptychoparia, sp.
Bornemannia, sp.
Albertella bosworthi Walcott [1908*b*, p. 22].
Albertella helena Walcott [1908*b*, p. 19].
Vanuxemella contracta, new genus and new species.
Bathyuriscus, sp. a.

On Mount Stephen, at about the same horizon, the following were found:
Hyolithes billingsi Walcott [1886, p. 134].
Scenella varians Walcott [1886, p. 127].
Olenopsis agnes, new species.
Bornemannia prima, new genus and new species.

4. Interbedded layers of gray fossiliferous limestone and greenish gray siliceous shale..... 20

Fauna:
Nisusia festinata (Billings) [1861, p. 10].
Scenella varians Walcott [1886, p. 127].
Hyolithellus.

MOUNT WHYTE FORMATION (continued):

Feet

4 (continued):

Ptychoparia.
Agraulos.
Protypus fieldensis, new species.
Olenellus canadensis, new species.

At this horizon on Mount Stephen the following were found:

Micromitra (Iphidella) pannula (White) [1874, p. 6].
Acrotreta sagittalis taconica (Walcott) [1887, p. 189].
Kutorgina cingulata (Billings) [1861, p. 8].
Kutorgina, sp. undt.
Nisusia festinata (Billings) [1861, p. 10].
Hyolithes billingsi Walcott [1886, p. 134].
Scenella varians Walcott [1886, p. 127].
Protypus, new species.
Agraulos, sp. undt.
Ptychoparia, 3 sp. undt.
Olenellus canadensis, new species.

Bow River Group

ST. PIRAN FORMATION [Walcott, 1908*a*, p. 4]:

1*a*. Siliceous and arenaceous greenish-colored shales in layers 1 to 3 inches in thickness, interbedded in shaly and thin-bedded gray and brownish gray sandstone, with a thick layer of compact, gray sandstone near the top..... 68

1*b*. Irregularly bedded brownish, dirty gray, and occasionally purplish-colored sandstones, more or less compact and quartzitic and in massive and thin layers that break down readily on slopes 310

Fauna:

Annelid trails and borings (*Scolithus*).
Hyolithes.
Olenellus canadensis ?, new species.
Ptychoparia (2 species).

1*c*. Massive bedded, compact, light gray and pinkish quartzitic sandstones 125

Fauna:

Annelid trails and borings (*Scolithus*).
Hyolithes.
Olenellus canadensis ?, new species (fragments).

The general dip of the strata is to the northwest 20°; strike, north 30° east.

The section is continuous, with the exception of the displacement between the Paget and Bosworth formations of the Upper Cambrian. This does not cut out any considerable thickness of strata, as is proven by the unbroken section in the cliffs of Mount Daly three miles to the north.

In the Lakes Louise and Agnes section, about five miles southeast of Mount

Bosworth, the total thickness of the St. Piran formation is 2,705 feet. Below the St. Piran the following section occurs:

LAKE LOUISE FORMATION [Walcott, 1908*a*, p. 5]:

	Feet
1. Compact, gray, siliceous shale	105

Fauna:
Annelid trails.
Cruziana.
Micromitra (Iphidella) louise Walcott [1908*d*, p. 56].

FAIRVIEW FORMATION [Walcott, 1908*a*, p. 5]:

1. Thin and thick layers of gray, quartzitic, brownish weathering, compact sandstones (estimated)	600+

This formation is much thicker to the southeast.

RÉSUMÉ, MOUNT BOSWORTH SECTION

UPPER CAMBRIAN.

SHERBROOKE FORMATION:

	Feet	Feet
1. Gray, partly cherty limestones	175	
2. Oölitic limestones and shaly band	590	
3. Arenaceous dolomitic limestone	610	
Total		1,375

PAGET FORMATION:

1. Massive bedded bluish gray limestone	60	
2. Oölitic limestone with bands of shale	300+	
Total		360+

BOSWORTH FORMATION:

1. Gray, arenaceous, dolomitic limestone	600+	
2. Shaly and thin-bedded, dolomitic limestones with two bands of shale	987	
3. Shales	268	
Total		1,855+
Total Upper Cambrian		3,590+

MIDDLE CAMBRIAN.

ELDON FORMATION:

1. Siliceous and arenaceous limestone	788	
2. Bluish gray limestone	95	
3 and 4. Arenaceous limestone	1,845	
Total		2,728

PROFILE VIEW OF RIDGES SOUTHEAST (IN THE DISTANCE) AND WEST (FOREGROUND) OF LAKE LOUISE

The distant profile shows the Fairview formation at the base of Fairview Mountain. The Lake Louise formation is at (*a*), and from (*a*) to about (*b*) the St. Piran quartzitic sandstones. The Mount Whyte and Cathedral formations form the summits of the distant peaks. The quartzitic sandstones of the St. Piran formation are well shown on the ridge in the foreground.

RÉSUMÉ, MOUNT BOSWORTH SECTION (continued):

STEPHEN FORMATION:

	Feet	Feet
1. Thin-bedded, dark and bluish gray limestone	315	
2. Alternating limestones and shales	325	
Total		640

CATHEDRAL FORMATION:

1. Arenaceous dolomitic limestone	1,595
Total Middle Cambrian	4,963

LOWER CAMBRIAN.

MOUNT WHYTE FORMATION:

1. Thin-bedded limestones	224
2. Sandstone	31
3. Siliceous shale	115
4. Gray limestone	20
Total	390

ST. PIRAN FORMATION:

1. Sandy shales and quartzitic sandstones as exposed at Lake Agnes	2,705

LAKE LOUISE FORMATION:

1. Compact siliceous shale as exposed at Lake Louise	105

FAIRVIEW FORMATION:

1. Quartzitic sandstones as exposed at Lake Louise	600+
Total Lower Cambrian	3,800+

Upper Cambrian	3,590+
Middle Cambrian	4,963
Lower Cambrian	3,800+
Total thickness of sections examined	12,353+

Below the section of the quartzitic sandstones on Fairview Mountain there is, in the Bow River valley, a considerable, but unknown, thickness of sandstones and siliceous shales that have not been examined or measured.

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