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MOUNT STEPHEN ROCKS AND FOSSILS

BY

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SCIENTIFIC SECTION.

MOUNT STEPHEN ROCKS AND FOSSILS.

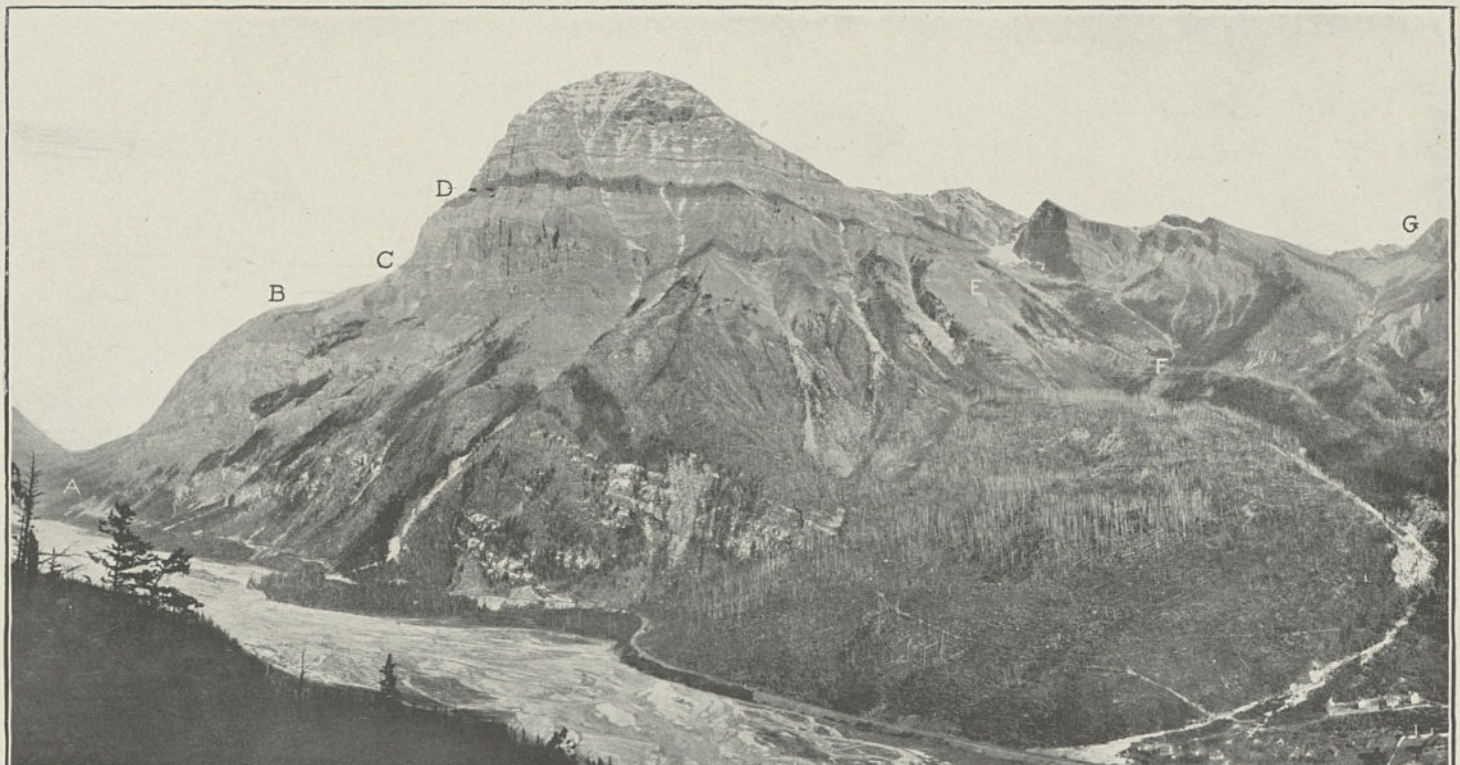
By Charles D. Walcott.

The north face and slope of Mount Stephen presents a wonderfully interesting section of rocks in which many finely preserved fossils occur. At the base, where the railroad passes through the north shoulder of the mountain mass, fossils of the Lower Cambrian fauna occur in the hard, brown sandstones and in the bluish-gray limestones and shales above them for 315 feet. The characteristic fossil of this horizon is a large trilobite called *Olenellus*. No whole ones have been found on Mount Stephen, but an entire specimen found at about the same place in the section in Nevada is shown by Figure 1, Plate II. Above the Lower Cambrian formations comes the massive Cathedral limestone, 1680 feet thick, which forms the summits of Cathedral Mountain. These limestones are sandy and impure and in Mount Stephen only worm borings have been seen in them. Above the Cathedral formation there is a series of thin layers of bluish limestone and shale, 525 feet thick, which is called the Stephen formation. In this may be found many fragments of fossils that belong to the Middle Cambrian fauna. We have now reached the level of the celebrated fossil bed of Mount Stephen. The rock is a gray, siliceous and sandy shale that, 2200 feet above the railroad station at Field, is 150 feet in thickness. A sharp fold in the shale and the rock below has bent the layers sharply down the slope in the direction of Field. The frost, rain and snow have gradually broken up the great layers of shale and scattered them down the slopes. Nature has done all that

she could to open up and make accessible the great storehouse of fossils contained in the shales. Nearly every fragment of shale found on the slopes from 2000 to 2600 feet above Field has fossils upon it; not only fragments, but usually entire specimens of trilobites. The fossil bed thins out rapidly to the northeast and southwest. It is in fact a lens-shaped formation, thinning out from the center in all directions. The shales were originally a sandy mud that was slowly deposited as thin layers in quiet water. For some unknown reason, the trilobites died by thousands and were buried by the successive layers of mud. Small marine shells occur quite abundantly in some of the layers along with the trilobites and smaller fossils of various kinds. The largest and most abundant trilobite is called *Ogygopsis klotzi,* and from it the name *Ogygopsis shale* is given to the band or lens of siliceous shale in which the trilobite occurs.

The Stephen formation, with the Ogygopsis shale, forms the dark, bluish-gray band that extends across the north face of the mountain just above the shoulder, over the railroad tunnel. Another dark band of limestone, 150 feet thick, that shows in all photographs of Mount Stephen from the north, is 650 feet higher up, the interval being occupied by massive beds of gray siliceous limestone. A few fragments of Middle Cambrian fossils occur in the dark, bluish-gray limestone. Above the dark band, massive beds of gray, sandy limestone rise tier above tier for 2700 feet to the summit of the mountain. This great series is called the *Eldon formation,* from Eldon, north of which, in the slopes of Castle Mountain, it has a fine development.

Southwest of Mount Stephen the layers of rock are broken and bent to the southwest and west until they pass beneath Mount Dennis. All belong to the Cambrian period. A few fossils occur in the amphitheatre east of Mount Dennis, but the best collecting



Chas. D. Walcott, Photo

THE NORTH-WEST FACE OF MT. STEPHEN—SHOWING THE KICKING-HORSE RIVER AT THE BASE

Chas. D. Walcott, Photo

VIEW LOOKING NORTH-WEST FROM THE "FOSSIL BED," WHICH IS SHOWN IN THE FOREGROUND

ground for fossils above the great fossil bed, Ogygopsis shale, is in the Mount Bosworth section on the continental divide.

The principal locality from which good fossils can readily be obtained is on the slope of Mount Stephen, above Field. The best way to make a collection from the "fossil bed" is to ride up the trail on a pony to about 2000 feet above the railroad, collect specimens, securely wrap them in paper, place them in a bag, tie the bag to the saddle, and lead the pony down the mountain. A fine lot can be secured in a long day's trip, 6 a.m. to 6 p.m.

In order that the reader may understand the location of the "fossil bed" and the position of the various formations in the Mount Stephen section, four photographs taken in 1907 and a geological section are given in connection with this paper; also a list of the fossils from the "fossil bed" and illustrations of the more common species.

No. 1. Northwest fact of Mount Stephen, showing the Kicking Horse River at the base.

A—The railroad tunnel.

B—The great north shoulder.

C—The lower bluish-black limestone belt.

D—The upper bluish limestone belt.

E—The celebrated "fossil bed."

F—Best locality to camp in working "fossil bed."

G—East slope of Mount Dennis.

No. 2. View looking northwest from the "fossil bed," which is shown in the foreground. The trail from Field can be followed with a saddle animal to the large dead pine tree on the left. Just below this is the ridge upon which the trail is located. To the left of the ridge

near the triangular patch of snow is the best place to camp when working at the "fossil bed." It is 1600 feet above Field.

This picture gives a beautiful view of the various channels of the Kicking Horse River, the mass of Mt. Burgess, and the Van Horne range to the left of Mt. Burgess.

No. 3. View looking west from the "fossil bed" toward Mt. Dennis. The character of the "fossil bed" is beautifully shown, also the structural character of Mt. Dennis.

No. 4. View of the amphitheatre on the southwest side of the upper portion of Mt. Stephen. The "alcove" erosion of the cliff on the south side of the amphitheatre is beautifully shown. Middle Cambrian fossils occur in the rock shown in the lower right hand corner of the view.

GEOLOGICAL SECTION OF MOUNT STEPHEN.

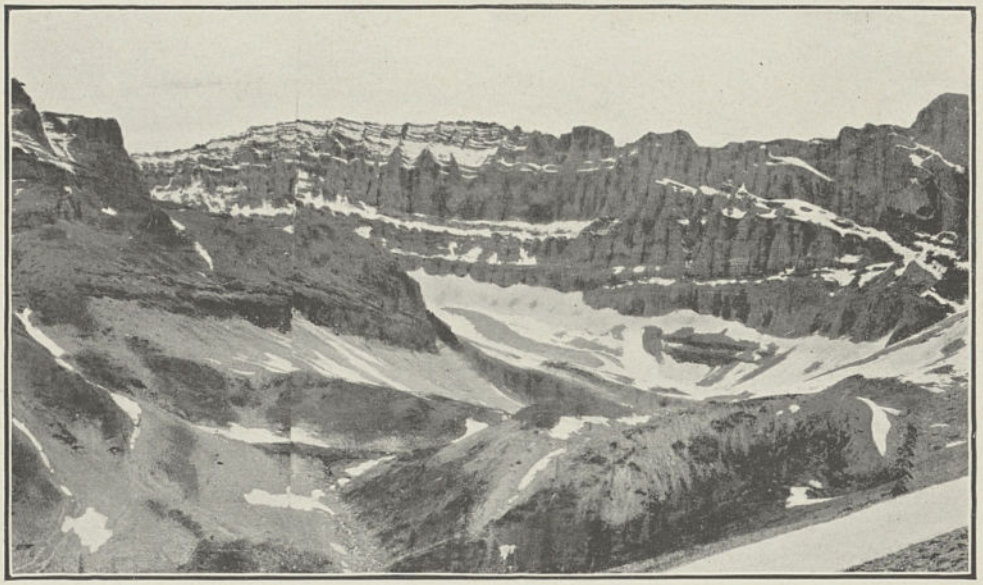
STUDIED JULY, 1907.

The section is from the summit of the mountain down the northeast and north slopes to the Canadian Pacific Railroad track below the tunnel and through the basal quartzitic sandstones.

The massive, siliceous, dolomitic limestone (*Eldon formation*) forming the upper portion of the mountain was not measured above the bluish-gray limestone and shaly band. Its thickness is estimated at 2,700+ feet. It is 2728 feet thick on Mount Bosworth. An attempt was made to measure the Cathedral formation, but owing to step-faulting, the result is not satisfactory. This formation has a thickness of 1595 feet on Mount Bos-

Chas. D. Walcott, Photo

VIEW LOOKING WEST FROM THE "FOSSIL BED" TOWARD MT. DENNIS



Chas. D. Walcott, Photo

VIEW OF THE AMPHITHEATRE ON SOUTH-WEST SIDE OF MT. STEPHEN

Chas. D. Walcott, Photo

JUVENILE GEOLOGISTS AT THE "FOSSIL BED," MT. STEPHEN

worth, so the measured and estimated thickness of 1680 feet on Mount Stephen is given in the section. No attempt was made to carry the section from Mount Stephen across to Mount Dennis through the Bosworth formation owing to local displacement and the alteration of the strata in Mount Dennis.

MIDDLE CAMBRIAN. (Summit of Mountain)

Eldon Formation—

1a. Massive bedded, gray, siliceous and dolomitic limestone, estimate .....2700 + ft.

1b. Bluish-gray limestone with bands of dark siliceous shale in lower portion .....190 ft.

Fauna—Middle Cambrian.

The fossils are very poorly preserved but the following have been recognized:

Protospongia (spicules)
Lingulella, species undetermined.
Hyolithes, species undetermined.
Agnostus, cf. montis Matthew.
Zacanthoides spinosus (Walcott)
Ptychoparia, species undetermined.
Bathyuriscus (pygidium)
Ogygopsis (pygidium)

1c. Gray arenaceous and dolomitic limestone .....650 ft.

Stephen Formation—

1. Calcareous and siliceous shales 150 ft.

This shale is given the name of *Ogygopsis shale* from the predominating trilobite contained in it, *Ogygopsis klotzi.* A detailed description of this

shale and its contained Middle Cambrian fauna may be found on page . In a siliceous shale about one-half mile east of the great fossil bed the following species were found:

Obolus mcconnelli (Walcott)
Nisusia (*Jamesella*) cf. *nautes* Walcott.
Hyolithes carinatus Matthew
Orthotheca, species undetermined.
Scenella varians Walcott.
Ptychoparia, species undetermined.

2. Thin bedded, bluish-black limestone forming dark broken cliff in many sections.....325 ft.

Fauna—Middle Cambrian.

In the upper portion of this formation just beneath the Ogygopsis shale in a bluish-black shaly limestone in the amphitheatre between Mount Stephen and Mount Dennis the following species of fossils were found:

Obolus mcconnelli (Walcott)
Acrotreta depressa Walcott.
Hyolithellus annulata (Matthew)
Ptychoparia, species undetermined.
Neolenus serratus (Rominger)
Ogygopsis klotzi (Rominger)

At another locality just east of the great "fossil bed" there were found in the limestone beneath the Ogygopsis shale the following species of fossils:

Micromitra, species undetermined.
Nisusia alberta Walcott.
Hyolithes, species undetermined.
Bathyuriscus rotundatus (Rominger)
Neolenus serratus (Rominger)

Near the base of this thin-bedded limestone the following species of fossils were found:

Micromitra, species undetermined.
Obolus mcconnelli (Walcott)
Micromitra (*Iphidella*) *pannula* (White)
Acrotreta (large)
Hyolithes, species undetermined.
Agnostus montis Matthew.
Agraulos, species undetermined.
Ptychoparia, species undetermined.
Zacanthoides, species undetermined.
Bathyuriscus, species undetermined.
Albertella, species undetermined.

2a. Massive bedded gray limestone, breaking down into thin layers on weathering ..... 37 ft.

3a. Gray and greenish siliceous shale 47 ft.

3b. Gray oolitic limestone in layers, 6 in. to 2 ft. thick..... 4 ft 6 in.

Fauna—Middle Cambrian.

Micromitra, species undetermined.
Nisusia alberta(?) Walcott.
Hyolithes, species undetermined.
Microdiscus, species undetermined.
Ptychoparia, species undetermined .

3c. Greenish siliceous shale..... 15 ft.

3d. Gray oolitic limestone..... 6 ft. 6 in.

3e. Gray, impure dolomitic limestone, compact, fine-grained and weathering buff and yellow... 38 ft.

3f. Greenish siliceous shale..... 1 ft.

3g. Similar to 3e..... 52 ft.

3h.	Gray oolitic limestone.....	2 ft. 2 in.
3i.	Similar to 3e.....	3 ft.
3j.	Gray oolitic limestone.....	4 ft. 2 in.
3k.	Similar to 3e.....	5 ft. 8 in.
3l.	Gray oolitic limestone.....	2 ft. 3 in.
3m.	Similar to 3e.....	5 ft.
3n.	Gray oolitic limestone.....	3 ft. 9 in.
3o.	Thin-bedded, bluish-grey limestone, weathering buff	10 ft.
	Total of 3	200 ft.

Cathedral Formation—

1. Massive bedded, arenaceous, siliceous limestone .....60 ft.

2. Massive bedded, arenaceous, siliceous dolomitic limestone. At 495 feet from the base the beds are thinner and of a dark gray color for 30 to 40 feet. At 825 feet the massive layers are banded with light and dark grey colors..1560 ft.

   Owing to small step faults the thickness of this series of strata is uncertain. The entire thickness on the northeast side was measured and an allowance made for duplication by faulting.

   This great limestone series forms bold, high cliffs on the east face of Mount Stephen and the west side of Cathedral Mountain.

Fauna—Annelid borings and trails at a few horizons.

3. Massive bedded arenaceous dolomitic limestone .....60 ft.

Total of Cathedral formation.....1680 ft.

LOWER CAMBRIAN—

Whyte Formation—

1. Thin-bedded bluish-black and gray limestone ..... 3 ft.

Fauna (from 1 and the interbedded limestones at the top of 2)

Nisusia (*Jamesella*) *lowi*, new species.
Stenotheca elongata Walcott var.
Platyceras, new species.
Scenella varians Walcott
Hyolithes billingsi Walcott
Ptychoparia, species a.
Crepicephalus, new species.
Protypus, new species.
Albertella, species undetermined.

2. Gray siliceous shale with interbedded gray fossiliferous limestone in layers 5 in. to 2 ft. thick in the upper portion .....108 ft.

Fauna (In the shale of the central portion)

Cystid plates.
Micromitra (*Paterina*), species undetermined
Acrotreta sagittalis taconica Walcott.
Nisusia (*Jamesella*) *lowi*, new species.

Hyolithes (fragment)
Hyolithellus cf. *micans* Billings
Scenella varians Walcott
Olenellus (fragments of thoracic segments)

3. Thin-bedded, compact, hard, dark, bluish-gray limestone, with a little interbedded gray, siliceous shale and a few beds of coarser gray limestone, 6 to 10 inches thick..52 ft.

Fauna (near the top)

Acrothele colleni, new species.
Acrotreta sagittalis taconica Walcott
Scenella varians Walcott
Stenotheca elongata Walcott var.
Albertella, species undetermined.
Olenellus (fragments).
Bathyuriscus, species undetermined.

Fauna (near the base)

Micromitra (*Paterina*) *labradorica* (Billings) var.
Micromitra (*Iphidella*) *pannula* (White)
Acrotreta sagittalis taconica Walcott
Bornemannia prima, new genus and new species
Ptychoparia, 3 species.

4. Brownish-gray, quartzitic sandstone in layers 2 to 4 inches thick 32 ft.

Fauna—

Microdiscus, species undetermined.
Olenellus (fragments).
Ptychoparia, species undetermined.
Protypus, species undetermined.

5. Gray, siliceous shale.....102 ft.

Fauna—

Hyolithes billingsi Walcott
Scenella varians Walcott
Ptychoparia, 2 species.

6. Bluish-black and gray limestone..18 ft.

Fauna—

Micromitra (*Iphidella*) *pannula* (White)
Acrotreta sagittalis taconica Walcott
Kutorgina cingulata Billings
Nisusia festinata Billings
Hyolithes billingsi Walcott.
Scenella varians Walcott
Protypus, new species.
Agraulos, species undetermined.
Ptychoparia, 3 species.
Olenellus canadensis, new species.

BOW RIVER TERRANE.

St. Piran Formation—

1. Massive bedded quartzitic sandstone .....300+ ft.

In the Lakes Agnes and Louise section the St. Piran formation has a thickness of 2640 feet.

Beneath the St. Piran the Lake Louise shale is 105 feet in thickness. In it occur a few fossils as follows:

Micromitra (*Iphidella*) *louise,* new species.

Cruziana (casts of tracks and burrows made in the mud by trilobites)

Beneath the Lake Louise shale there is a great thickness of quartzitic sandstone and siliceous shales of which about 600 feet of the upper portion is exposed at Lake Louise.

FAUNA OF THE GREAT FOSSIL BED.

(Ogygopsis Shale)

The fossils occur in a gray siliceous and arenaceo-calcareous shale, only a trace of calcareous matter showing. The shale usually rests on a thin-bedded limestone, but in one instance a lentile of quartzitic gray sandstone occurs between the lower limestone and the shale. This is at the upper northeast end of the exposure of the shales, and here several species of fossils occur that were not seen elsewhere, notably *Burlingia hectori* Walcott.

Fossils are very rare for 50 feet above the base of the shale and then only the more common species such as *Ogygopsis klotzi, Bathyuriscus rotundatus* and *Ptychoparia cordillerae.*

The list of named fossils from this shale is as follows:

1. *Hyolithellus flagellum* (Matthew)
2. *Hyolithellus annulata* (Matthew)
3. *Orthotheca corrugata* Matthew
4. *Orthotheca major,* new species.
5. *Hyolithes sp.*
6. *Hyolites carinatus* Matthew.
7. *Stenotheca wheeleri,* new species.
8. *Platyceras romingeri* Walcott
9. *Platyceras bellianus,* new species.
10. *Acrotreta depressa* (Walcott)
11. *Micromitra (Iphidella) pannula* (White)

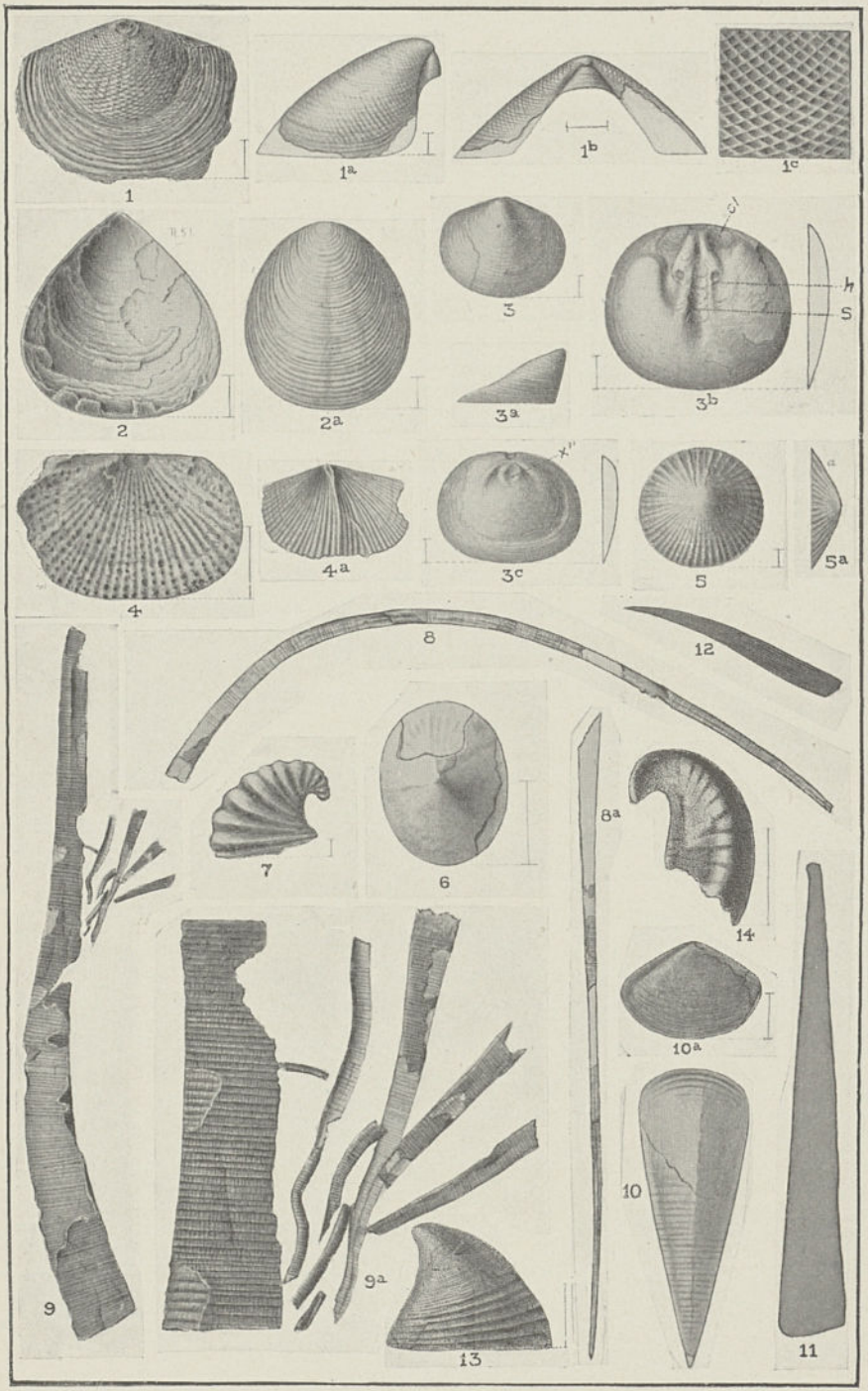


PLATE I.—MT. STEPHEN FOSSILS

12. *Obolus mcconnelli* (Walcott)
13. *Nisusia alberta* Walcott
14. *Philhedra columbiana* (Walcott)
15. *Scenella varians* Walcott
16. *Anomolocaris canadensis* (Whiteaves)
17. *Anomolocaris whiteavesi,* new species.
18. *Anomolocaris* (*?*) *acutangulus,* new species.
19. *Agnostus montis* Matthew
20. *Dorypyge* (*Kootenia*) *dawsoni* (Walcott).
21. *Bathyuriscus rotundatus* (Rominger)
22. *Bathyuriscus pupa* Matthew. Probably 23.
    Conocephalites cf. *perseus* Matthew—30.
    Corynexochus romingeri Matthew—25.
23. *Bathyuriscus occidentalis* (Matthew)
24. *Bathyuriscus ornatus* Walcott
25. *Karlia stephenensis* Walcott
    Neolenus granulata Matthew—26.
26. *Neolenus serratus* (Rominger)
27. *Ogygopsis klotzi* (Rominger)
28. *Oryctocephalus reynoldsi* Reed
29. *Burlingia hectori* Walcott
30. *Ptychoparia cordillerae* (Rominger)
31. *Ptychoparia palliseri,* new species.
32. *Zacanthoides spinosus* (Walcott)

DESCRIPTION OF PLATE I.

MICROMITRA (*IPHIDELLA*) *PANNULA* (White)

Figs. 1, 1a, 1b. Top, side and back views of a ventral valve.

Fig 1c. Surface greatly enlarged.

OBOLUS MCCONNELLI (Walcott)

Fig. 2. An imperfect ventral valve, enlarged.

Fig. 2a. A dorsal valve, enlarged.

ACROTRETA DEPRESSA (Walcott)

Figs. 3 and 3a. Top and side views of an elevated ventral valve.

Fig. 3b. Cast of the interior of a dorsal valve.

Fig. 3c. Cast of the interior of a ventral valve.

NISUSIA ALBERTA (Walcott)

Fig. 4. A cast of the exterior surface showing bases of surface spines.

Fig. 4a. A compressed valve.

PHILHEDRA COLUMBIANA (Walcott)

Figs. 5 and 5a. Top and side views, greatly enlarged. (Very rare).

SCENELLA VARIANS Walcott

Fig. 6. Top view of a specimen with the apex nearer the center than usual.

STENOTHECA WHEELERI, new species.

Fig. 7. Side view of the type specimen. (Comparatively rare).

HYOLITHELLUS FLAGELLUM (Matthew)

Fig. 8. A long curved specimen.

Fig. 8a. A slender nearly straight specimen.

HYOLITHELLUS ANNULATA (Matthew)

Fig. 9. A large specimen with a group of small tubes adjoining it.

Fig. 9a. Enlargement of a portion of the specimen represented by figure 9. The small tubes are much like those of *Hyolithellus flagellum.*

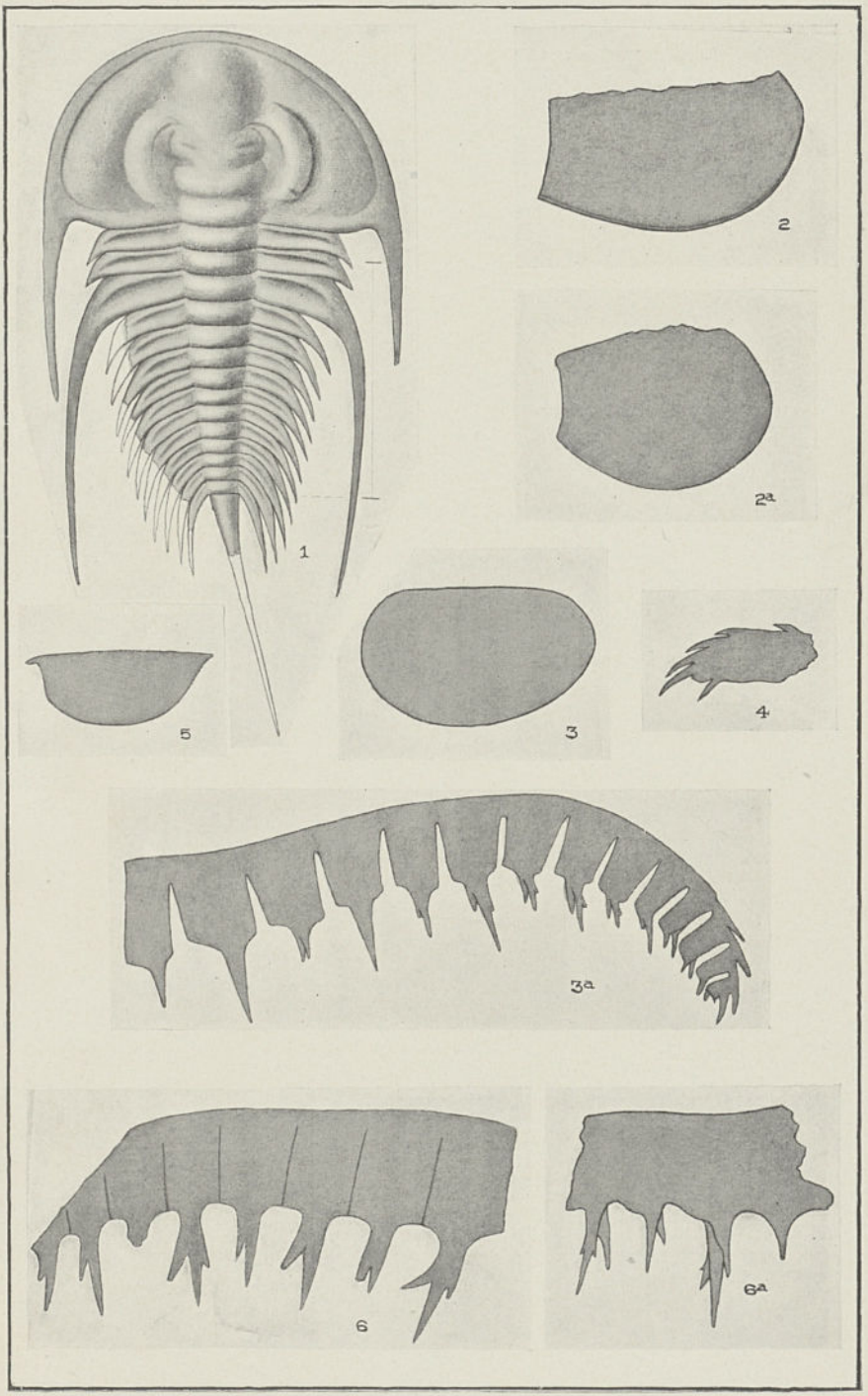


 PLATE II —MT. STEPHEN FOSSILS

HYOLITHES CARINATUS Matthew

Fig. 10. Shell as it appears flattened in the shale.

Fig. 10a. Operculum that covered the opening of the shell.

ORTHOTHECA MAJOR, new species.

Fig. 11. This is a thin shell compressed in the shale.

ORTHOTHECA CORRUGATA Matthew

Fig. 12. Portion of a flattened tube.

PLATYCERAS (?) BELLIANUS, new species.

Fig. 13. Side view of shell flattened in the shale. (Very rare).

DESCRIPTION OF PLATE II.

OLENELLUS GILBERTI · Meek ·

Fig. 1. Introduced to show the character of the trilobites which occur in fragments at the tunnel near the north base of Mount Stephen.

ANOMOLOCARIS (?) WHITEAVESI, new species.

Figs. 2 and 2a. Broken and compressed specimens of the carapace.

Figs. 6 and 6a. Abdominal segments tentatively referred to this species.

Fig. 4. A caudal segment, probably of this species.

ANOMOLOCARIS CANADENSIS Whiteaves

Fig. 3. Carapace referred to this species. This is the most abundant form of carapace.

Fig. 3a. Thirteen abdominal and one caudal segment.

ANOMOLOCARIS (?) ACUTANGULUS, new species

Fig. 5. A carapace, very rare.

DESCRIPTION OF PLATE III.

ORYCTOCEPHALUS REYNOLDSI Reed

Fig. 1. A nearly entire specimen twice enlarged. Not rare.

BATHYURISCUS OCCIDENTALIS (Matthew)

Fig. 2. A very rare species.

BATHYURISCUS ORNATUS Walcott

Fig. 3. A comparatively rare species.

KARLIA STEPHENENSIS Walcott

Fig. 4. A small and rather rare species.

PTYCHOPARIA CORDILLERAE (Rominger)

Fig. 5. This is one of the common species. It is usually about one-half the size of this figure.

PTYCHOPARIA PALLISERI, new species.

Fig. 6. A large rare species.

AGNOSTUS MONTIS Matthew

Fig. 7. The fragments of this species are very abundant in some layers.

BURLINGIA HECTORI Walcott

Fig. 8. Greatly enlarged. This is a small, very rare species.

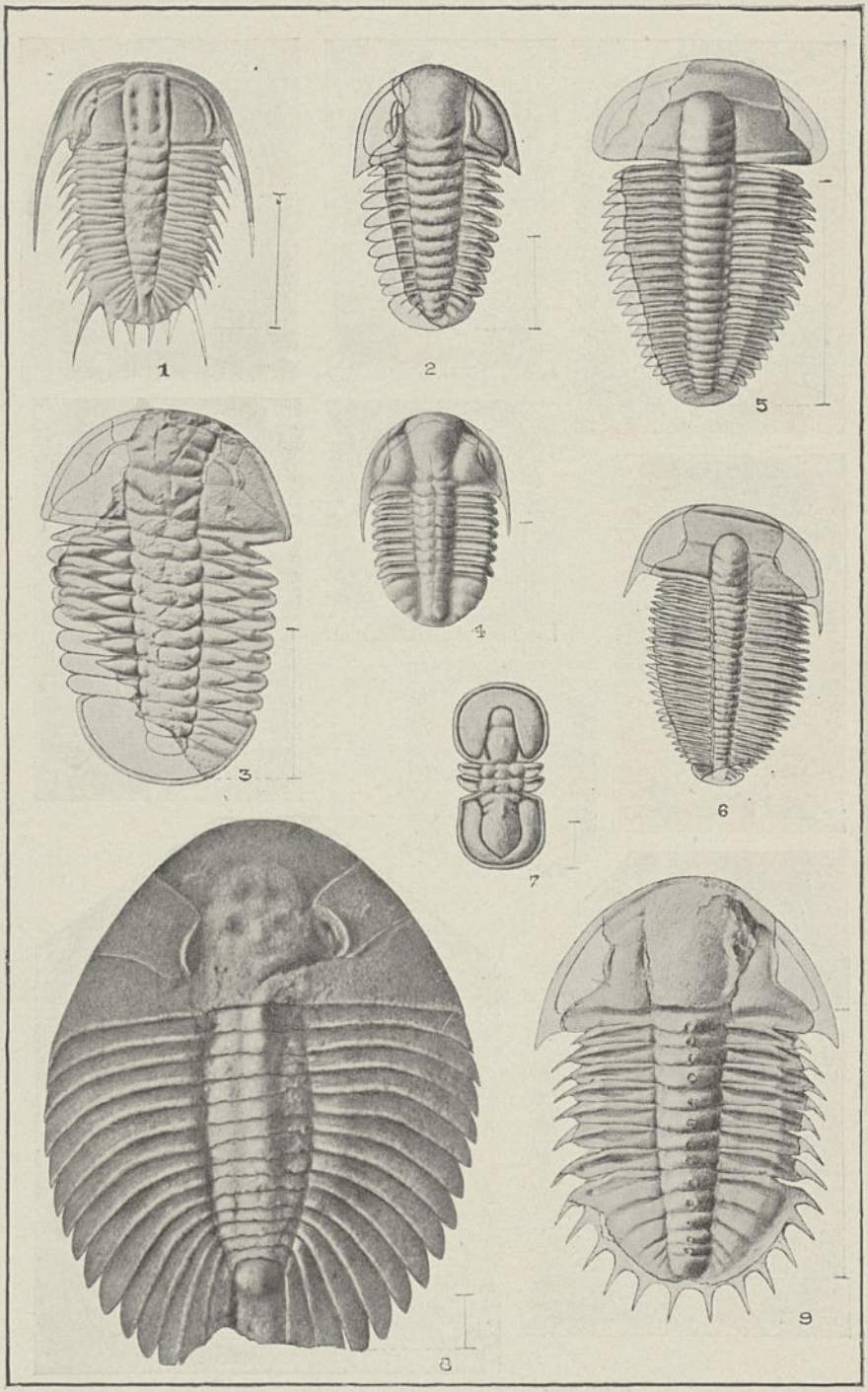


PLATE III.—MT. STEPHEN FOSSILS

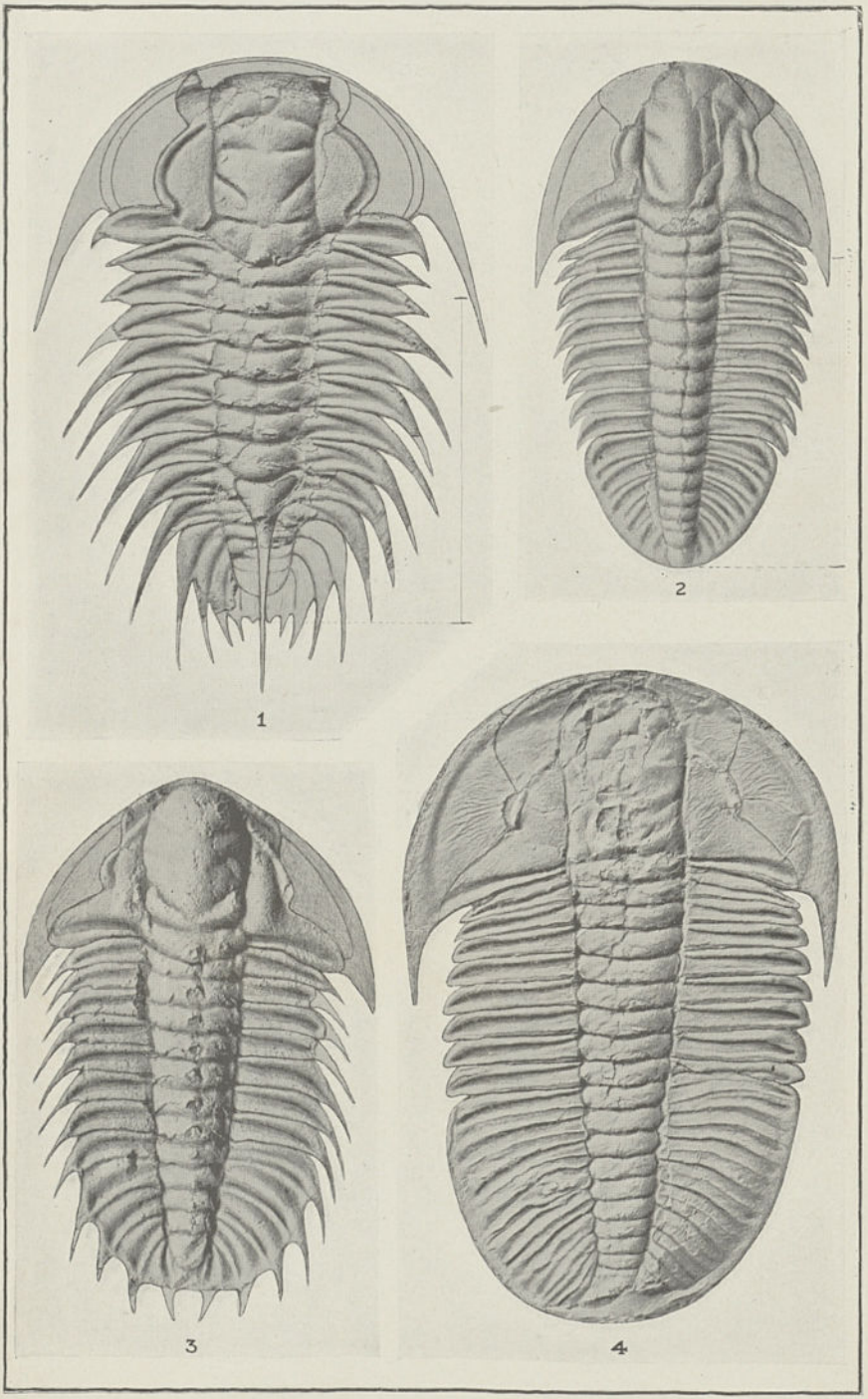


PLATE IV.—MT. STEPHEN FOSSILS

DORYPGE (KOOTENIA) DAWSONI Walcott

Fig. 9. A large specimen. Not very abundant, but often mistaken for *Neolenus serratus.*

DESCRIPTION OF PLATE IV.

ZACANTHOIDES SPINOSUS (Walcott)

Fig. 1. A large specimen partially crushed in the shale. A common species.

BATHYURISCUS ROTUNDATUS (Rominger)

Fig. 2. The average size of this species is about one-half that of this figure. It is quite abundant.

NEOLENUS SERRATUS (Rominger)

Fig. 3. A common species.

OGYGOPSIS KLOTZI (Rominger)

Fig. 4. This is the largest and most abundant trilobite in the fossil bed.