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(WITH SIX PLATES)

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INTRODUCTION

The Spence shale occurs in the northern Wasatch Mountains, in northeastern Utah and adjacent portions of Idaho. Thus far neither this shale nor its fauna has been found south of Brigham, but it is present in both the Wasatch proper and its eastern prong, the Bear River Range. Fossils are everywhere present, sometimes in great abundance and variety.

In 1896 R. S. Spence sent some very interesting and well-preserved Middle Cambrian fossils to Dr. Charles D. Walcott. Correspondence shows that additional material was sent during the next 10 years. Late in the summer of 1906 Dr. Walcott moved camp from Blacksmith Fork to the eastern slopes of the Bear River Range in the vicinity of the locality discovered by Mr. Spence. A brief description of the sections studied in 1906, together with formational names, was published by Walcott in April 1908 (1908a). In December of the same year (1908b) the sections were republished in more detail, including preliminary faunal lists. Unfortunately, the several sections measured in both divisions of the Wasatch were combined into a composite section, thereby obscuring essential stratigraphic facts.

The Spence shale was defined (Walcott 1908a) as "argillaceous shales" about 30 feet thick with "an extremely abundant and varied lower Middle Cambrian fauna," and in the fuller description (Walcott 1908b) the words "and sandy shale" were added. This thin stratigraphic unit was regarded as a member at the base of the Ute formation. It is not a mappable unit and therefore deserves recognition only for its abundant and striking fauna.

The type locality for the Spence shale is in Spence Gulch, which is situated on the eastern slopes of the Bear River Range, about 5 miles southwest of Liberty and 15 miles west of Montpelier, Idaho. Similar beds, but with few fossils, are recognized to the south near Garden City. On the western slope of the Bear River Range, the

Spence shale fauna occurs in the base of the Ute formation in Blacksmith Fork. Deiss (1938) remeasured this section, which forms the standard for the northern Wasatch region, and concluded that the Spence was not present in Blacksmith Fork. But these studies indicate that Walcott's original assignment was probably correct. In the Wasatch proper Spence shale fossils were obtained from Two Mile Canyon, near the northern terminus of the range, and from a belt of unknown extent several miles north of Brigham.

At the latter locality the fauna is found in more calcareous shales than elsewhere. Usually, the Spence shale is a rather soft argillaceous shale, but the fossils are never completely flattened. It seems that fossiliferous lime nodules occur at most localities; at some places these are small, very hard pyritiferous concretions, and at others they consist of crystalline limestone. Irregular oolitic limestone layers are also evidently developed locally.

Shortly after the large collections were made from Spence Gulch in 1906, illustrations of the more conspicuous elements of the fauna were prepared. The 1912 monograph includes the brachiopods, and from time to time trilobite species were described incidentally in other papers. Even the present paper does not describe every species, but it gives a fairly accurate concept of the fauna, only a few obscure forms remaining. Neither are the large number of embryonic specimens considered.

The strata in the Pend Oreille Lake region (Resser, 1938) are the only precise equivalents of the Spence shale. Close affinities exist southward in the Wasatch and southwestward from and including the Ophir shale of the Oquirrh Range. Exact correlations are not attempted until several other faunas have been studied.

In order to save many repetitions of locality descriptions, they are placed here in full, and reference is made to them in the text by number only.

Locality 55c.—Middle Cambrian, Spence shale; about 5 miles southwest of Liberty, 15 miles west of Montpelier, Bear River Range, Idaho.

Locality 51L.—Middle Cambrian, Spence shale; Blacksmith Fork, about 10 miles east of Hyrum, Bear River Range, Utah.

Locality 55e.—Middle Cambrian, Spence shale; mouth of first small canyon south of Wasatch Canyon, east of Lakeview Ranch, $4\frac{1}{2}$ miles north of Brigham, Wasatch Mountains, Utah.

Locality 20x.—Middle Cambrian, "Langston," Spence, Ute; near top of gulch, about 2 miles north of Brigham City, Wasatch Mountains, Utah.

Locality 5g.—Middle Cambrian, Spence shale; Two Mile Canyon, 2 miles southeast of Malad, Wasatch Mountains, Idaho.

Locality 32x.—Middle Cambrian, Ute, Spence, Bloomington; Wasatch Canyon, 5 miles north of Brigham, Wasatch Mountains, Utah.

It will be observed that part of the collections from all but localities 55c and 54L consists of other than Spence shale fossils. Consequently, assignment of species to the Spence shale is certain only for locality 55c where all fossils came from a thin bed with no chance for admixture, and locality 5g on the western side of the Wasatch Mountains. Species believed to represent the Spence fauna have been chosen from the collections of localities 55e, 20x, and 32x. This choice is based on lithology and generic assemblages on hand pieces of rock.

Westonia ella (Hall and Whitfield) was described originally from locality 55e. At several places this species presumably appears in the Spence shale fauna, but evidently is present also in the higher beds of the Ute formation. However, since the species was not found at Spence Gulch, it has been omitted from the illustrations.

Zacanthoides is present also in localities 55e and 20x, but the species are not identifiable owing to the fragmentary nature of the material.

The Archaeocyathinae are possibly represented (pl. 1, fig. 39).

DESCRIPTION OF SPECIES

ALGAE

MORANIA Walcott, 1919

MORANIA, sp. undet.

Plate 1, fig. 40

A few Spence shale surfaces show flat algae of the *Morania* type. *Morania* is found in highly fossiliferous argillaceous shales almost everywhere in Lower and Middle Cambrian strata.

Locality 55c.

Figured specimen.—U.S.N.M. no. 96491.

ECHINODERMATA

EOCRINUS Jaekel, 1918

EOCRINUS LONGIDACTYLUS (Walcott)

Plate 1, figs. 41, 42

Eocystites?? longidactylus WALCOTT, U. S. Geol. Surv. Bull. 30, p. 94, pl. 5, fig. 3; pl. 6, fig. 1, 1886.

Eocrinus longidactylus JAEKEL, Pal. Zeitschr., vol. 3, p. 24, 1918.

The identification of this species is not altogether certain, but as far as the state of preservations allows, careful comparison seems to indicate that it should be so identified.

Localities 55c and 55e.

Cotypes.—U.S.N.M. no. 15315; plesiotypes, no. 96492.

WORMS

SELKIRKIA Walcott, 1911

SELKIRKIA SPENCEI, n. sp.

Plate 1, figs. 34, 35

This species from the Spence shale averages smaller than *S. major*. The rate of taper is also less, so that the margins of *S. spencei* are almost parallel.

Localities 55c, 55e, and 54L.

Cotypes.—U.S.N.M. no. 96493.

BRACHIOPODA

MICROMITRA Meek, 1873

MICROMITRA LEPIDA, n. sp.

Plate 1, figs. 11-13

This species is characterized by its large size, many of the shells measuring 10 mm long and 7 mm wide. The ventral valve is rather highly elevated. The dorsal valve preserves internal markings which are the first to be found in any species of the genus. The surface of both valves is ornamented with the usual strong growth lines, and both valves show fine ribbing.

Locality 55c.

Cotypes.—U.S.N.M. no. 51458.

IPHIDELLA Walcott, 1905

IPHIDELLA GRATA, n. sp.

Plate 1, figs. 14-18

This brachiopod was referred by Walcott to *I. pannula*, but its large size alone distinguishes it from the numerous species referred to *I. pannula*, except certain ones in the Grand Canyon and from localities northward of Montana. The characteristic ornamentation is beautifully developed and covers practically the entire shell with equal intensity. The hinge line is rather long and on the dorsal valve

is nearly straight. The crenulated ornamentation gives way somewhat at the outer margin of old shells to strong growth lines.

Localities 55c and 54L.

Cotypes.—U.S.N.M. nos. 51448, 27444.

LINGULELLA Salter, 1866

LINGULELLA EUCHARIS, n. sp.

Plate I, figs. 1-3

The *Lingulella* species in the Spence shale was referred to the Upper Cambrian species, *L. desiderata*. *L. eucharis* is of medium size averaging about 3 mm in length. The illustrations show that it averages broader than any of the numerous species referred to *L. desiderata*. Growth lines are normally defined, and the usual faint ribbing shows where the outer surface of the shell is exfoliated.

Localities 55c and 55e.

Cotypes.—U.S.N.M. nos. 51704, 51826.

ACROTHELE Linnarsson, 1876

ACROTHELE AFFINIS, n. sp.

Plate I, figs. 19-22

The Spence shale species of *Acrothele* was referred to *A. subsidua*, but it averages larger and differs further in the more central position of the apex. The ventral valve had considerable elevation. The exterior of both valves is marked by strong growth lines. Well-preserved outer surfaces show characteristic crenulations. The average size of the shells is about 8 mm.

Localities 55c, 55e, and 20x.

Cotypes.—U.S.N.M. no. 52015.

ACROTRETA Kutorga, 1848

ACROTRETA DEFINITA Walcott

Plate I, figs. 7-10

Acrotreta definita WALCOTT, Proc. U. S. Nat. Mus., vol. 25, p. 584, 1902; U. S. Geol. Surv. Mon. 51, p. 683, pl. 64, figs. 2, 3, 1912.

Locality 55c.

Holotype and paratypes.—U.S.N.M. no. 35270.

ACROTRETA LEVATA, n. sp.

Plate 1, figs. 4-6

Another species with a very high ventral valve occurs with *A. definita*. Besides the height of the ventral valves, this species is characterized by its strong growth lines and the narrowness of the false pedicle groove.

Locality 55c.

Cotypes.—U.S.N.M. no. 52108.**WIMANELLA** Walcott, 1908

Walcott proposed *Wimanella* for smooth, nonplicate brachiopods. He failed to observe that his specimens of the type species were not well preserved and that the ribs were effaced. Because of this error many species of *Wimanella* have been referred to *Nisusia*. In fact, most Middle Cambrian forms referred to *Nisusia* are *Wimanella*, but thus far the genus does not extend above the Middle Cambrian.

WIMANELLA SPENCEI (Walcott)

Plate 1, figs. 27, 28

Nisusia (Jamesella) spencei WALCOTT, U. S. Geol. Surv. Mon. 51, p. 737, text fig. 62, pl. 93, figs. 7, 7a, 1912.

Localities 55c, 20x, and 32x.

Cotypes.—U.S.N.M. no. 52435; plesiotypes, no. 96498.**WIMANELLA RARA** (Walcott)

Plate 1, fig. 29

Nisusia rara WALCOTT, (part), Smithsonian Misc. Coll., vol. 53, no. 3, p. 97, pl. 9, fig. 13a, 1908; U. S. Geol. Surv. Mon. 51, p. 729, text fig. 60, 1912.

It is possible that this single shell is not a good species but merely a peculiarly preserved specimen of *W. spencei*.

Locality 55c.

Holotype.—U.S.N.M. no. 52295.**WIMANELLA NAUTES** (Walcott)

Plate 1, figs. 23-26

Nisusia (Jamesella) nautes WALCOTT, U. S. Geol. Surv. Mon. 51, p. 734, pl. 93, figs. 6-6b, 1912.

Locality 55c.

Cotypes.—U.S.N.M. no. 52432; plesiotypes, no. 96497.

GASTROPODA

HYOLITHES Eichwald, 1840**HYOLITHES CECROPS** Walcott

Plate 1, figs. 36-38

Hyolithes cecrops WALCOTT, Smithsonian Misc. Coll., vol. 67, no. 2, p. 27, pl. 5, figs. 3-3c, 1917.

Hyolithes idahoensis RESSER, idem, vol. 97, no. 3, p. 5, pl. 1, figs. 57, 58, 1938.

This is an abundant species, but owing to its large size and shale matrix, few complete specimens are available. Numerous operculae are preserved. Assembly of many specimens shows that the Spence shale form, together with that in the Rennie shale, is identical with the Ross Lake shale species.

Ross Lake; (loc. 63j) Popes Peak, 1½ miles south of Stephen, and other localities, British Columbia.

Rennie; (loc. 37m) North Gold Creek, Pend Oreille Lake.

Spence; localities 55c, 55e, and 54L.

Cotypes.—U.S.N.M. no. 63724; plesiotypes, nos. 95021, 96496.

HYOLITHES ORNATELLUS, n. sp.

Plate 1, figs. 30-32

This is the most highly ornamented species of *Hyolithes* known. The anterior side is flat and depressed below the rounded margins, while the posterior surface is arched. Strong striations run at right angles to the axis on the anterior surface, but on the posterior are parallel with the front margin.

Locality 55c.

Cotypes.—U.S.N.M. no. 96494.

"ORTHOTHECA" SOLA, n. sp.

Plate 1, fig. 33

A single conical tube was found among the thousands of Spence shale fossils. This shell has nearly a circular cross-section and is about 8 mm long and 4 mm wide at the aperture.

Locality 55c.

Holotype.—U.S.N.M. no. 96495.

AGNOSTIDA

AGNOSTUS Brongniart, 1822

AGNOSTUS BONNERENSIS Resser

Plate 2, figs. 24-26

Agnostus bonnerensis RESSER, Smithsonian Misc. Coll., vol. 97, no. 3, p. 6,
pl. 1, figs. 16, 17, 1938.

This species is abundant in the Spence shale.

Middle Cambrian, Lakeview; (loc. 37n) Lakeview, Pend Oreille
Lake, Idaho.

Locality 55c.

Plesiotypes.—U.S.N.M. no. 96499.

AGNOSTUS BRIGHAMENSIS, n. sp.

Plate 2, figs. 27-29

Photographs of this species are mounted to show the associated
fauna, *Oryctocephalus*, *Pagetia*, *Clavaspidella*, and *Lingulella*.

Compared with *A. bonnerensis*, this species differs first in its more
circular outline for both shields. Little further difference is noticeable
in the head. A sharp difference is brought about in the pygidium
by the deeper transverse rhachial furrows but more particularly by
the failure of the rear rhachis to penetrate the pleural lobe.

Locality 20x.

Holotype and paratypes.—U.S.N.M. no. 96500.

TRILOBITA

PAGETIDAE Kobayashi

PAGETIA Walcott, 1916

PAGETIA CLYTIA Walcott

Plate 2, figs. 30-32

Pagetia clytia WALCOTT, Smithsonian Misc. Coll., vol. 64, no. 5, p. 408, pl. 67,
figs. 2-2c, 1916.

In spite of the great abundance of this trilobite it is difficult to find
really good specimens.

Localities 55c and 20x.

Cotypes.—U.S.N.M. nos. 62862-7.

ZACANTHOIDEA Swinnerton

ZACANTHOIDES Walcott, 1888

ZACANTHOIDES IDAHOENSIS Walcott

Plate 3, figs. 18-20

Zacanthoides idahoensis WALCOTT (part), Smithsonian Misc. Coll., vol. 53, no. 2, p. 26, pl. 3, figs. 1, 6, 1908. [Not figs. 2-5, 10 = *Z. holopygus*; figs. 7 = *Z. disjunctus*; figs. 8, 9, 11 = *Z. gradatus*.]

This species is now restricted by elimination of three other species included among the original illustrations. Walcott mentioned the different forms present but did not carry his observations to their logical conclusion.

Locality 55c.

Lectotype.—U.S.N.M. no. 53434; paratypes, nos. 53432, 53438.

ZACANTHOIDES ADJUNCTUS, n. sp.

Plate 3, figs. 13, 14

Zacanthoides idahoensis WALCOTT (part), Smithsonian Misc. Coll., vol. 53, no. 2, p. 26, pl. 3, fig. 7, 1908. (See *Z. idahoensis*.)

Walcott figured a pygidium of this species. The pygidium of *Z. adjunctus* is characterized by a wide axis and extensive fusion of the pleura, so that the tail makes a far more solid plate than in *Z. idahoensis*. The outer spine is long but is free only as far as the end of the axis. The second pair of spines is fairly long, but slender, and the remaining three pairs of spines are short and sharp-pointed.

Locality 55c.

Holotype and paratypes.—U.S.N.M. nos. 53429, 53427.

ZACANTHOIDES GRADATUS, n. sp.

Plate 3, figs. 15-17

Zacanthoides idahoensis WALCOTT (part), Smithsonian Misc. Coll., vol. 53, no. 2, p. 26, pl. 3, figs. 8, 9, 11, 1908. (See *Z. idahoensis*.)

This species is characterized by a rather broad pygidial axis. The marginal spines decrease in size slightly for the first three pairs; then abruptly for the remainder. It is thus that the species is distinguished chiefly from *Z. idahoensis* in which the pygidial spines continue to decrease at a fairly even rate from the outer to the inner pair.

The cranidium is referred to the species on the basis of its wide glabella.

Locality 55c.

Holotype.—U.S.N.M. no. 96521; paratypes, nos. 53430-1, 3.

ZACANTHOIDES ABBREVIATUS, n. sp.

Plate 2, figs. 7-9

Z. abbreviatus is represented by fewer specimens than most other species in the Spence shale. It is characterized by a rather wide axis and a considerable degree of fusion in the pygidium. Like *Z. idahoensis* the pygidial spines decrease in size at a regular rate from the outer to the inner pair. But these spines are shorter, the axis stouter and the degree of fusion of the pygidium greater than in *Z. idahoensis*.

Locality 55c.

Holotype and paratypes.—U.S.N.M. no. 96501.**ZACANTHOIDES SERRATUS, n. sp.**

Plate 2, figs. 4-6

This small species is relatively uncommon. Walcott had illustrations of this distinctive pygidium prepared, but recognizing it as a separate species, did not publish the figures. Aside from the slender axis throughout, the rather long thoracic pleura and the pygidial structure characterize the species. In it the spines are fused but remain distinct, terminating in rather broad short spines. These spines terminate at nearly a straight line, hence give the rear of the pygidium its serrate margin.

Locality 55c.

Holotype and paratypes.—U.S.N.M. no. 96502.**ZACANTHOIDES HOLOPYGUS, n. sp.**

Plate 2, figs. 10-12

Zacanthoides idahoensis WALCOTT (part), Smithsonian Misc. Coll., vol. 53, no. 2, p. 26, pl. 3, figs. 2-5, 10, 1908. (See *Z. idahoensis*.)

At first it was thought that this small species was merely a young stage of one of the larger forms, but careful sorting shows that such is not the case. *Z. holopygus* varies in length from less than one-eighth of an inch to more than 2 inches. As a whole this trilobite has a more even oval shape than most species of *Zacanthoides*, which is due to the fact that the thoracic terminations are relatively broader. It is the most common Spence shale species.

Z. holopygus has rather large eyes, and the anterior facial suture diverges sharply, leaving rather long anterior angles. The pygidium is fused into a solid shield, including all marginal spines except the

outer pair, the other spines being reduced to a serrated border. The long thoracic spine is not on the fifth but the last segment.

Locality 55c.

Holotype.—U.S.N.M. no. 96522; paratypes, nos. 53435-6-7, 53440.

DOLICHOMETOPINAE Walcott

BATHYURISCUS Meek, 1873

BATHYURISCUS ATOSSA Walcott

Plate 5, fig. 15

Bathyriscus atossa WALCOTT, Smithsonian Misc. Coll., vol. 64, no. 5, p. 336, pl. 48, figs. 2, 2a-b, 1916. RESSER, Smithsonian Misc. Coll., vol. 93, no. 5, p. 15, 1935.

Locality 55c.

Lectotype.—U.S.N.M. no. 62642; paratypes, nos. 62643-4.

BATHYURISCUS BRIGHAMENSIS, n. sp.

Plate 5, figs. 3, 4

This species is fully typical of the genus. It is characterized by a rather wide glabella, nine thoracic segments, and a rather wide pygidium. A broad indentation notches the rear margin rather deeply, and the anterior marginal pygidial spines are small.

The holotype evidently is a pathological specimen, for the anterior pleural segments on the right side have coalesced and in healing an injury have produced an extraordinarily long spine.

Locality 20x.

Holotype and paratype.—U.S.N.M. no. 96524.

POLIELLA Walcott, 1916

POLIELLA CARANUS (Walcott)

Plate 2, fig. 21

Bathyriscus (Poliella) caranus WALCOTT, Smithsonian Misc. Coll., vol. 64, no. 5, p. 350, pl. 46, fig. 5, 1916.

Poliella caranus RESSER, Smithsonian Misc. Coll., vol. 93, no. 5, p. 44, 1935.

Locality 55c.

Holotype.—U.S.N.M. no. 62628.

POLIELLA ANTEROS Walcott

Plate 2, figs. 19, 20

Bathyriscus (Poliella) anteros WALCOTT, Smithsonian Misc. Coll., vol. 64, no. 5, p. 349, pl. 46, fig. 5, 1916.

Locality 55c.

Holotype.—U.S.N.M. no. 62622.

GLOSSOPLEURA Poulsen, 1927**GLOSSOPLEURA BION** (Walcott)

Plate 5, figs. 1, 2

Dolichometopus bion WALCOTT, Smithsonian Misc. Coll., vol. 64, no. 5, p. 363, pl. 52, figs. 2-2c, 1916.

Glossopleura bion RESSER, Smithsonian Misc. Coll., vol. 93, no. 5, p. 32, 1935.

Locality 55c.

Cotypes.—U.S.N.M. nos. 62709-12.

GLOSSOPLEURA SIMILARIS, n. sp.

Plate 5, figs. 9-11

This species is similar to *G. producta*. The eyes, however, are shorter and the palpebral lobes smaller, and in the pygidium fusion is less complete. The species is characterized by a rather narrow pygidial border, a narrow doublure, and segmentation in both axis and pleural lobes. The palpebral lobes are strongly bowed. Fine irregular lines cover the surface.

Localities 55c and 54L.

Holotype.—U.S.N.M. no. 96525; paratypes, no. 96526.

GLOSSOPLEURA UTAHENSIS Resser

Plate 5, fig. 16

Bathyriscus productus WALCOTT (part), U. S. Geol. Surv. Bull. 30, p. 217, pl. 30, figs. 1, 1b, 1886.

Bathyriscus anax WALCOTT (part), Smithsonian Misc. Coll., vol. 64, no. 5, p. 335, pl. 48, fig. 1b, 1916.

Glossopleura utahensis RESSER, Smithsonian Misc. Coll., vol. 93, no. 5, p. 33, 1935.

The pygidium, identified with *Clavaspidella anax*, is refigured.

Locality 55e. (Holotype locality 30a, Big Cottonwood Canyon, Wasatch Mountains.)

Holotype and paratypes.—U.S.N.M. nos. 62641, 62639.

GLOSSOPLEURA GIGANTEA, n. sp.

Plate 5, fig. 17

This is the largest species known in the genus, and is moreover one of the largest Middle Cambrian trilobites known except, of course, the enormous species of *Paradoxides*. The holotype is over 5 inches long, and other fragments show that the average size is nearly as great.

This species is characterized by a large glabella, somewhat swollen in front. There appear to be 8 thoracic segments. Compared with other Middle Cambrian species, the pygidium of *G. gigantea* has a distinctly circular outline.

Locality 20x.

Holotype.—U.S.N.M. no. 96527.**CLAVASPIDELLA Poulsen, 1927****CLAVASPIDELLA BITHUS (Walcott)**

Plate 5, fig. 12

Bathyuriscus? bithus WALCOTT, Smithsonian Misc. Coll., vol. 64, no. 5, p. 340, pl. 47, figs. 4, 4a, 1916.

Clavaspidella bithus RESSER, Smithsonian Misc. Coll., vol. 93, no. 5, p. 20, 1935.

Locality 55c.

Lectotype.—U.S.N.M. no. 62635; paratype, no. 62636.**CLAVASPIDELLA ANAX (Walcott)**

Plate 5, figs. 5, 6

Bathyuriscus anax WALCOTT (part), Smithsonian Misc. Coll., vol. 64, no. 5, p. 335, pl. 48, figs. 1, 1a, c, d, 1916.

Clavaspidella anax RESSER, Smithsonian Misc. Coll., vol. 93, no. 5, p. 21, 1935.

Localities 55e and 32x.

Lectotype.—U.S.N.M. no. 62637; paratypes, nos. 62638-40.**ORYCTOCEPHALIDAE Raymond****ORYCTOCEPHALUS Walcott, 1886****ORYCTOCEPHALUS WALCOTTI Resser**

Plate 2, figs. 15-18

Oryctocephalus walcotti RESSER (part), Smithsonian Misc. Coll., vol. 97, no. 3, p. 9, pl. 1, fig. 23, 1938.

This species is common in the Spence shale.

Middle Cambrian, Lakeview; near Lakeview, Pend Oreille Lake, Idaho.

Localities 55c and 5g.

Plesiotypes.—U.S.N.M. nos. 96503-4.

ORYCTOCARE Walcott, 1908

ORYCTOCARE GEIKEI Walcott

Plate 2, figs. 22, 23

Oryctocare geikei WALCOTT, Smithsonian Misc. Coll., vol. 53, no. 2, p. 23, pl. 1, figs. 9, 10, 1908.

No additional specimens of this rare trilobite were found when the thousands of specimens from the locality were again examined. The mistaken reference of this species to *Oryctocephalus* and *Utia* in the Lakeview limestone of Pend Oreille Lake, Idaho, has been adjusted elsewhere.

Locality 55c. Lakeview; near Lakeview, Pend Oreille Lake, Idaho.

Lectotype and paratypes.—U.S.N.M. nos. 53426-28.

LEIOSTEGIDAE Bradley

OLENOIDES Meek, 1877

OLENOIDES WAHSATCHENSIS (Hall and Whitfield)

Plate 4, figs. 1, 2

Dikellocephalus wahsatchensis HALL and WHITFIELD, U. S. Geol. Expl. 40th Par., vol. 4, p. 241, pl. 1, fig. 35, 1877.

Dikellocephalus ? gothicus HALL and WHITFIELD, U. S. Geol. Expl. 40th Par., vol. 4, p. 242, pl. 1, fig. 36, 1877.

Olenoides wahsatchensis WALCOTT, U. S. Geol. Surv. Bull. 30, p. 189, pl. 29, figs. 2, 2a, 1886.

Locality 20x.

Cotypes.—U.S.N.M. no. 15447.

OLENOIDES BRIGHAMENSIS, n. sp.

Plate 3, figs. 8, 9

This is a small species associated with *Ehmaniella* and differs from the other two Wasatch species in several respects. The cranidium does not depart from the norm, and is rather highly arched in both directions. The pygidium has six pairs of marginal spines which are rather short.

Locality 20x.

Holotype and paratype.—U.S.N.M. no. 96513.

OLENOIDES EVANSI, n. sp.

Plate 4, figs. 3, 4

This species is characterized by a quadrate glabella similar to species of *Kootenia*, but the pygidium has the true *Olenoides* feature of separate pleura. It has seven pairs of spines. The pygidium of *O. evansi* resembles that of *O. clongatus* due to its triangular shape and elongation to accommodate seven spines. The occipital ring and thoracic segments each bear a small median spine or tubercle, which are lacking from the axial rings of the pygidium.

A crushed and poorly preserved hypostoma occurs with portions of a few pygidia and is thought to belong to the species.

Locality 55e.

Holotype and paratype.—U.S.N.M. no. 96514.

KOOTENIA Walcott, 1888**KOOTENIA IDAHOENSIS, n. sp.**

Plate 3, figs. 1-3

This species belongs to the *serrata* group of the genus and is a six-spined form. The cranium has the usual quadrate outline and proportions, and the surface is ornamented with lines and granules. The neck spine is slender and not very long.

The thorax has seven segments terminating in rather blunt spines, which have the usual elongate, scaly granulations.

Six blunt spines margin the pygidium. All spines are coarsely granulated.

Locality 55c.

Holotype and paratypes.—U.S.N.M. no. 96505.

KOOTENIA SPENCEI, n. sp.

Plate 3, figs. 4, 5

Only two incomplete pygidia have been found of this seven-spined species. Unfortunately, neither pygidium is well preserved. The pleural grooves remain on exfoliated specimens. Six pairs of the marginal spines are long and slender, possibly attaining a length greater than the pygidium. Each spine had a medial furrow for a considerable distance from the border. The seventh pair of spines is short.

Locality 55c.

Holotype and paratypes.—U.S.N.M. no. 96506.

KOOTENIA MATHEWSI, n. sp.

.Plate 3, figs. 6, 7

This species belongs to the seven-spined group. It is characterized by long, round spines, the longest likely exceeding the length of the pygidium. The seventh pair is short and slender.

This species is very similar to *K. spencei*, being distinguished by the smaller spread and curvature of the spines and their lack of median grooves.

Locality 20x.

Holotype and paratype.—U.S.N.M. no. 96507.

KOOTENIA GRACILIS, n. sp.

Plate 3, figs. 11, 12

This beautiful trilobite is associated with *Ehmaniella* and *Olenoides brighamensis* in the thin limestone layers intercalated in the shales.

K. gracilis is one of the few six-spined species in the genus. Evidently the seventh pair, which is usually greatly reduced, has become altogether obsolescent. The glabella is long, but otherwise the cranidium is normal in all respects. Fusion is normal in the pygidium and the long, slender spines are straight and hence well spread out.

Locality 20x.

Holotype and paratype.—U.S.N.M. no. 96508.

PTYCHOPARIDAE Matthew

ALOKISTOCARE Lorenz, 1906**ALOKISTOCARE IDAHOENSE, n. sp.**

Plate 4, figs. 8, 9

This species has 23 or 24 thoracic segments and is finely granulated on the outer surface. Exfoliated surfaces show lines and punctation. The genal spines extend back to about the fifth thoracic segment. The pygidium is completely fused.

Locality 55c.

Holotype and paratype.—U.S.N.M. no. 96507.

ALOKISTOCARE SPENCENSE, n. sp.

Plate 4, figs. 10, 11

This is also an abundant species associated with *A. idahoense*. Compared to that species, *A. spencense* is characterized by a narrower

cranidium. In keeping with that narrowness, the trilobite as a whole is more slender.

Localities 55c, 55e, and 20x.

Holotype and paratypes.—U.S.N.M. no. 96516.

ALOKISTOCARE LATICAUDUM, n. sp.

Plate 4, figs. 15-19

This species is characterized by a wide brim and wide, long, genal spines, a wide pygidium and 17 thoracic segments. The genal spines extend back to about the 14th segment. Fusion has not obliterated pleural furrows in the pygidium.

Localities 55c and 55e.

Holotype and paratype.—U.S.N.M. nos. 96517, 8.

ALOKISTOCARE SEPTUM, n. sp.

Plate 4, figs. 5-7

This is a wide-tailed form like *A. laticaudum*. It differs in having a narrower glabella. But the distinctive feature is the great genal spines which extend almost to the pygidium.

Locality 55c.

Holotype and paratype.—U.S.N.M. no. 96520.

ALOKISTOCARE PUNCTATUM, n. sp.

Plate 4, figs. 20, 21

Reduction of brim brings this species closer to *Chancia*, than most species referred to *Alokistocare*. But since a rim is not differentiated by thickening, this form is called *Alokistocare*.

The cranidium is rather wide and the anterior margin not so much curved. On exfoliated specimens the eye lines are heavy and the surface is strongly punctate. One specimen retains 15 thoracic segments, indicating a thorax of possibly 20 segments.

Locality 55e.

Holotype and paratypes.—U.S.N.M. no. 96519.

CHANCIA Walcott, 1924

CHANCIA EBDOME Walcott

Plate 4, figs. 12-14

Chancia ebdome WALCOTT, Smithsonian Misc. Coll., vol. 75, no. 2, p. 55, pl. 10, fig. 4, 1924. Idem, no. 3, p. 80, pl. 17, fig. 26, 1925.

Locality 55c.

Holotype.—U.S.N.M. no. 70274.

CHANCIA EVAX Walcott

Plate 5, figs. 18, 19

Chancia evax WALCOTT, Smithsonian Misc. Coll., vol. 75, no. 3, p. 81, pl. 17, fig. 27, 1925.

Localities 55c and 55e.

Holotype.—U.S.N.M. no. 70275.**CHANCIA ANGUSTA**, n. sp.

Plate 5, figs. 13, 14

This species differs from *C. cbdome* chiefly in that the cranium is narrower, and that the surface of the head is more finely granulose. *C. angusta* is characterized by a glabella which tapers at the usual rate and attains slightly more than half the cranial length. Three pairs of furrows are faintly defined, the rear pair being directed sharply backward. Eyelines are well developed on the under side of test. Eyes moderately elevated.

Exfoliated specimens have all furrows accentuated, and the double impression modifies the appearance of the unfurrowed brim.

Locality 55c.

Holotype and paratypes.—U.S.N.M. no. 96523.**ALOKISTOCARELLA** Resser, 1938**ALOKISTOCARELLA SPENCEI**, n. sp.

Plate 3, fig. 10

This species is represented by several cranidia, all of which are, unfortunately, almost entirely exfoliated. This, of course, accentuates all furrows and ridges. *A. spencei* is characterized by a truncate glabella of normal size and an upturned narrow rim. The width of the fixigene at the eye is about equal to that of the glabella at the same point, which makes the cranium wide.

Locality 55c.

Holotype.—U.S.N.M. no. 96509.**ELRATHIA** Walcott, 1924**ELRATHIA SPENCEI**, n. sp.

Plate 6, figs. 15-17

This species has 17 thoracic segments. The cranium is wide, the glabella occupying about three-fourths its length. The small pygidium is characteristic of the genus, and it has an indented rear margin.

Locality 55c.

Holotype and paratypes.—U.S.N.M. no. 96540.

ELRATHIA RARA, n. sp.

Plate 6, fig. 18

This species is based on a single individual, consisting of the cranidium and 17 segments. Most of the cranidium is exfoliated, and shows strong striations on the preglabellar area. A narrow, straight rim is demarcated.

Locality 55c.

Holotype.—U.S.N.M. no. 96541.**ELRATHINA Resser, 1937****ELRATHINA OFFULA, n. sp.**

Plate 2, figs. 13, 14

This genus and species is represented by only a few cranidia. The illustrations show the relative proportion of the several parts, the characteristic constriction of brim width, and the slightly concave brim, with the rim only weakly defined. Eyes are rather small.

Locality 55c.

Holotype and paratype.—U.S.N.M. no. 96510.**EHMANIELLA Resser, 1937****EHMANIELLA QUADRANS (Hall and Whitfield)**

Plate 6, figs. 28-32

Crepicephalus? (*Loganellus*) *quadrans* HALL and WHITFIELD, U. S. Geol. Expl. 40th Par., vol. 4, p. 238, pl. 2, figs. 11-13, 1877.

Ptychoparia quadrans WALCOTT, U. S. Geol. Surv. Bull. 30, p. 199, pl. 29, figs. 4, 4a, b, 1886; Smithsonian Misc. Coll., vol. 64, p. 204, 1916.

Ehmaniella quadrans RESSER, Smithsonian Misc. Coll., vol. 95, no. 22, p. 10, 1937.

Localities 20x, 55e, and 54L.

Holotype and paratypes.—U.S.N.M. no. 15432; plesiotype, no. 96539.**CLAPPASPIS Deiss, 1939**

The genotype, *C. typica* Deiss, comes from the Pentagon shale of Lewis and Clark Range, Montana. Average size and shape, normal development of eye lines and furrows, and eyes situated slightly behind the middle of the head, characterize the genus. All species are evidently ornamented by some sort of granulated surface. Deiss did not have any entire individuals and so could not illustrate the thorax. Several Spence shale individuals have 14 thoracic segments.

Five species in the Spence shale are referred to *Clappaspis*.

Clappaspis appears to be related to *Ehmaniella* or at least most closely resembles that genus. The only differences of consequence are the slightly narrower preglabellar area and the granulated surface, for the pygidia are clearly constructed on the same plan.

CLAPPASPIS SPENCEI, n. sp.

Plate 6, figs. 5, 6

This is the widest of the five species recognized in the Spence shale. It is further distinguished by two sets of granules rather evenly distributed, the smaller ones being more numerous. Exfoliated specimens have coarse irregular striations on the preglabellar area.

Locality 55c.

Holotype and paratypes.—U.S.N.M. no. 96530.

CLAPPASPIS IDAHOENSIS, n. sp.

Plate 6, figs. 26, 27

Three complete individuals represent this species. The cranium is narrower than *C. spencei* and has a shorter, more conical glabella. *C. idahoensis* is characterized by scattered granules of uneven size. The thorax has 14 segments.

Locality 55c.

Holotype and paratypes.—U.S.N.M. no. 96531.

CLAPPASPIS LANATA, n. sp.

Plate 6, fig. 7

A single cranium represents this species, which has a narrow cranium, long glabella, and the surface is closely crowded with small granules. Rather heavy striations occur on the preglabellar area.

Locality 55c.

Holotype.—U.S.N.M. no. 96532.

CLAPPASPIS CORIACEA, n. sp.

Plate 6, figs. 11, 12

This species is rather wide. Coarse granules are widely scattered over the surface, which is covered with a small set of closely crowded granulations. Exfoliated specimens appear pitted.

Locality 55c.

Holotype and paratypes.—U.S.N.M. no. 96533.

CLAPPASPIS DOTIS, n. sp.

Plate 6, figs. 13, 14

This species is represented by the largest number of specimens. It is characterized by a short glabella, and closely crowded granulations which are of medium size.

Locality 55c.

Holotype and paratypes.—U.S.N.M. no. 96534.

FAMILY UNDESIGNATED

VISTOIA Walcott, 1925**VISTOIA? MINUTA, n. sp.**

Plate 2, figs. 1, 2

One of the illustrated specimens of this species is mounted as a cranidium, but this may be only an accidental resemblance. Certainly most of the examples available are pygidia. Whenever such trilobites as these retain their full relief, difficulty is experienced in distinguishing heads and tails. Consequently, the question is not brought to a final conclusion.

Even though this trilobite is very small, it is referred to *Vistoia* chiefly because it fits no other Middle Cambrian genus in any respect. It may well be that entire specimens will show that the cranidium disagrees with that of *Vistoia prisca* and then a new genus can be erected.

Aside from its small size, *V. ? minuta* is characterized by simplicity. The pygidium has a simple, highly arched semicircular outline. An axis about a third the width of the pygidium is faintly outlined by shallow dorsal furrows, which do not unite in the rear except by the faintest trace. One specimen retains several simple thoracic segments.

Localities 55c and 5g.

Holotype and paratypes.—U.S.N.M. no. 96511.

UTIA Walcott, 1925**UTIA CURIO** Walcott

Plate 2, figure 3

Utia curio WALCOTT, Smithsonian Misc. Coll., vol. 75, no. 2, p. 60, pl. 14, fig. 4, 1924. Idem, no. 3, p. 119, pl. 15, figs. 11-14, 1925. RESSER (part), idem, vol. 97, no. 3, p. 9, pl. 1, figs. 19, 20, 1938.

Several hundred specimens of this unique trilobite have now been segregated. One of the cotype cranidia has about nine thoracic segments attached, but no pygidium has been assigned to the species.

Locality 55c. Lakeview; (loc. 37n) Lakeview, Pend Oreille Lake, Idaho.

Cotypes.—U.S.N.M. nos. 70235-7; plesiotypes, no. 95041.

BYTHICHEILUS, n. gen.

Trilobites of less than average size. Cranidium rather large. Glabella well defined except in front where the dorsal furrow coalesces with the depression in the brim. Fixigenes about as wide as the glabella. Eyelines formed by abrupt depression of anterior fixigenes. Eyes rather large, situated back of the cranidial midpoint. Brim less than one-third cranidial length. Narrow, striated upturned rim clearly defined. Preglabellar area depressed in a peculiar manner, which suggests generic name. Libragenes narrow with moderate genal spines. Striated rim sharply upturned almost to the tip of the genal spines.

Thorax with 14 segments, rather straight, parallel to each other, divided evenly by pleural furrows and bent down rather abruptly at geniculation.

Pygidium small, completely fused, with dorsal furrow shallow and not clearly defined around the rear.

Genotype.—*B. typicum*, new species.

BYTHICHEILUS TYPICUM, n. sp.

Plate 6, figs. 1-4

The generic description and illustrations present the specific features adequately.

Locality 55c.

Holotype and paratypes.—U.S.N.M. no. 96537.

BYTHICHEILUS ALVEATUM, n. sp.

Plate 6, figs. 8-10

This species differs from *B. typicum* in having a longer depression in the preglabellar area, a less upturned rim, less indentation of the front of the glabella by the median depression, and stronger eyeridges due to the more abrupt slope of the brim.

B. alveatum is characterized by a curved anterior margin, fixigenes about three-fourths as wide as the glabella, and by a depressed preglabellar area. Exfoliated specimens show pronounced glabellar furrows and strong eyelines.

Locality 55c.

Holotype and paratypes.—U.S.N.M. no. 96538.

SPENCIA, n. gen.

Small trilobites characterized by a rather large, slightly tapered glabella which extends to the anterior furrow. Brim reduced to thickened rim, wider in the middle than at the ends. This causes the anterior furrow to join the dorsal furrow in front of the glabella. Fixigenes convex, anteriorly nearly as wide as the glabella. Eyelines fairly prominent. Eyes small, situated slightly behind the middle of the head.

Libragenes small, with short but sharp-pointed genal spines.

Thorax has 16 segments. The pygidium is small, trilobate, and well fused.

Surface of cranium and ridges of the thoracic segments marked by scattered granules.

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

SPENCIA TYPICALIS, n. sp.

Plate 6, figs. 22-25

This species is characterized by scattered granules and a rather wide space where the anterior and dorsal furrows join.

Locality 55c.

Holotype and paratypes.—U.S.N.M. no. 96535.

SPENCIA PLENA, n. sp.

Plate 6, figs. 19-21

This species is characterized chiefly by the swollen rim and the narrowing of the preglabellar area or rather the anterior and dorsal furrows. Scattered granules occur on the more elevated portions of the cranium.

Locality 55c.

Holotype and paratypes.—U.S.N.M. no. 96536.

STAUROHOLCUS, n. gen.

Small trilobites; only cranidia known. Glabella about three-fourths the length of cephalon, without furrows, truncate with rounded anterior corners, tapering only slightly. Fixigenes fully as wide as glabella. Eyelines faint, but clearly defined. Eyes small, situated about the mid-point. Occipital spine present. Brim rounded at anterior corners. Rim thickened in center, upturned. Preglabellar area

depressed in center, giving rise to the appearance of the anterior and dorsal furrows crossing each other in the center.

Name.— $\sigma\tau\alpha\upsilon\rho\sigma$ = cross; $\delta\lambda\kappa\omicron\varsigma$ = furrow.

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

STAUROHOLCUS TYPICALIS, n. sp.

Plate 5, figs. 7, 8

The illustrations and generic description portray the specific characters.

Locality 55c.

Holotype and paratypes.—U.S.N.M. no. 96528.

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EXPLANATION OF PLATES

All figures are natural size unless otherwise designated. Species without locality references are all from locality 55c.

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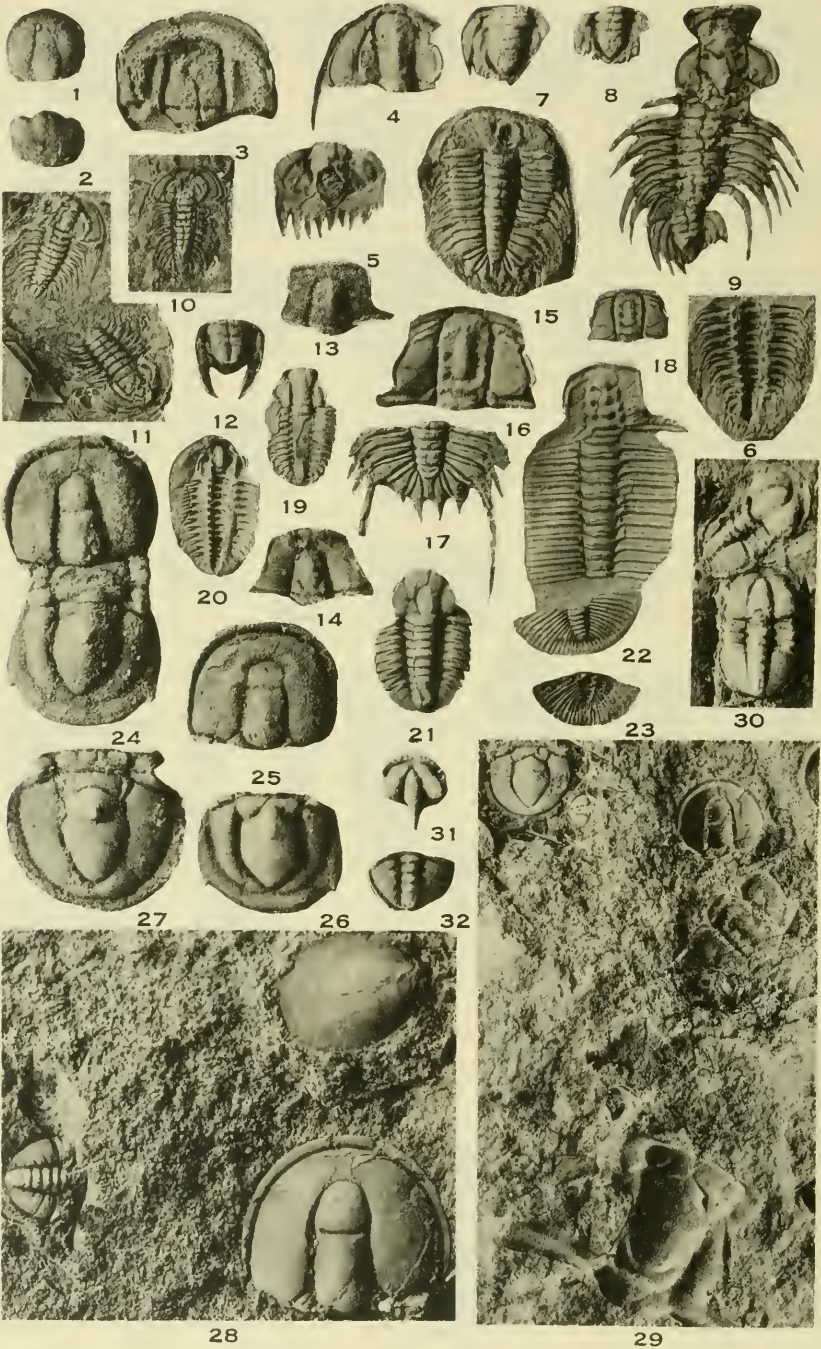
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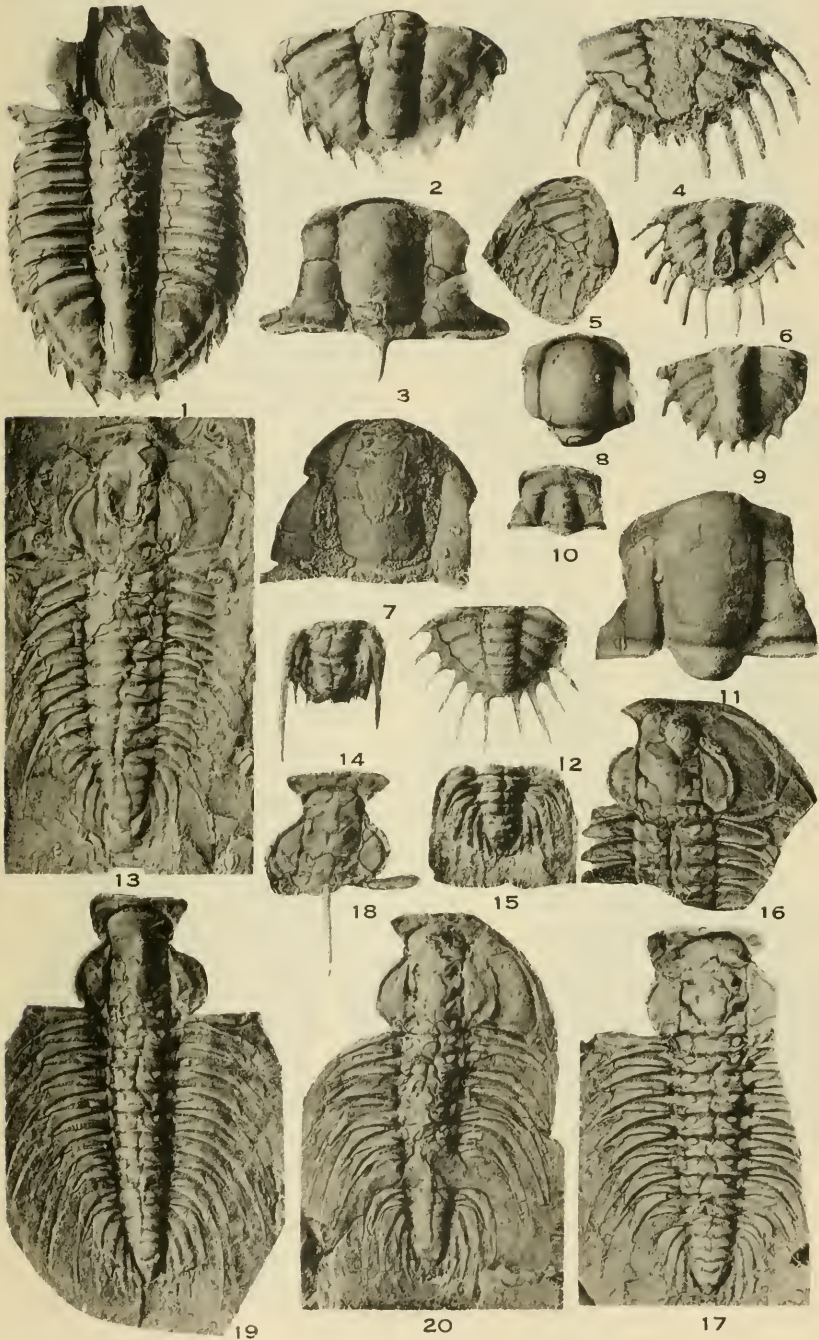
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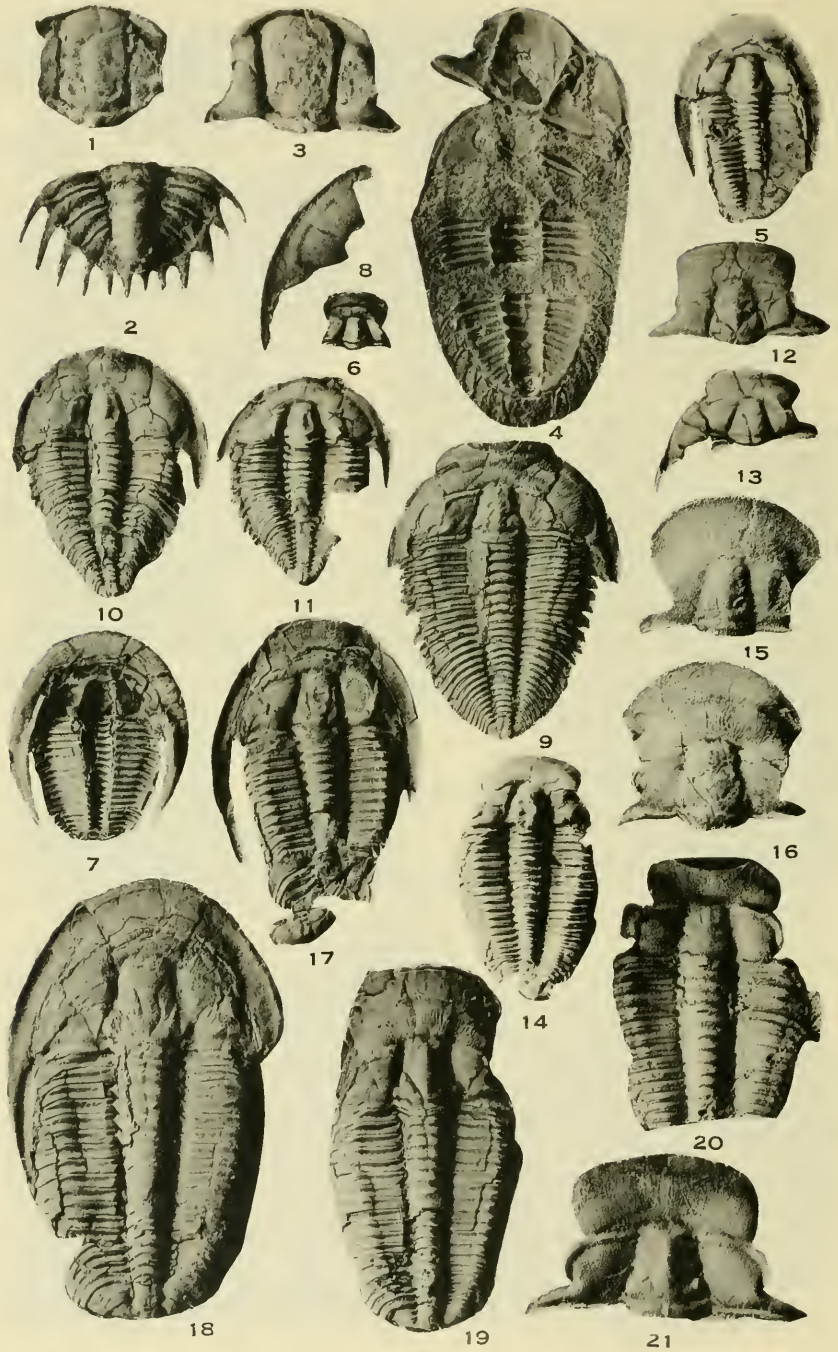
BRACHIOPODS, HYOLITHES, AND OTHER FOSSILS
(See explanation of plates at end of text.)



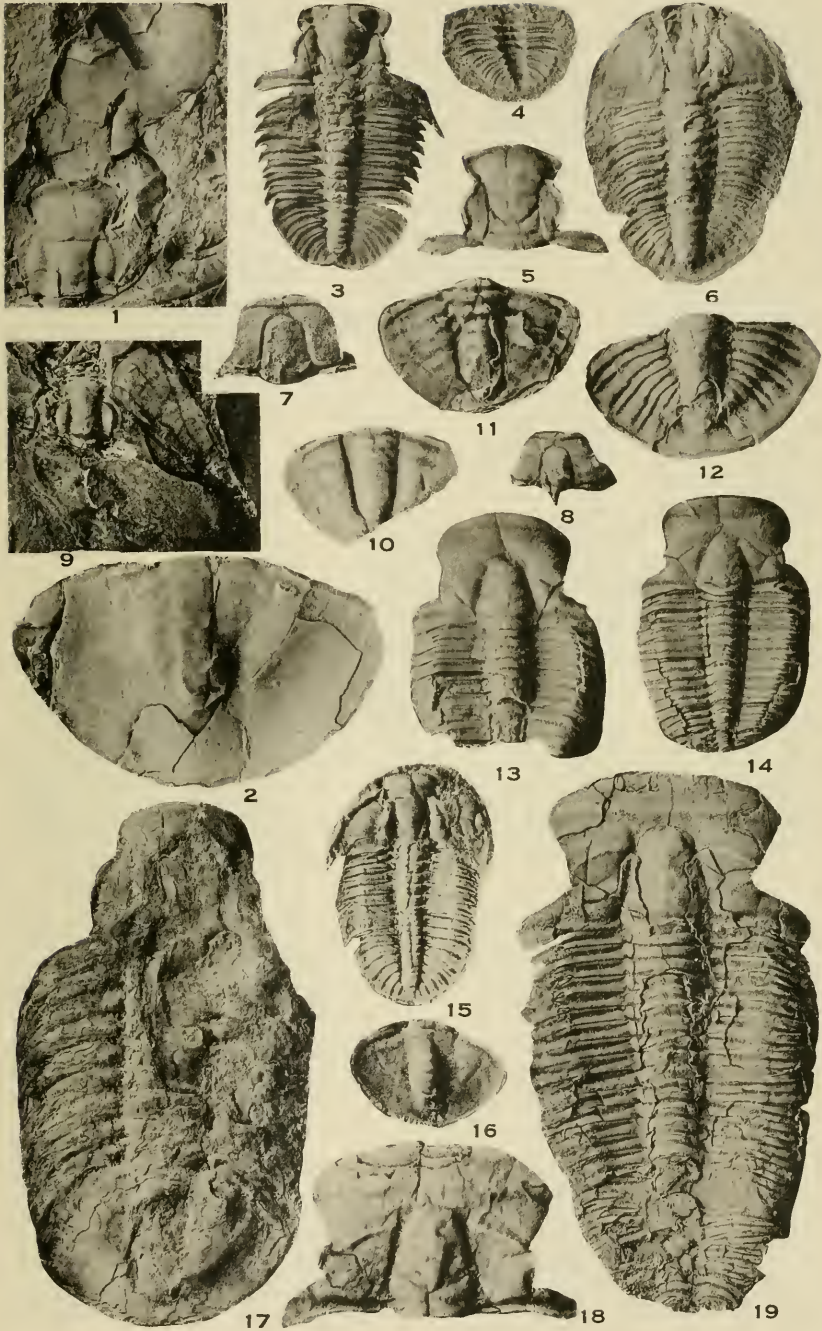
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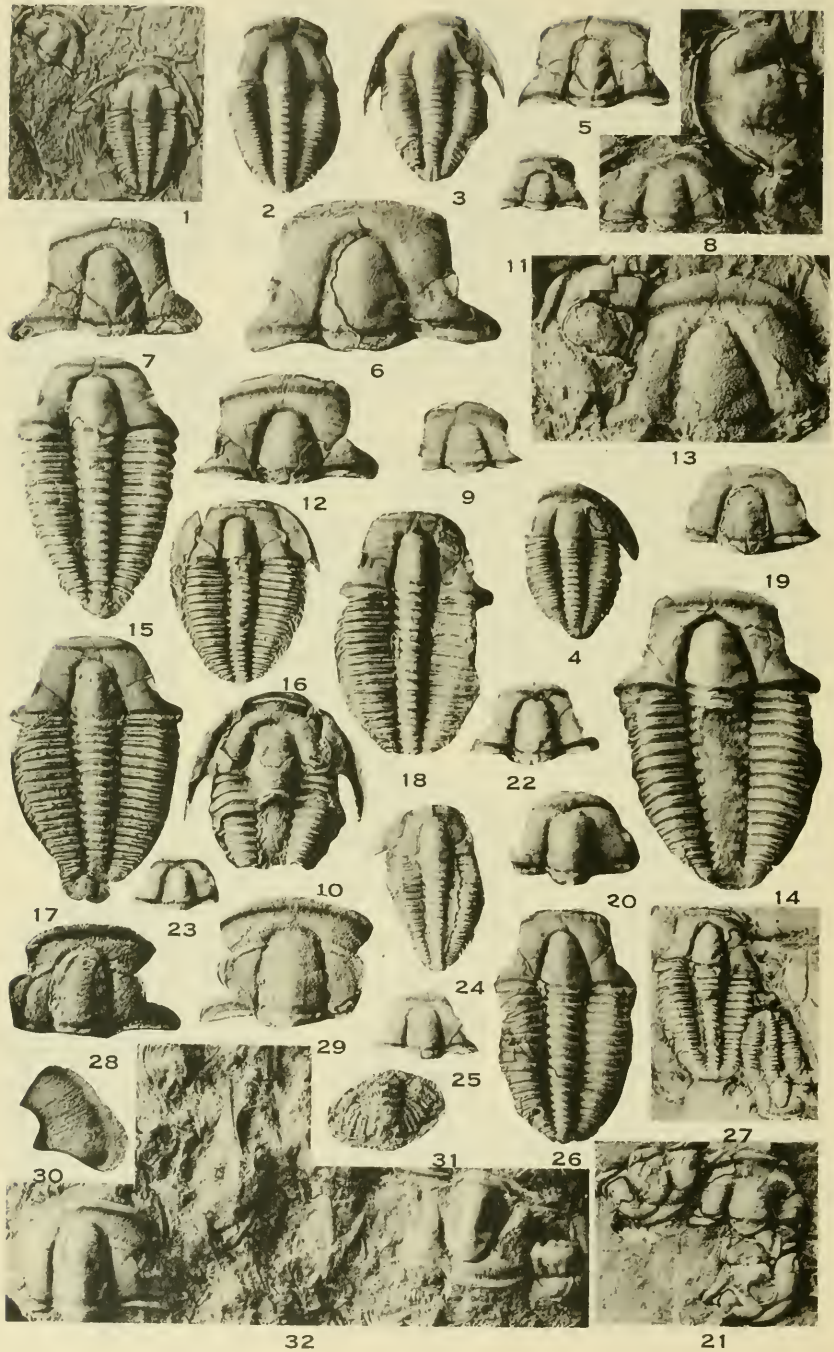
KOOTENIA, OLENOIDES, AND ZACANTHOIDES
(See explanation of plates at end of text.)



OLENOIDES, ALOKISTOCARE, AND CHANCIA
(See explanation of plates at end of text.)



SPENCE SHALE TRILOBITES
(See explanation of plates at end of text.)



SPENCE SHALE TRILOBITES
(See explanation of plates at end of text.)