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VOLUME 97, NUMBER 3

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(WITH ONE PLATE)

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Curator, Division of Invertebrate Paleontology,
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The Lord Baltimore Press
BALTIMORE, MD., U. S. A.

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INTRODUCTION

From 1921 to 1924 Dr. Edward Sampson, of Princeton University, then a member of the United States Geological Survey, examined the Pend Oreille mining district which surrounds the southern part of Pend Oreille Lake, Bonner County, Idaho. A fossiliferous Middle Cambrian series crops out in several of the fault blocks into which the district is divided. This was the first Cambrian outcrop discovered in that part of North America. Subsequently, other Cambrian areas were found in the northwestern United States and the adjacent portions of Canada, in the extensive area previously thought barren of Cambrian strata except for the occurrence in the Lewis and Clark Range, west-central Montana. These occurrences were briefly discussed in 1934.[1] Since the Pend Oreille Lake area is isolated from other Cambrian outcrops and the stratigraphic succession is clearly determined, description of the faunas is desirable.

Dr. Sampson published a brief summary[2] of his findings in the district and described the stratigraphy, naming three Cambrian formations.

BELTIAN

Before discussing the Middle Cambrian formations a few words descriptive of the underlying Beltian strata are in order. Five Beltian formations, totaling more than 30,000 feet, are described beneath the Middle Cambrian. This enormous thickness of sediments consists of argillaceous sandstone, fine-grained massive sandstone, and heterogeneous beds of quartzite, sandstone, and argillite, with or without a

[1] Resser, C. E., Recent discoveries of Cambrian beds in the northwestern United States. Smithsonian Misc. Coll., vol. 92, no. 10, 1934.

[2] Sampson, Edward, Geology and silver ore deposits of the Pend Oreille District, Idaho. Idaho Bur. Mines Geol., Pamphlet 31 (mimeographed), 1928.

calcareous content. Cross-bedding, sun cracks, ripple marks and the other usual Beltian features characterize the series, but contemporaneous igneous rocks are evidently lacking, which is also the case in the Beltian strata of nearby western Montana.

MIDDLE CAMBRIAN

The Middle Cambrian series of the Pend Oreille region begins with a quartzite, which is followed in turn by argillaceous shale and calcareous formations. No mention is made of younger strata, and the published structure sections indicate that the Cambrian is not overlain by other beds.

Gold Creek quartzite.—The Gold Creek quartzite, which is estimated to average 400 feet in thickness, is easily distinguished from the Beltian by its coarser grain. Some of the conglomeratic beds contain pebbles up to 3 inches in diameter and cross-bedding is a characteristic feature. Outcrops are conspicuous because of the resistance of the rock to weathering. Unfortunately, the contact of the Gold Creek with the Beltian rocks is not clearly exposed so that essential history is lacking.

Rennie shale.—This formation is only 50 to 75 feet thick and consists of soft olive argillaceous shale, sometimes micaceous. Because it is so easily eroded, the Rennie shale seldom crops out. In fact, the fossils here described were collected from the bed of a brook.

The published summary fails to mention the fossiliferous limestone nodules present in the Rennie shale. They evidently are about the same size and shape as similar nodules obtainable from most Cambrian shales in the Cordilleran region. Internally, however, these nodules are peculiar as they consist of an odd mixture of brown and blue limestone. Both sorts occur as distinct masses, sometimes sharply angular, but more frequently irregular in shape, and the change from one to the other is abrupt. The brown limestone, which looks like a fine sandstone, is evidently rather pure calcium carbonate, judging from its rapid effervescence, and, since this portion of the rock does not scratch steel, it is assumed to be free from silica or sand. On the other hand, the blue limestone masses contain sand grains or silica, even though they also effervesce freely. Fossils are absent from the brown masses but are very abundant in the blue portions. Strangely, there are but two species of trilobites in these nodules, the abundant *Vanuxemella idahoensis* and rare examples of *Albertella sampsoni.* Neither species has been recognized in the larger shale fauna, although elsewhere these trilobite forms are found together.

The shale has the species listed below. Besides the names given in this list there is a poor specimen that seems to be *Eocystites.* A few imperfect specimens of *Obolus* and a fragment of a shell similar to *Westonia ella* represent the brachiopods.

Elrathia sampsoni Resser
Elrathia longiceps Resser
Glossopleura intermedia Resser
Hyolithes idahoensis Resser
Margaretia angustata Resser
Schistometopus typicalis Resser
Urotheca sampsoni Resser

Lakeview limestone.—Where unaltered, two rock types characterize this conspicuous and commercially valuable formation. One type consists of cliff-forming massive beds which vary from nearly pure limestone to nearly pure dolomite. The other beds are shaly, containing thin-bedded, highly fossiliferous limestone. Sampson does not state what relative position the two types hold with respect to each other, but the thin-bedded and shaly material probably forms the lower portion of the formation. Metamorphism caused different degrees of alteration, some of the beds becoming a crystalline marble.

Black crystalline limestone from the shaly beds yields an abundant fauna which is listed below.

Acrothele speciosa Resser
Acrotreta nitens Resser
Agnostus bonnerensis Resser
Alokistocare noduliferum Resser
Alokistocare natale Resser
Alokistocare nactum Resser
Alokistocare notatum Resser
Alokistocare normale Resser
Alokistocare nothum Resser
Clavaspidella minor Resser
Elrathia idahoensis Resser
Iphidella cf. *pannula* (White)
Lingulella idahoensis Resser
Pagetia fossula Resser
Oryctocephalus walcotti Resser
Utia curio Walcott
Zacanthoides sampsoni Resser

A small collection of altered rock, presumably from the Lakeview formation, contains a pygidium of *Glossopleura.* Another lot of impure dark blue limestone is especially interesting because it contains, among other fossils, a species of *Tonkinella,* unfortunately too poorly preserved to illustrate. This is not the *Tonkinella*-like form described below as the pygidium possibly belonging to *Utia.*

RELATIONSHIP OF THE FAUNAS

It has already been pointed out that the faunas of the Rennie shale, both in the limestone nodules and in the shale, have no species in common. Nevertheless, both must be regarded as one fauna, since elsewhere they occur together. Neither have any species been found common between the Rennie shale and the Lakeview limestone. These faunas also are elsewhere found intermingled. From these facts it seems that these faunas represent faunal subzones or possibly facies developments, but for purposes of correlation it is necessary to treat the faunas of the Rennie and Lakeview formations as a unit.

The fossils in the Rennie shale are clearly related to those in the Stephen formation.[3] *Margaretia, Elrathia, Glossopleura,* and the particular form of *Hyolithes* are definite relatives of species in the Stephen. On the other hand *Vanuxemella* and *Albertella* are more characteristic of the older Ptarmigan formation of the Canadian Rockies. The Lakeview is also related to the Stephen, particularly by the *Agnostus, Oryctocephalus,* and *Zacanthoides.* The numerous species of *Alokistocare* are found more commonly in other Middle Cambrian formations than in the Stephen.

Close connection exists between the Lakeview and the Spence shale[4] of southern Idaho. *Pagetia* and the rare trilobite *Utia curio* indicate that these two formations are identical in age. The other genera, both in the Lakeview and in the Rennie, occur in the Spence also.

DESCRIPTION OF THE FOSSILS

The identifiable material is described and illustrated as completely as possible. In order to avoid unnecessary printing, locality numbers are given with the descriptions and in the plate legend. A full description of the two localities is given below.

Locality 37m: Middle Cambrian, Rennie shale; headwaters North Gold Creek, south side of Packsaddle Mountain, east of Pend Oreille Lake, Idaho.

Locality 37n: Middle Cambrian, Lakeview limestone; cement mine just north of Lakeview, Pend Oreille Lake, Idaho.

MARGARETIA Walcott, 1931

MARGARETIA ANGUSTATA, n. sp.

Plate 1, fig. 2

A number of narrow flexible tubes have a surface roughened by elongate depressions typical of *Margaretia.* Compared with the genotype, *M. dorus,* as well as species in process of publication, *M. angustata* is considerably smaller in size, averaging less than one-fourth the diameter of the smaller specimens of the other species.

Locality 37m.

Holotype.—U.S.N.M. no. 95019.

[3] Walcott, C. D., Mount Stephen rocks and fossils. Canadian Alpine Journ., vol. 1, no. 2, 1908.

[4] Walcott, C. D., Smithsonian Misc. Coll., vol. 53, no. 1, p. 8, 1908.

UROTHECA Matthew, 1899

UROTHECA SAMPSONI, n. sp.

Plate 1, fig. 1

Long, slender tubes abundant in the Rennie shale are referable to this genus. The illustrated specimen appears to have a carina but is merely broken in the middle. Faint annulations seem to occur on some individuals.

Locality 37m.

Holotype.—U.S.N.M. no. 95020.

HYOLITHES Eichwald, 1840

HYOLITHES IDAHOENSIS, n. sp.

Plate 1, figs. 57, 58

A species of *Hyolithes* occurs in the shale; unfortunately, most of the specimens are poorly preserved. The species is evidently related to *H. carinata* but is larger, the carina is less pronounced, and the operculum has wider wings.

Locality 37m.

Cotypes.—U.S.N.M. no. 95021.

LINGULELLA Salter, 1866

LINGULELLA IDAHOENSIS, n. sp.

Plate 1, fig. 18

This shell is nearest to *L. isse* in shape, but it is a smaller brachiopod. It is possible that this brachiopod is one of the Middle Cambrian forms now included in *L. desiderata.*

Locality 37n.

Holotype.—U.S.N.M. no. 95022.

ACROTHELE Linnarsson, 1876

ACROTHELE SPECIOSA, n. sp.

Plate 1, figs. 6, 7

This form is most like *A. colleni,* from which it differs in having weaker ribs and growth lines, but more particularly in the narrowness of the false area.

Locality 37n.

Cotypes.—U.S.N.M. no. 95023.

ACROTRETA Kutorga, 1847

ACROTRETA NITENS, n. sp.

Plate 1, figs. 3-5

The generic reference is not certain, for this species differs from all described forms of *Acrotreta*. Recently, similarly constructed species have been found in both Lower and Middle Cambrian collections. The illustrations present clearly the characteristics of the species.

Locality 37n.

Cotypes.—U.S.N.M. no. 95024.

AGNOSTUS Brongniart, 1822

AGNOSTUS BONNERENSIS, n. sp.

Plate 1, figs. 16, 17

This agnostid is a typical form of the Cordilleran Middle Cambrian. The characteristic features place it between *A. montis* Matthew of the Stephen formation and *A. interstrictus* White from the Wheeler shale of Utah. *A. bonnerensis* has also been compared with the undescribed species in the Spence shale fauna, from which it differs in possessing axial furrows on the pygidium.

Locality 37n.

Holotype and paratypes.—U.S.N.M. no. 95025.

PAGETIA Walcott, 1916

PAGETIA FOSSULA, n. sp.

Plate 1, figs. 8-11

P. fossula is similar to *P. clytia* from the Spence shale, but differs in having a median furrow like *P. bootes.* The pygidium has short axial spines.

Locality 37n.

Cotypes.—U.S.N.M. no. 95026.

ALBERTELLA Walcott, 1908

ALBERTELLA SAMPSONI, n. sp.

Plate 1, figs. 24-26

The glabella of this species is long and is not expanded much in front. The pygidium is wide, much like *A. helena* and has a rather wide concave border, with a nearly straight posterior margin. The spines diverge more than average.

Locality 37m.

Holotype and paratypes.—U.S.N.M. no. 95027.

ALOKISTOCARE Lorenz, 1906

ALOKISTOCARE NORMALE, n. sp.

Plate 1, fig. 14

This species is much like *A. subcoronatum* except for its larger size. Also the furrows, eyelines, and distribution of relief in the brim are different.

Locality 37n.

Holotype.—U.S.N.M. no. 95028.

ALOKISTOCARE NODULIFERUM, n. sp.

Plate 1, figs. 52, 54

This species has a wide brim, the test is finely and closely granulated, the brim is striated beneath the test, and two nodes are situated in the dorsal furrow a short distance forward of the occipital furrow.

Locality 37n.

Holotype and paratype.—U.S.N.M. no. 95029.

ALOKISTOCARE NATALE, n. sp.

Plate 1, fig. 53

A. natale is nearest like *A. noduliferum.* It has a brim of about the same size, and other proportions are similar. Small nodes are also present in the rear portion of the dorsal furrow. However, the surface of *A. natale,* which is finely granulated, has, in addition, scattered larger granules.

Locality 37n.

Holotype.—U.S.N.M. no. 95030.

ALOKISTOCARE NACTUM, n. sp.

Plate 1, figs. 41, 42

A. nactum is characterized by a medium brim, on which a rather wide flat rim is differentiated by its upturned position.

Locality 37n.

Holotype and paratype.—U.S.N.M. no. 95032.

ALOKISTOCARE NOTHUM, n. sp.

Plate 1, figs. 51, 55

This species is more normal than *A. nactum,* which it resembles. A medium swelling causes the rim to be less even in width throughout.

Locality 37n.

Holotype and paratype.—U.S.N.M. no. 95031.

ALOKISTOCARE NOTATUM, n. sp.

Plate 1, fig. 43

This species departs considerably from the norm of the genus because of its convexity. The test is finely granulated, and only a narrow rim is differentiated by the upturned edge.

Locality 37n.

Holotype.—U.S.N.M. no. 95033.

ELRATHIA Walcott, 1924

ELRATHIA IDAHOENSIS, n. sp.

Plate 1, figs. 36-40

A fullness in all parts of the cranidium characterizes this species. It is typical of the genus in all respects. The thorax has about 15 segments.

Locality 37n.

Holotype and paratypes.—U.S.N.M. no. 95034.

ELRATHIA SAMPSONI, n. sp.

Plate 1, figs. 31, 35, 58

Several cranidia of various sizes are illustrated, thus presenting the characteristics of the species. Compared with *E. idahoensis,* the species is somewhat narrower at the eyes, and the glabella is also tapered more.

Locality 37m.

Holotype and paratypes.—U.S.N.M. no. 95035.

ELRATHIA LONGICEPS, n. sp.

Plate 1, fig. 50

Compared with *E. sampsoni,* this species has a longer glabella and relatively shorter brim; also, the brim is divided more nearly equally between the rim and preglabellar area.

Locality 37m.

Holotype.—U.S.N.M. no. 95036.

GLOSSOPLEURA Poulsen, 1927

GLOSSOPLEURA INTERMEDIA, n. sp.

Plate 1, fig. 56

Several pygidia, libragenes, and two incomplete hypostomata, but no cranidia, were found in the shale collections. One pygidium is figured. It is more like *G. boccar* than the Spence shale form because the doublure is not so wide. Fusion is carried nearly to the extinction of the rib furrows.

Locality 37m.

Holotype.—U.S.N.M. no. 95037.

ORYCTOCEPHALUS Walcott, 1886

ORYCTOCEPHALUS WALCOTTI, n. sp.

Plate 1, figs. 22, 23

A small fragmentary granulated cranidium, with a typical *Oryctocephalus* glabella is tentatively referred to the species.

The pygidium is nearest like *O. reynoldsi,* differing in having heavier spines and more clearly impressed pleural grooves.

Locality 37n.

Holotype and paratype.—U.S.N.M. no. 95038.

CLAVASPIDELLA Poulsen, 1927

CLAVASPIDELLA MINOR, n. sp.

Plate 1, figs. 45, 49

A number of specimens in the Lakeview limestone evidently belong to *Clavaspidella.* This species is much smaller than any other thus far described; also, both the pygidial axis and the eye lobes are long.

Locality 37n.

Holotype and paratypes.—U.S.N.M. no. 95039.

UTIA Walcott, 1924

UTIA CURIO Walcott

Plate 1, figs. 19-21

Specific differences are not apparent between the *Utia* of the Lakeview limestone and of the Spence shale, consequently the Idaho form is identified as *U. curio.*

A peculiar small pygidium characterized by its radiating furrows and grooves is tentatively assigned to the species.

Locality 37n.

Plesiotypes.—U.S.N.M. no. 95041.

VANUXEMELLA Walcott, 1908

VANUXEMELLA IDAHOENSIS, n. sp.

Plate 1, figs. 13-15

This species has stronger pygidial furrows than *V. nortia,* and also larger rear spines. Comparison with the Montana species, *V. con-*

tracta, shows that *V. idahoensis* has the rear spines set wider apart, giving the entire pygidium a wider aspect. *V. idahoensis* has incompletely fused pleural furrows.

Locality 37m.

Cotypes.—U.S.N.M. no. 95042.

SCHISTOMETOPUS, n. gen.

Diagnosis.—Glabella long, occupying nearly the entire cranidial length; tapered slightly. There are four pairs of glabellar furrows and the occipital furrow. Fixigenes about half width of glabella. Anterior suture slightly divergent. Posterolateral limbs rather short. Eyes small, situated slightly behind the midpoint. Eyelines curved backward, arising opposite anterior pair of glabellar furrows. Brim consists of rim only. Two deep furrows run forward from the anterior angles of the dorsal furrow and separate a central thickened portion from the two flat lateral portions of the rim.

Genotype.—*S. typicalis,* new species.

Name.—σχιστος = divided: μετοπος = forehead.

SCHISTOMETOPUS TYPICALIS, n. sp.

Plate 1, fig. 12

During preparation the important rim was injured because the specimen was thought to be an *Elrathia.* Fortunately, enough of the rim remains to show its features. It will be observed that the glabella of *S. typicalis* is like that of *Elrathia sampsoni* because of the four sets of furrows.

Locality 37m.

Holotype.—U.S.N.M. no. 95040.

ZACANTHOIDES Walcott, 1888

ZACANTHOIDES SAMPSONI, n. sp.

Plate 1, figs. 27-30

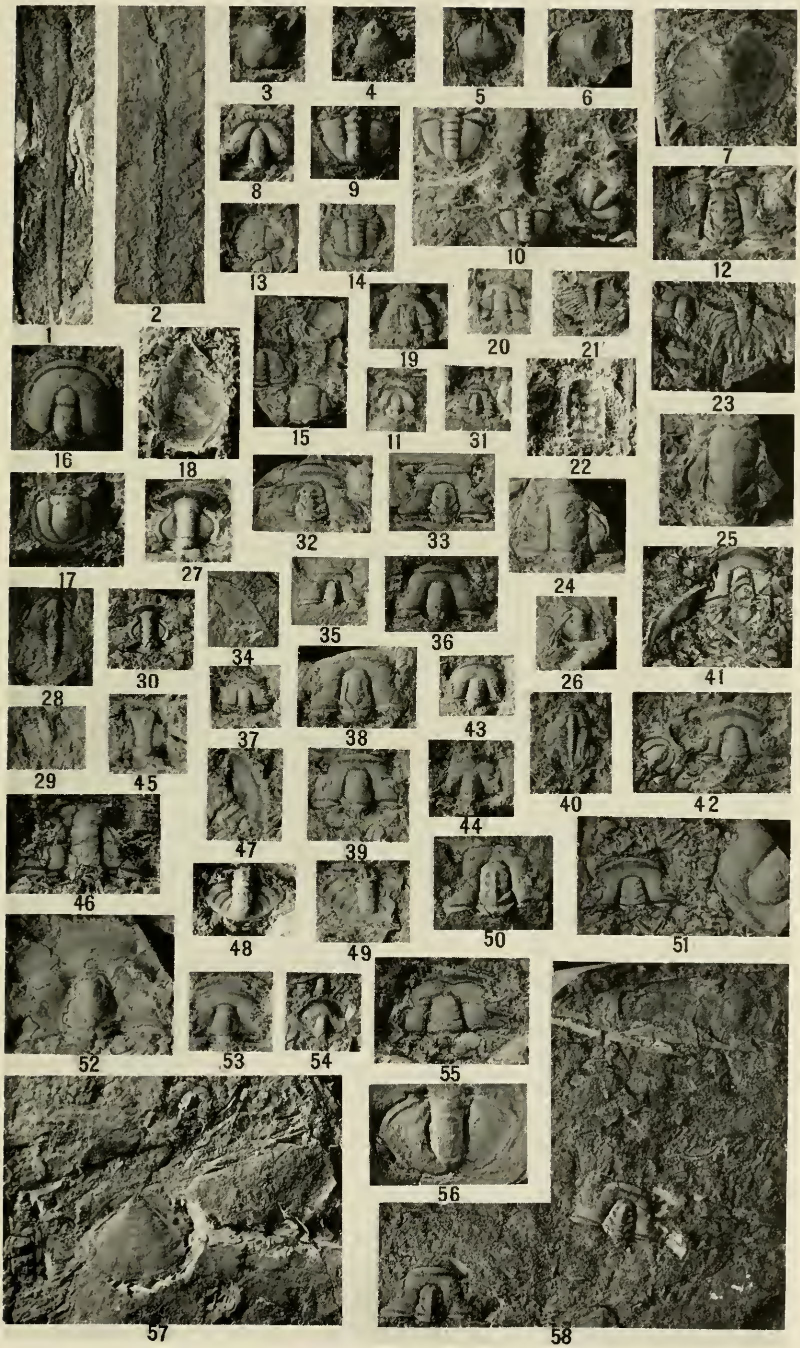
A small form of *Zacanthoides* is present in the Lakeview limestone. The pygidium has spines of nearly equal length, and the thorax has 8 or 9 segments. Glabellar furrows are short and shallow.

Locality 37n.

Holotype and paratypes.—U.S.N.M. no. 95043.

EXPLANATION OF PLATE

Figs. 1, 2, 12-15, 24-26, 31-35, 56, 58, are from Loc. 37m.
Figs. 3-11, 16-24, 27-30, 36-55, are from Loc. 37n.



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(For explanation, see page 11.)