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Trilobites from the Park Shale of Montana and Yellowstone National Park

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TRILOBITES FROM THE PARK SHALE OF MONTANA AND YELLOWSTONE NATIONAL PARK

by

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INTRODUCTION

Ten type Cambrian formations and sections in Central Montana and Yellowstone National Park were revised by Deiss (1936, p. 1257-1342) in 1936. Deiss remeasured all the sections, collected and zoned fossils in them and emended the definitions of the formations. The Park shale, now considered the youngest Middle Cambrian formation in the area, was demonstrated to lie between the Meagher (Middle Cambrian) and Pilgrim (Upper Cambrian) limestones in all the sections in the area. The trilobites collected from the Park shale were studied by the writer during 1938 and 1939. The results of the study are given in this thesis which contains descriptions and illustrations of 10 new genera and 40 new species.

ACKNOWLEDGMENTS

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To Mr. Donald Duncan of Princeton University the writer wishes

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HISTORICAL SUMMARY

The history of the previous work on Cambrian formations and stratigraphy of Central Montana and Yellowstone National Park has been recently summarized by Deiss, (1936, p. 1261-1268). Consequently to repeat a complete historical summary of the Cambrian is unnecessary.

Peale (1890, p. 131) working in the Three Forks Area, was the first to divide the rocks of this system into formations. He assigned all the Cambrian rocks to the Gallatin sandstones and overlying Gallatin limestones. A year later Peale (Walcott 1891, p. 324-325) divided the Gallatin sandstones into two members and the Gallatin limestones into five members. He gave the name Obolella shales to rocks known today as Park shale, and considered them as a member of the Gallatin limestone.

In 1893 Peale revised his earlier nomenclature and changed the name of the Gallatin sandstones to the Flathead formation and Gallatin limestones to Gallatin formation. In so doing Peale (1893, p. 14) said:

> "The following system of nomenclature for the Paleozoic section was determined upon for the contiguous sheets in Montana, after consultation with Mr. Arnold Hague's division."

The Obolella shale was retained as a member name and was assigned to the Gallatin formation. Peale (1893, p. 23) discussed the Obolella

shales as follows:

> "For a space of 280 feet above the trilobite limestones the outcrops are very obscure in most places, owing to the soft character of the shales, whose erosion has caused the formation of deep ravines parallel to the strike of the beds. Such exposures as have been seen, however, leave no doubt that the entire space is occupied by shaly beds, which are mostly calcareous. There are a few thin beds of limestone and several calcareous sandy beds with micaceous surfaces in the central portion of the outcrops. The lower beds are covered from the breaking down of the shales above, and the upper beds are concealed by the yellowish debris washed down from the overlying limestones. Very fine, rather dark greenish shales prevail in the lower part, while the upper beds are very much lighter in color. The only organic remains found were from the middle of the series, and they consist solely of undetermined species of Obolella, from which the shales have been provisionally named the Obolella shales."

In 1899 Iddings and Weed (1894, p. 2) worked in the Livingston quadrangle, and thought that the Gallatin formation of Peale included both Upper and Middle Cambrian rocks. Consequently they shifted the Obolella shales (correctly) to the Flathead formation.

In 1896 Peale (1896, p. 2) repeated his description of the Cambrian rocks in the Three Forks area (Peale, 1893, p. 20-25). However, in his columnar section he followed Iddings and Weed in drawing the line between the Flathead and Gallatin formations at the top of the Obolella shales. Peale (1896, p. 2) remarked as follows concerning the Obolella shales:

> "Following the trilobite limestones, the Obolella shales occupy a space of about 280 feet. The outcrops are very obscure, owing to the soft character of the calcareous and sandy beds, the erosion of which has formed deep ravines parallel to the strike of the beds. An undetermined species of Obolella is the only fossil recognized as coming from this horizon."

In the same year Weed and Pirrson (1896, p. 34-37) divided the Cambrian strata in the Castle Mountains into two formations: Flathead and Gallatin, and again drew the boundary above the Obolella shale.

In 1899 Weed assigned all the Cambrian rocks of the Fort Benton quadrangle to one formation, the Barker. In doing so Weed (1899a, p. 2) said: "...they could not be mapped separately on the scale of these sheets." He divided the Barker into seven members named from the base upward (1) Flathead sandstone, (2) Wolsey shale, (3) Meagher limestone, (4) Park shale, (5) Pilgrim limestone, (6) Dry Creek shale and, (7) Yogo limestone. Weed (1899a,p.2) commented on the Park shale by saying:

> "...Meagher limestones, 110 feet thick, (are) overlain by several hundred feet of Park shales and limestone conglomerates. Above this is 140 feet of the massively bedded Pilgrim limestone..."

In the same year Weed (1899b, p. 2) applied the nomenclature of the Cambrian rocks in the Fort Benton area to those in the Little Belt Mountains, and discussed the Park shale in the Little Belt Mountains area as follows:

> "The overlying Park shale is a very thin-bedded, soft, and crumbly rock, often containing glistening grains of mica, which is mostly greenish gray in color, but also shows various shades of red and purple."

A year later Weed (1900, p. 284) described the Park shale as a formation and correlated it with the Obolella shales in the Three Forks, Livingston, and Fort Benton quadrangles. His definition of the Park shale is (Weed, 1900, p. 286):

> "Park shale.— The greater part of the Cambrian rocks seen in the mountain area probably belong to this formation. The lower strata are gray or greenish micaceous shales. Higher in the section these contain intercalated thin layers of limestones, which are impure and often consist of flat limestone pebbles— a true intraformational conglomerate. These beds are well exposed in the road cuttings at the head of Sheep Creek, in the valleys of Dry Wolf, Pilgrim, and Tenderfoot creeks, and near Barker. Their thickness is estimated at 800 feet."

During the following thirteen years no work was done on the Park shale. In 1913 Knopf (1913, p. 89-91), in a report on the ore deposits of the Helena mining district, quoted an unpublished manuscript of Weed's (Knopf, 1913, p. 90-91) in which the Park shale was again assigned to the Middle Cambrian and was described as follows:

> "Park shale.— The Park shale consists of earthy and micaceous dark-gray to green or purple shales. The rocks are not well indurated and crumble readily, so that very few good exposures are seen. A partial section is exposed in the quarry near the upper part of the city of Helena, and shows the formation to contain lavender or pinkish beds, grading through green shales to a grayish earthy shale carrying an abundance of small fossil shells, identified as Obolella. The upper portion contains limestone lenses in a jaspery shale, which grades downward into a dense cherty rock resembling hornstone. This shale has an estimated thickness of 150 feet. It forms the flat bench on the summit of Mount Helena, between the apex and the northern cliffs, and covers the ridge followed by the trail."

Three years later Walcott (1916, p. 271) measured a Cambrian section on the north side of Beaver Creek in the Big Belt Mountains. He noted the presence of the Park formation in that vicinity and described it as "green and purple argillaceous shale," 290 feet thick.

In 1916 Haynes (1916, p. 276-278) measured a section of the Cambrian rocks northeast of Logan, Montana, (Three Forks area).

He placed the Park shale in the Middle Cambrian and in Peale's old Gallatin formation.

From 1916 to 1936 no important work was published concerning the Park shale. In 1936 Deiss (1936, p. 1269-1325) remeasured the Park shale in Central Montana and Yellowstone Park, collected and zoned fossils in it and gave graphic comparisons of the original and emended sections. Deiss corrected the error which appeared in an unpublished manuscript of Calvert's quoted by Walcott (1916, p. 274-275) and also in a later work by Reeves (1931, p. 137, 145). Calvert, in describing the Cambrian section at the head of Swimming Woman Creek in the Big Snowy Mountains included in the Wolsey shale beds which are equivalent to the Park.

In his definition of the Park shale Weed (1900, p. 284) made several erroneous statements and failed to definitely assign a type locality. Because of these facts Deiss (1936, p. 1283-1284; 1332-1333) emended the definition of the Park shale and assigned the Dry Wolf Creek section as the type locality. The emended definition of the Park shale is:

> "Emended definition.— The Park shale, tentatively considered the youngest Middle Cambrian formation in the area, lies between the Meagher and the Pilgrim limestones in central and southern Montana, and in Yellowstone National Park. The greatest thickness of the formation (unfortunately, only an estimate) is 330 feet, on Keegan Butte in the Little Belt Mountains, and the least thickness is 120 feet, on Crowfoot Ridge in Yellowstone Park. Although the average thickness of the Park shale is approximately 200 feet, the formation is thinner than 170 feet in five of the eight sections in which it is exposed.
>
> The most striking characteristic of the Park shale is the uniformly fissile, slightly micaceous shale of which the formation is composed. The shale is dominantly green-gray,

> extremely fissile, nearly unfossiliferous, and slightly micaceous. Thinner zones of shales, usually in the lower-middle part of the formation, are chocolate-brown to dark-maroon. Thin-bedded, gray, crystalline, micaceous limestones, and occasionally thin-bedded, brown-weathering, micaceous sandstones are irregularly intercalated with the shales. In some of the sections, notably on Crowfoot Ridge, and on Dry Wolf Creek, crystalline limestone lenses, 10 to 24 inches in diameter and 1 to 5 inches in thickness, are intercalated with the shales in the middle and upper parts of the formation. These lenses are usually rich in trilobite fragments and brachiopods. The color, fissility, and composition of the shale, the thin-bedded intercalated limestones, and particularly the presence of the fossiliferous limestone lenses, cause the Park shale to resemble closely the Wolsey. However, the stratigraphic position, and particularly the strikingly different faunas, readily distinguish the two formations. The type section of the Park shale is on the north side of Dry Wolf Creek, on the eastern side of the Little Belt Mountains."

The writer has not worked on the Park shale in the field, but has thoroughly studied the trilobites which Deiss collected from the Park shale. These collections were made from three localities given according to their geographic position from north to south, (1) Dry Wolf Creek in the Little Belt Mountains, (2) Nixon Gulch in the Bridger Range of the Three Forks area, and (3) Crowfoot Ridge in the Madison Range of Yellowstone National Park (Fig. 1). The results of this study are given in the following pages.

FOSSIL LOCALITIES

The fossil localities listed below are the same as those given by Deiss (1936, p. 1279, 1311, 1318).

Loc. 38-1. The spur east of the eastern small unnamed creek which heads on Big Baldy Mountain and north of Dry Wolf Creek, Judith Basin county, sec. 14, T. 14 N., R. 9 E. Park shale, 57 to 124 feet below base of overlying Pilgrim limestone.

Loc. 46-1. On both sides of Nixon Gulch, Gallatin county, secs. 14, 22, 23, 27, and 28, T.2 N., R. 3 E. Park shale, 12 to 30 feet above base.

Loc. 43-4. Southern end of Gallatin Range in the northwestern corner of Yellowstone National Park, 8 to 9 miles south of the Montana-Wyoming boundary. Park shale, 1 to 56 feet above base.

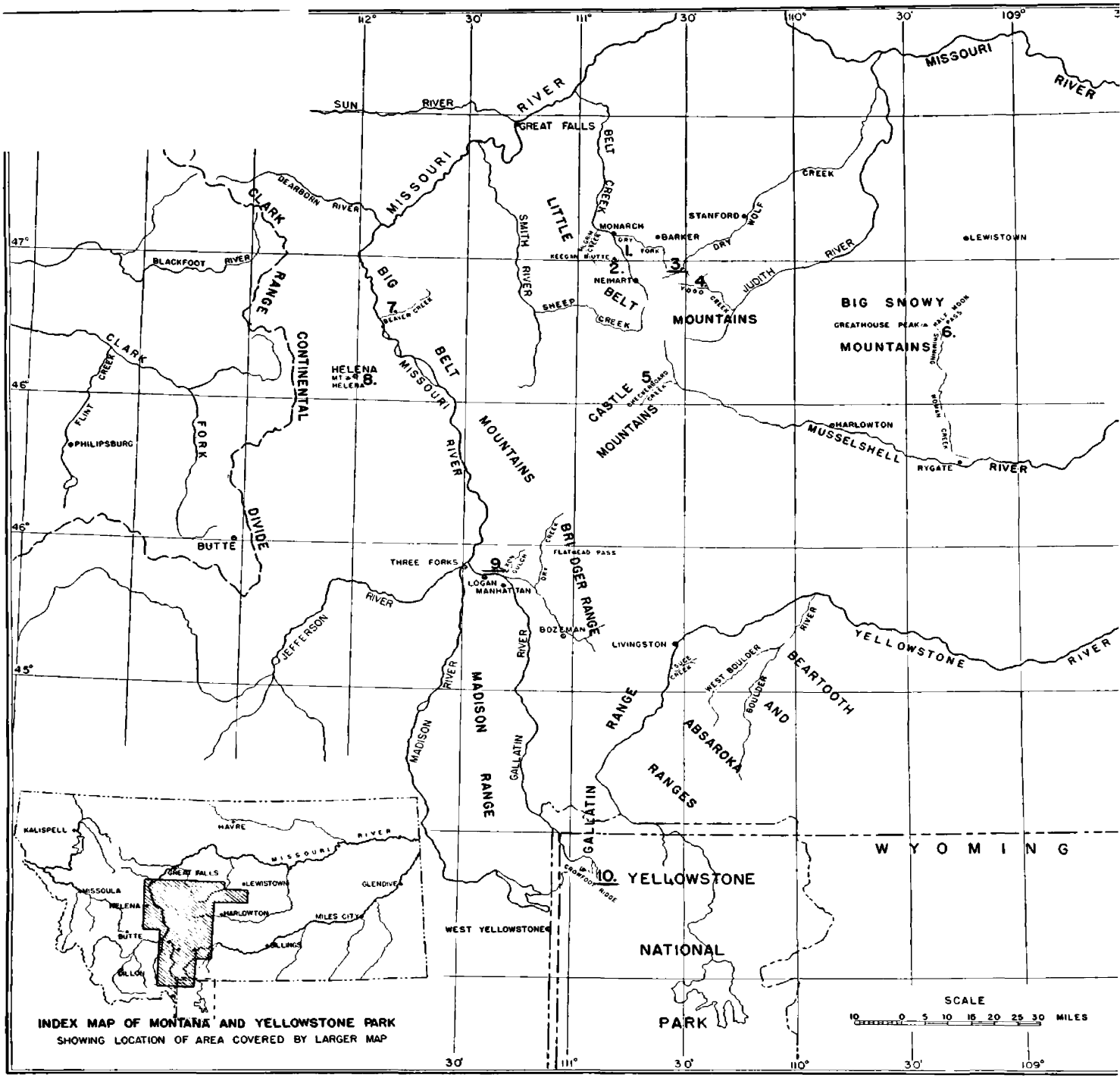

Figure 1. MAP OF AREA SHOWING LOCATION OF SECTIONS

Numerals indicate location of stratigraphic sections: (1) Belt Creek, Keegan Butte, (3) Dry Wolf Creek, (4) Yogo Gulch, (5) Checkerboard Creek, Half Moon Pass, (7) Beaver Creek, (8) Grizzly-Oro Fino Gulch, (9) Nixon G and (10) Crowfoot Ridge.

The three underlined numerals (3, 9, 10) indicate the sections from whi the trilobites described in this paper were obtained.

CORRELATION OF THE PARK SHALE

LOCAL CORRELATIONS

In 1936 Deiss tentatively correlated the shale above the Meagher limestones in Central Montana and Yellowstone National Park with the Park shale of the Little Belt Mountains. His criteria for doing so were (Deiss 1936, p. 1339):

> "(1) the stratigraphic position of the shale, beneath the Pilgrim and above the Meagher limestones; (2) the uniform composition and thickness of the shale; and (3) superficial comparison of the fossils."

A study of the trilobite collections from Crowfoot Ridge and Dry Wolf Creek now reveals that the Park shale in these areas can be closely correlated as both collections contain Parasolenopleurella, Neoplaguriella, Deisella, Meteoropolus, and Beltia. The shale called Park in the Three Forks area contains a different fauna than the Park shale on Crowfoot Ridge and Dry Wolf Creek and can not be correlated upon evidence from the trilobites. Consequently the "Park" shale in the Three Forks area can only be correlated with the Park shale in Crowfoot Ridge and Wolf Creek upon its stratigraphic relations.

REGIONAL CORRELATIONS

Examination of the literature failed to show any trilobites which could be identified with those from the Park shale other than Deisella and Olenoides?. The Park shale in Crowfoot Ridge and Dry Wolf Creek is tentatively believed to be of the same age as the St. Albans formation of Vermont because Deisella, a Middle-Upper Cambrian transitional genus described by Howell and Duncan (1939, p. 7), occurs

in each of these localities.

CONCLUSIONS

The evidence obtained from the study of the Park shale trilobites now seems to substantiate the following conclusions:

The Park shale is Late Middle Cambrian in age. All the genera described in the following pages are new except Deissella and Olenoides? and are more closely related to Middle than to Upper Cambrian forms.

The fauna which occurs in the Three Forks area at the base of the Park shale appears to be older than the fauna in Dry Wolf Creek and on Crowfoot Ridge. This older fauna contains several poorly preserved "Agnostids" superficially resembling those from the Pentagon shale of northwestern Montana and the Marjum limestone of Utah, several "glyphaspid" tails similar to those in the Steamboat limestone of northwestern Montana (Deiss 1939, p. 94) and Olenoides?. The other genera in the fauna are unlike any previously published.

The trilobites from Dry Wolf Creek and Crowfoot Ridge belong to the same or similar genera, and are considered younger than those from Nixon Gulch, because some of the trilobites closely resemble genera in the basal Upper Cambrian (Dresbach), and others resemble those in the youngest Middle Cambrian faunules.

The Park fauna from Crowfoot Ridge and Dry Wolf Creek is considered in part equivalent to the Centropleura vermontensis fauna of Vermont described by Howell (1937, p. 1147-1210).

FAUNAL CHART

	Dry Wolf Creek	Nixon Gulch	Crowfoot Ridge
Acanthopolus primus n. gen. and n. sp.	x		
Atoporhis primus n. gen. and n. sp.		x	
Beltia convergens n. sp.	x		
convexa n. sp.			x
crassa n. sp.	x		
discrepans n. sp.	x		
drywolfensis n. sp.	x		
nitida n. sp.	x		
plana n. sp.	x		
profunda n. sp.	x		
rotunda n. sp.	x		
typica n. gen. and n. sp.	x		
Campylolkus discrepans n. sp.		x	
elongatus n. sp.		x	
typicus n. gen. and n. sp.		x	
Coelorhis typicus n. gen. and n. sp.		x	
Deisselia crowfootensis n. sp.			x
drywolfensis n. sp.	x		
elongata n. sp.	x		
magna n. sp.	x		
typica n. sp.			x
Meteoropolus anulatus n. sp.			x
bilobatus n. sp.	x		
crassus n. sp.			x
discrepans n. sp.			x
latus n. sp.			x
nitidus n. sp.			x
primus n.gen. and n. sp.			x
Neoplagiurella gigas n. sp.	x		
immatura n. sp.			x
parallela n. sp.	x		
typica n. gen. and n. sp.			x
Olenoides? elongatus n. sp.		x	
Oxypolus primus n. gen. and n. sp.		x	
Parkia? minuta n. sp		x	
plana n. sp.		x	
prima n. gen. and n. sp.		x	
Parasolenopleurella crowfootensis n. sp.			x
drywolfensis n. gen. and n. sp.	x		
obscura n. sp.	x		

DESCRIPTION OF GENERA AND SPECIES

Genus ACANTHOPOLUS, n. gen.

DIAGNOSIS: Cranidium 3 mm. to 4 mm. in length. Facial sutures subparallel in front of eyes; directed obliquely backward behind eyes forming broad postero-lateral limbs.

Glabella abnormally high, strongly convex; long, broad, moderately tapered; anterior end broadly rounded. Glabellar furrows oblique, in two pairs. Occipital furrow deep, broad. Occipital ring extended into strong elevated spine.

Brim consists of well developed rim; deep broad marginal furrow and poorly defined preglabellar area. Rim sharply elevated; uniform in width.

Fixed cheeks broad; laterally depressed. Dorsal furrow broad, shallow; confluent with marginal furrow in front of glabella. Eye lobes not observable on specimen studied. Eye ridges faint.

Thorax and pygidium unknown.

REMARKS: Acanthopolus, n. gen. differs from Deissella (Howell and Duncan, 1939, p. 7) in possessing an abnormally high glabella, laterally depressed fixed cheeks, a broad shallow dorsal furrow, and a broad deep occipital furrow.

GENOTYPE: Acanthopolus primus, n. gen. and n. sp.

NAME: Greek, ἄκανθα, spine, πόλος, axis, referring to the spined axis.

Acanthopolus primus, n. sp.

Plate 1, figs. 1, 2.

DESCRIPTION: The generic description gives the essential characteristics of the species.

NAME: Latin, primus, first, referring to this species as the type of the genus.

OCCURRENCE: Park shale (38-1) Dry Wolf Creek, Little Belt Mountains.

HOLOTYPE 94, PARATYPE 75, Montana State University.

Genus ATOPORHIS, n. gen.

DIAGNOSIS: Description taken from a fragmentary cranidium and pygidium. Cranidium strongly convex. Facial sutures not preserved; probably diverge in front of eyes, probably directed laterally back of eyes forming short postero-lateral limbs.

Glabella strongly convex, tapered, smooth; anterior end acutely rounded. Occipital ring narrow, widened medially, well defined by deep broad furrow.

Brim narrow. Rim convex, elevated, narrow; curved posteroiorly in front of glabella. Marginal furrow broad, deep. Preglabellar area flat, depressed.

Fixed cheeks convex, depressed laterally; half width of glabella between eyes. Dorsal furrow deep, rounded in cross section. Eye lobes small. Eye lines absent.

Pygidium convex. Axis long, wide, broadly rounded posteriorly, subcylindrical, elevated above pleural lobes; only anterior furrow

clearly defined. Dorsal furrows faint anteriorly, absent posteriorly.

Pleural lobe flat, exhibits only faint anterior pleural furrow. Border poorly defined, steeply inclined. Marginal spines short, flat, sharp, depressed; five on each pleural lobe.

GENOTYPE: Atoporhis primus, n. gen. and n. sp.

NAME: Greek, ατοπος, queer, ῥις, nose, referring to the queer rim.

Atoporhis primus, n. sp.

Plate 1, figs. 3, 4.

DESCRIPTION: The generic description gives the essential characteristics of the species.

NAME: Latin, primus, first, referring to this species as the type of the genus.

OCCURRENCE: Park shale, (46-1) Nixon Gulch, Three Forks area.

HOLOTYPE 42, PARATYPE 33, Montana State University.

Genus BELTIA, n. gen.

DIAGNOSIS: Cranidia convex, 5 mm. to 15 mm. in length. Facial sutures diverge in front of eyes. Posterior portions directed laterally and slightly posteriorly forming broad, short, postero-lateral limbs.

Glabella moderate in length, broad, depressed, subparallel sided to moderately tapered; anterior end broadly to acutely rounded. Glabellar furrows generally absent, position frequently indicated by extremely faint color markings. Occipital ring uniform in width, well defined by narrow occipital furrow.

Brim one-third or less length of cranidium. Rim subequal in width to or narrower than preglabellar area, more or less convex, uniform in width, either gently elevated to depressed. Preglabellar area moderately to strongly convex. Marginal furrow well defined, slightly to strongly curved; in some species exhibits shallow elongate depressions opposite antero-lateral angles of glabella.

Fixed cheeks approximately half width of glabella opposite eyes, laterally depressed or slightly elevated, convex or flat. Dorsal furrow strong, angular to rounded in cross section. Eye lobes slightly curved, of medium size, located just in front of middle of glabella. Eye lines faint or absent.

Pygidia strongly convex, transversely elliptical, 6 mm. to 9 mm. in length. Axis moderately tapered, subcylindrical, high. Three strong axial furrows and faint posterior furrow present. Dorsal furrow strong anteriorly, faint posteriorly. Pleural lobe flat to strongly convex, exhibits four narrow well defined pleural furrows extending to border. Border narrow, uniform in width, moderately defined. Faint pair spines on anterior segment may be present.

GENOTYPE: Beltia typica, n. gen. and n. sp.

NAME: This genus is named for its occurrence in the Little Belt Mountains.

Beltia convergens, n. sp.

Plate 1, figs. 5, 6.

DESCRIPTION: Cranidium flatly convex in longitudinal, flat in cross section. Glabella moderately tapered, anterior end broadly

rounded. Glabellar furrows absent. Occipital ring narrow, well defined by a weak occipital furrow.

Rim subequal to or less than width of preglabellar area; slightly convex, horizontal. Preglabellar area convex; depressed. Marginal furrow narrow, deep, slightly curved.

Fixed cheeks gently convex. Dorsal furrow broad, strong. Eye lines absent.

REMARKS: Beltia convergens, n. sp. differs from B. nitida, n. sp. in possessing a tapered glabella and a deeper dorsal furrow.

NAME: Latin, convergens, converge, referring to the convergence of the dorsal furrows.

OCCURRENCE: Park shale, (38-1) Dry Wolf Creek, Little Belt Mountains.

HOLOTYPE 128, PARATYPE 136, Montana State University.

Beltia convexa, n. sp.

Plate 1, fig. 7.

DESCRIPTION: Glabella faintly furrowed moderately tapered; anterior end acutely rounded. Brim wide. Rim convex, horizontal, uniform in width, subequal in width to strongly convex preglabellar area. Marginal furrow broad, deep, curves anteriorly in front of glabella.

Fixed cheeks convex, laterally depressed. Dorsal furrow broad, strong. Eye lobes moderate. Eye lines faint.

REMARKS: Beltia convexa, n. sp. differs from B. crassa, n. sp. in possessing an acutely rounded glabella, a horizontal rim subequal

in width to preglabellar area and laterally depressed fixed cheeks; and from B. plana, n. sp. in having an acutely rounded glabella, a convex uniform rim subequal in width to preglabellar area, and laterally depressed fixed cheeks.

NAME: Latin, convexa, convex, referring to the strongly convex preglabellar area.

OCCURRENCE: Park shale (43-4), Crowfoot Ridge, Yellowstone National Park.

HOLOTYPE 230, Montana State University.

Beltia crassa, n. sp.

Plate 1, figs. 8-10.

DESCRIPTION: Glabella smooth to faintly furrowed, moderately tapered; anterior end broadly rounded. Brim wide. Rim narrow, convex, horizontal. Preglabellar area wide, strongly convex. Marginal furrow broad, deep, curves anteriorly in front of glabella.

Fixed cheeks convex, horizontal. Dorsal furrows strong, rounded in cross section. Eye lobes not preserved. Eye lines faint.

Pleural lobe of pygidium evenly convex. Post-axial ring blends posteriorly with steeply inclined border.

REMARKS: Beltia crassa, n. sp. differs from B. plana, n. sp. to which it appears most closely related in possessing a narrow, convex rim of uniform width.

The pygidium differs from that of B. discrepans, n. sp. in that the posterior end of the axis merges with steeply inclined border.

NAME: Latin, crassus, coarse, referring to the coarse character of the cranidium.

OCCURRENCE: Park shale, (38-1) Dry Wolf Creek, Little Belt Mountains.

HOLOTYPE 112, PARATYPES 145, 163, Montana State University.

Beltia discrepans, n. sp.

Plate 1, figs. 11-14.

DESCRIPTION: Glabella broad, subtriangular in transverse section, moderately tapered; despressed anteriorly, anterior end acutely rounded. Glabellar furrows absent. Rim slightly convex, gently elevated, subequal in width to preglabellar area. Marginal furrow broad and deep on the lateral parts of brim, shallow in front of glabella. Preglabellar area convex.

Fixed cheeks convex, laterally depressed. Dorsal furrow broad, strong. Eye lines light. Eye lobes not preserved in specimens studied.

Pleural lobe of pygidium evenly convex. Post-axial ring acutely rounded, distinct. Border well defined, moderately inclined.

REMARKS: Beltia discrepans, n. sp. differs from B. nitida, n. sp. in possessing a moderately tapered glabella, convex laterally depressed fixed cheeks, and a broad marginal furrow deep on lateral portions of brim and shallow in front of glabella; from B. convergens, n. sp. in having an acutely rounded glabella, convex laterally depressed fixed cheeks, and relatively shallower dorsal furrows; from B. rotunda, n. sp. in having laterally depressed fixed cheeks, a rim subequal in

width to preglabellar area, and relatively shallower dorsal furrows; from B. drywolfensis, n. sp. in having laterally depressed fixed cheeks, a higher glabella and a more depressed brim; and from B. typica, n. sp. in having an elevated rim subequal in width to preglabellar area, laterally depressed fixed cheeks and a higher glabella subtriangular in transverse section.

NAME: Latin, discrepans, referring to subtriangular transverse section of the glabella.

OCCURRENCE: Park shale (38-1), Dry Wolf Creek, Little Belt Mountains.

HOLOTYPE 122, PARATYPES 131, 146, 156, Montana State University.

Beltia drywolfensis, n. sp.

Plate 1, figs. 15, 16.

DESCRIPTION: Cranidia average 10 mm. in length. Glabella depressed, moderately tapered; anterior end rounded. Glabellar furrows absent.

Rim less than width of preglabellar area, convex, elevated. Preglabellar area convex. Marginal furrow wide, well defined, moderately curved, exhibits a pair of elongate depressions opposite anterolateral angles of glabella.

Fixed cheeks elevated, convex. Dorsal furrow deep. Eye lines absent.

REMARKS: Beltia drywolfensis, n. sp. differs from B. nitida, n. sp. in possessing a wider brim, a broad moderately arched marginal furrow, a convex elevated rim, a broad deep dorsal furrow, convex

fixed cheeks and a tapered glabella; from B. convergens, n. sp. in having a convex elevated rim, broad moderately curved marginal furrow, and convex fixed cheeks; from B. rotunda, n. sp. in having an elevated fixed cheek and an elevated rim which is less than the width of preglabellar area. B. drywolfensis, n. sp. differs from all of the above species in possessing a pair of shallow elongate depressions in the marginal furrow.

NAME: The species is named for its occurrence in Dry Wolf Creek.

OCCURRENCE: Park shale (38-1), Dry Wolf Creek, Little Belt Mountains.

HOLOTYPE 129, PARATYPE 120, Montana State University.

Beltia nitida, n. sp.

Plate 1, figs. 17, 18.

DESCRIPTION: Cranidia convex in longitudinal section; flat in cross section. Glabella subparallel sided, slightly depressed, flatly convex; anterior end broadly rounded. Glabellar furrows indicated by three pairs of extremely faint color markings. Occipital ring uniform in width, well defined by deep, narrow occipital furrow.

Brim one-fourth or less length of cranidium. Rim subequal in width to preglabellar area, slightly convex, horizontal. Preglabellar area moderately convex. Marginal furrow narrow, of moderate depth, slightly curved.

Fixed cheeks gently convex. Dorsal furrow moderate, well defined. Eye lines extremely faint.

REMARKS: Beltia nitida, n. sp. is compared with B. convergens, n. sp., B. rotunda, n. sp., B. drywolfensis, n. sp., B. typica, n. sp., B. discrepans, n. sp., B. crassa, n. sp., B. plana, n. sp., B. convexa, n. sp., and B. profunda, n. sp. in remarks on each.

NAME: Latin, nitidus, trim, referring to the trim features of the cranidium.

OCCURRENCE: Park shale (38-1), Dry Wolf Creek, Little Belt Mountains.

HOLOTYPE 125, PARATYPE 126, Montana State University.

Beltia plana, n. sp.

Plate 1, figs. 19, 20.

DESCRIPTION: Glabella faintly furrowed, moderately tapered; anterior end broadly rounded. Brim wide. Rim two-thirds to one-half width of preglabellar area, widened medially, nearly flat, horizontal. Preglabellar area strongly convex. Marginal furrow broad shallow.

Fixed cheeks convex, horizontal. Dorsal furrows strong, rounded in cross section. Eye lobes not preserved. Eye lines faint.

Pleural lobe of pygidium flat lateral to axis. Border poorly preserved, moderately inclined laterally, steeply inclined posteriorly. Post-axial ring high, distinct from border.

REMARKS: The cranidium is compared with Beltia discrepans, n. sp. in remarks under that species. The pygidium differs from that of B. discrepans in having flat pleural lobes and a steeply inclined posterior border; and from that of B. crassa, n. sp. in having flat pleural lobes and high, post-axial ring distinct from border.

NAME: Latin, planus, flat, referring to the nearly flat rim.

OCCURRENCE: Park shale (38-1), Dry Wolf Creek, Little Belt Mountains.

HOLOTYPE 115, PARATYPE 161, Montana State University.

Beltia profunda, n. sp.

Plate 2, figs. 1, 2.

DESCRIPTION: Glabella smooth, moderately tapered; anterior end acutely rounded. Rim slightly convex, horizontal, uniform in width, narrower than strongly convex preglabellar area. Marginal furrow broad, deep, curves slightly outward in front of glabella.

Fixed cheeks convex, laterally depressed. Dorsal furrows strong, deep, rounded in cross section. Eye lobes moderate. Eye lines absent.

REMARKS: Beltia profunda, n. sp. differs from B. crassa, n. sp. in possessing an acutely rounded glabella, a slightly convex horizontal rim, a narrower preglabellar area, and no eye lines; from B. plana, n. sp. in having an acutely rounded glabella, deep marginal and dorsal furrows, no eye lines, and a narrower slightly convex uniform rim; and from B. convexa, n. sp. in having a more strongly tapered and acutely rounded glabella, deeper dorsal furrows, horizontal fixed cheeks, and no eye lines.

NAME: Latin, profundus, deep, referring to deep dorsal furrows.

OCCURRENCE: Park shale (38-1), Dry Wolf Creek, Little Belt Mountains.

HOLOTYPE 121, PARATYPE 125, Montana State University.

Beltia rotunda, n. sp.

Plate 2, figs. 3, 4.

DESCRIPTION: Glabella tapered, anterior end acutely rounded, convex, depressed. Glabellar furrows absent.

Rim convex, slightly depressed, subequal to preglabellar area. Preglabellar area convex. Marginal furrow wide, strong, rounded in cross section, slightly curved.

Fixed cheeks convex, horizontal. Dorsal furrow strong, rounded in cross section. Eye lobes not preserved in specimen studied. Eye lines faint.

REMARKS: Beltia rotunda, n. sp. differs from B. nitida, n. sp. in possessing a relatively wider cranidium, stronger rounded marginal and dorsal furrows, a tapered acutely rounded glabella, convex horizontal fixed cheeks, and a depressed rim; and from B. convergens, n. sp. in having an acutely rounded glabella, a strong broad marginal furrow, convex horizontal fixed cheeks, and a depressed rim.

NAME: Latin, rotundus, round, referring to the rounded marginal and dorsal furrows.

OCCURRENCE: Park shale (38-1), Dry Wolf Creek, Little Belt Mountains.

HOLOTYPE 124, PARATYPE 130, Montana State University.

Beltia typica, n. sp.

Plate 2, Figs. 5-7.

DESCRIPTION: Glabella slightly convex, moderately tapered, anterior end rounded. Glabellar furrows absent. Occipital ring well

defined by narrow occipital furrow.

Rim narrow, convex, horizontal or slightly depressed. Preglabellar area slightly convex. Marginal furrow broad, well defined.

Fixed cheeks convex, horizontal. Dorsal furrows strong. Eye lobes not preserved in specimens studies. Eye lines absent.

Pygidium five-ninths long as wide. Post-axial ring merges dorsoventrally with border. Pleural lobe evenly convex. Border faint, steeply inclined posteriorly, extended antero-laterally into short posteriorly directed spine.

REMARKS: Beltia typica, n. sp. differs from B. nitida, n. sp. and B. convergens, n. sp. in possessing a wider brim, convex fixed cheeks, a narrow moderately convex rim, and a strongly curved marginal furrow; from B. nitida, n. sp. in having a moderately tapered glabella; from B. rotunda, n. sp. in having a wider brim, and a narrow rim; and from B. drywolfensis, n. sp. in having horizontal fixed cheeks, a narrow rim, and wider brim.

The pygidium of Beltia typica, n. sp. differs from that of all other species in possessing a pair of faint marginal spines on anterior segments of pleural lobes.

NAME: Latin, typicus, typical, referring to this species as the type of the genus.

OCCURRENCE: Park shale (38-1), Dry Wolf Creek, Little Belt Mountains, and (43-4), Crowfoot Ridge, Yellowstone National Park.

HOLOTYPE 132, PARATYPE 144, HYPOTYPE 206, Montana State University.

Genus CAMPYLOLKUS, n. gen.

DIAGNOSIS: Cranidium strongly convex. Facial sutures diverging in front of eyes; directed laterally and slightly posteriorly back of eyes forming short, narrow postero-lateral limbs. Postero-marginal furrow narrow, deep.

Glabella long, broad, strongly to moderately convex, tapered; anterior end broadly or acutely rounded. Occipital ring depressed, flat, widened medially, well defined by deep, narrow occipital furrow.

Brim one-fourth or less length of cranidium. Rim convex, depressed, subequal in width to or wider than preglabellar area; widened medially by posterior curvature of marginal furrow in front of glabella. Preglabellar area flat. Marginal furrow narrow, strong.

Fixed cheeks half width of glabella opposite eyes; depressed laterally. Dorsal furrow, narrow, strong. Eye lobes small, located opposite middle third of glabella. Eye lines absent.

Pygidium transversely elongate; strongly convex. Axis subparallel sided, long, one-third width of pygidium, exhibits three shallow furrows. Posterior end of axis high, distinct from border. Dorsal furrow strong anteriorly, obsolete posteriorly.

Pleural lobe strongly convex, marked by two or three faint pleural furrows extended to lateral edge. Border steeply inclined, blends into pleural lobes.

REMARKS: Campylolkus, n. gen. differs from Blountia (Walcott, 1916, p. 396) in possessing short narrow postero-lateral limbs, a medially widened rim, a marginal furrow which curves posteriorly in

front of glabella and no eye lines.

GENOTYPE: Campylolkus typicus, n. gen. and n. sp.

NAME: Greek, καμπυλος, curved, ολκος, furrow, referring to the curved marginal furrow.

Campylolkus discrepans, n. sp.

Plate 2, fig. 8.

DESCRIPTION: Glabella strongly convex, tapered; anterior end acutely rounded. Rim subequal in width to preglabellar area.

REMARKS: Campylolkus discrepans, n. sp. differs from C. typicus, n. sp. in possessing a more strongly tapered acutely rounded glabella and a wider preglabellar area.

NAME: Latin, discrepans, different.

OCCURRENCE: Park shale (46-1), Nixon Gulch, Three Forks area.

HOLOTYPE 41, Montana State University.

Campylolkus elongatus, n. sp.

Plate 2, fig. 9.

DESCRIPTION: Glabella moderately convex, tapered, anterior end acutely rounded. Rim wider than preglabellar area.

REMARKS: Campylolkus elongatus, n. sp. differs from C. typicus, n. sp. in possessing a moderately convex tapered acutely rounded glabella and a narrower preglabellar area; and from C. discrepans, n. sp. in having a moderately convex glabella and a narrow preglabellar area.

NAME: Latin, elongatus, elongated, referring to the long glabella.

OCCURRENCE: Park shale (46-1), Nixon Gulch, Three Forks area.

HOLOTYPE 43, Montana State University.

Campylolkus typicus, n. sp.

Plate 2, figs. 10, 11.

DESCRIPTION: Glabella strongly convex, very slightly tapered; anterior end broadly rounded. Rim subequal in width to preglabellar area. The description of the pygidium assigned to this species is given in the generic description.

REMARKS: Campylolkus typicus, n. gen. and n. sp. is compared with C. discrepans, n. sp. and C. elongatus, n. sp. in remarks on each.

NAME: Latin, typicus, typical, referring to the species as the type of the genus.

OCCURRENCE: Park shale (46-1), Nixon Gulch, Three Forks area.

HOLOTYPE 52, PARATYPE 15, Montana State University.

Genus COELORHIS, n. gen.

DIAGNOSIS: Cranidium broad, flat; may be depressed anteriorly. Facial sutures diverge abnormally in front of eyes; directed laterally back of eyes forming short, extremely narrow postero-lateral limbs.

Glabella half to two-thirds length of cranidium; broadly rounded. Occipital ring narrow; faintly defined by narrow, shallow occipital furrow.

Brim wide. Rim flat, uniform in width, gently elevated, subequal in width to preglabellar area. Marginal furrow broad, poorly defined,

rounded in cross section. Preglabellar area depressed, moderately convex.

Fixed cheeks flat, half width of glabella. Dorsal furrow shallow. Eye lobes faint. Eye lines absent. Eyes large, located opposite posterior part of glabella.

Associated pygidium semicircular in outline, flat. Axis narrow, short, smooth, subparallel sided, flatly convex; posterior end rounded. Dorsal furrow absent.

Pleural lobe flat, smooth, unfurrowed. Border narrow, uniform in width, blends almost imperceptibly into pleural lobes.

REMARKS: See remarks under Parkia, n. gen.

GENOTYPE: Coelorhis typicus, n. gen. and n. sp.

NAME: Greek, κοίλος, concave, ῥίς nose, referring to the concave brim.

Coelorhis typicus, n. sp.

Plate 2, figs. 12, 13.

DESCRIPTION: The generic description gives the essential characteristics of the species.

NAME: Latin, typicus, typical, referring to the species as the type of the genus.

OCCURRENCE: Park shale (46-1), Nixon Gulch, Three Forks area.

HOLOTYPE 54, PARATYPE 34, Montana State University.

Genus DEISSELLA Howell and Duncan, 1939.

Deisella Howell and Duncan, 1939, Wagner Free Inst. Sci., Bull., vol. 14, no. 1, p. 7.

ORIGINAL DESCRIPTION: "Cranidium wide at base, tapered rapidly anteriorly. Glabella approximately two-thirds the length of the cranidium, narrow, conical, truncate in front, strongly convex. Two distinct glabellar furrows, directed backward at an angle of approximately 45°, are distinguishable on the inner surface of the test. Occipital furrow narrow and deep laterally, broader and shallower medially. Occipital ring broad, convex, unspined in adult forms. Dorsal furrow very deep laterally, distinct but much shallower in front of glabella. Brim concave, divided into a convex, strongly upturned rim and a slightly convex preglabellar area by a broad, deep transverse furrow; whole brim bent steeply downward at sides. Free cheeks very wide, convex, highly elevated above dorsal furrow, so that the eyes are about level with the top of the glabella. Eyes of medium size; ocular ridge well developed, directed laterally from antero-lateral angle of the dorsal furrow, curved posteriorly and downward at the distal ends, marked by distinct, broad furrow. Facial sutures converge rapidly in front of the eyes, probably outlining the rather straight anterior edge of the cranidium. Surface of cranidium smooth.

"Associated free cheek of medium size, comparatively flat, with highly elevated ocular platform. Border narrow. Genal spine directed diagonally outward.

"Pygidium moderately convex, ovate in outline. Axis less than one-third total width of pygidium, moderately convex and elevated above pleural lobes, extended almost to posterior edge of pygidium, divided into six segments. Pleural lobes relatively flat, marked by five furrows. Border narrow. Surface of pygidium smooth.

"GENOTYPE: Ptychoparia? convexa Howell, Geol. Soc. America Bull., vol. 48, pp. 1182-1183, pl. 5, figs. 3-6, 12.

"REMARKS: Deissella is similar to Hysteropleura Raymond, 1937, in many respects. The glabella of Deissella is, however, proportionately larger, the eyes are larger, and the preglabellar area is slightly convex, whereas that of Hysteropleura appears to be concave. Deissella also bears some resemblance to Bolaspis and Acrocephalops, but differs from these genera in several features of the cranidium which need not be discussed here. Relationships with all three of these genera are, however, suggested by the characters which the genus has in common with them."

All species of Deissella from the Park shale differ from the genotype in that the occipital ring is extended into an elevated, long, tapered, spine.

Deissella crowfootensis, n. sp.

Plate 2, figs. 14, 15.

DESCRIPTION: Glabella strongly convex, long, moderately tapered, anterior end truncate. Glabellar furrows oblique in two pairs.

Brim narrow. Preglabellar area concave. Fixed cheeks strongly elevated. Dorsal furrow broad, deep. Eye lobes small, nearly vertical. Eye lines absent.

REMARKS: Deissella crowfootensis, n. sp. differs from D. typica, n. sp. in possessing a concave preglabellar area, a narrower brim, and a less tapered glabella; from D. elongata, n. sp. in having glabellar furrows, a wide moderately tapered truncate glabella, and broad deep dorsal furrows; from D. drywolfensis, n. sp. in having a wide moderately tapered truncate glabella, broad deep dorsal furrows, a narrow brim, and strongly elevated fixed cheeks; and from D. magna, n. sp. in having a long truncate glabella, a narrow brim and no eye lines.

NAME: This species is named for its occurrence in Crowfoot Ridge, Yellowstone National Park.

OCCURRENCE: Park shale (43-4), Crowfoot Ridge; Yellowstone National Park.

HOLOTYPE 195, PARATYPE 194, Montana State University.

Deissella drywolfensis, n. sp.

Plate 2, figs. 16, 17.

DESCRIPTION: Glabella convex, long, narrow, tapered, anterior end acutely rounded. Glabellar furrows oblique in two pairs.

Brim narrow. Preglabellar area narrow, concave. Fixed cheeks moderately elevated. Dorsal furrows narrow. Eye lobes not preserved in specimens studied. Eye ridges absent.

REMARKS: Deissella drywolfensis, n. sp. differs from D. typica, n. sp. in possessing a long narrow rounded glabella, a narrow brim, and a narrow concave preglabellar area; and from D. elongata, n. sp. in having a tapered glabella, two pairs of oblique glabellar furrows, and moderately elevated fixed cheeks.

NAME: The species is named for its occurrence in Dry Wolf Creek, Little Belt Mountains.

OCCURRENCE: Park shale (38-1), Dry Wolf Creek, Little Belt Mountains.

HOLOTYPE 79, PARATYPE 97, Montana State University.

Deissella elongata, n. sp.

Plate 2, fig. 18.

DESCRIPTION: Glabella long, narrow, subparallel sided, moderately convex, anterior end rounded. Glabellar furrows absent.

Brim narrow. Preglabellar area narrow, concave. Fixed cheeks strongly elevated. Dorsal furrows narrow. Eye ridges absent. Eye lobes not preserved in specimens studied.

REMARKS: Deissella elongata, n. sp. differs from D. typica, n. sp. in possessing a narrow preglabellar area, subparallel sided anteriorly rounded narrow glabella, a narrow dorsal furrow, and a concave preglabellar area.

NAME: Latin, elongatus, elongated, referring to the long narrow

glabella.

OCCURRENCE: Park shale (38-1), Dry Wolf Creek, Little Belt Mountains.

HOLOTYPE 69, Montana State University.

Deissella magna, n. sp.

Plate 3, figs. 1, 2.

DESCRIPTION: Glabella short, broad, moderately tapered, strongly convex; anterior end broadly rounded. Glabellar furrows oblique in two pairs.

Brim wide. Preglabellar area concave. Fixed cheeks strongly elevated. Dorsal furrows broad, rounded in cross section. Eye lobes not preserved in specimens studied. Eye lines moderate, perpendicular to and located opposite anterior part of glabella.

REMARKS: Deissella magna, n. sp. differs from D. typica, n. sp. in possessing eye lines, a short, strongly convex, broadly rounded glabella, concave preglabellar area and broad rounded dorsal furrows; from D. elongata, n. sp. in having glabellar furrows, a strongly convex moderately tapered glabella, eye lines, a wide brim, and broad dorsal furrows; and from D. drywolfensis, n. sp. in having eye lines, a wide strongly convex broadly rounded glabella, strongly elevated fixed cheeks and wider dorsal furrows.

NAME: Latin, magnus, large, referring to the size of the glabella.

OCCURRENCE: Park shale (38-1), Dry Wolf Creek, Little Belt Mountains.

HOLOTYPE 89, PARATYPE 111, Montana State University.

Deisella typica, n. sp.

Plate 3, figs. 3, 4.

DESCRIPTION: Glabella broad, moderately tapered, convex, anterior end truncate, possesses two pairs of obliquely directed furrows. Occipital furrow broad, shallow.

Brim wide. Rim perpendicular to preglabellar area. Preglabellar area flat, wide.

Fixed cheeks strongly elevated. Dorsal furrows broad. Eye lobes not preserved in specimens studied. Eye ridges absent.

REMARKS: Deisella typica, n. sp. is compared with D. elongata, n. sp., D. drywolfensis, n. sp., D. magna, n. sp., and D. crowfootensis, n. sp. in remarks on each.

NAME: Latin, typicus, typical, referring to this species as the typical species of the genus.

OCCURRENCE: Park shale (43-4), Crowfoot Ridge, Yellowstone National Park.

HOLOTYPE 197, PARATYPE 176, Montana State University.

Genus METEOROPOLUS, n. gen.

DIAGNOSIS: Cranidium strongly convex. Facial sutures diverging in front of eyes; extend postero-laterally back of eyes. Postero-lateral limbs broad, short; possess strong, broad, postero-marginal furrow. Glabella long, conical, high; moderately tapered; forms one-half width of cranidium opposite eyes; anterior end acutely rounded.

Occipital ring well defined, uniform in width, narrow. Occipital furrow deep, narrow.

Brim wide. Rim subequal in width to or narrower than preglabellar area; uniform in width; gently convex. Preglabellar area nearly flat. Marginal furrow strong, some species exhibit pair of shallow, elongate, depressions in front of antero-lateral angles of glabella; often curved anteriorly in front of glabella.

Fixed cheeks one-half width of glabella opposite eye lobes; convex, elevated or laterally depressed. Dorsal furrow deep; narrowly to broadly rounded in cross section. Eye lobes moderate, slightly curved; located opposite middle one-third of glabella. Eye lines moderate.

Pygidium subelliptically convex, average 5 mm. in length, 10 mm. in width. Posterior border bilobed in some specimens. Axis broad, high, exhibits two strong furrows and a weak posterior furrow. Dorsal furrows well defined anteriorly, frequently absent posteriorly.

Pleural lobe strongly convex to flat, marked by three or four moderate furrows which extend to border. Border narrow, uniform in width, faintly to moderately defined, steeply inclined to flat.

GENOTYPE: Meteoropolus primus, n. gen. and n. sp.

NAME: Greek, μετεωρος, elevated, πολος axis, referring to the high glabella.

Meteoropolus anulatus, n. sp.

Plate 3, figs. 5, 6.

DESCRIPTION: Species known from pygidium only. Pygidium

broadly bilobed in posterior outline. Pleural lobe slightly convex, transversely elongate. Posterior part of axis low, rounded, distinct from edge. Border absent.

REMARKS: Meteoropolus anulatus, n. sp. differs from M. bilobatus, n. sp. to which it appears to be most closely realted in having flat slightly convex transversely elongate pleural lobes and a broadly bilobed posterior border.

NAME: Latin, anulus, ring, referring to the prominent axial ring of the pygidium.

OCCURRENCE: Park shale (43-4), Crowfoot Ridge, Yellowstone National Park.

HOLOTYPE 172, PARATYPE 169, Montana State University.

Meteoropolus bilobatus, n. sp.

Plate 3, figs. 7, 8.

DESCRIPTION: Species known from pygidium only. Pygidium bilobed in posterior outline. Pleural lobes moderately convex. Posterior end of axis low, broadly rounded, distinct from faint border.

REMARKS: The pygidium of Meteoropolus bilobatus, n. sp. differs from that of other species in having the posterior edge acutely bilobed.

NAME: Latin, bilobus, two lobed, referring to the bilobed appearance of the posterior edge of the pygidium.

OCCURRENCE: Park shale (38-1), Dry Wolf Creek, Little Belt Mountains.

HOLOTYPE 152, PARATYPE 150, Montana State University.

Meteoropolus crassus, n. sp.

Plate 3, figs. 9-11.

DESCRIPTION: Cranidium convex. Glabellar furrows absent. Occipital furrow broad, strong. Rim slightly less than width of preglabellar area, strongly elevated. Marginal furrow narrow, deep. Fixed cheeks depressed laterally. Dorsal furrow strong, entire. Eye lobes not preserved in specimens studied. Eye lines strong.

Pygidium rounded in posterior outline. Pleural lobes of pygidium slightly convex. Posterior end of axis moderately high, acutely rounded, distinct from faint slightly inclined border.

REMARKS: Meteoropolus crassus, n. sp. differs from M. primus, n. sp. in possessing a convex, strongly elevated rim, a convex preglabellar area, a deep narrow marginal furrow, and strong eye lines; from M. nitidus, n. sp. in having a strong elevated rim that is narrower than preglabellar area, a deep marginal furrow, and a wide dorsal furrow; from M. latus, n. sp. in having a convex rim, a deeper marginal furrow, depressed fixed cheeks, and strong eye lines; and from M. discrepans, n. sp. in having a strongly elevated rim, a deeper marginal furrow, laterally depressed fixed cheeks, and a dorsal furrow of medium depth.

NAME: Latin, crassus, coarse, referring to the coarse character of the cranidium.

OCCURRENCE: Park shale (43-4), Crowfoot Ridge, Yellowstone National Park.

HOLOTYPE 224, PARATYPES 147, 208, Montana State University.

Meteoropolus discrepans, n. sp.

Plate 3, figs. 12-14.

DESCRIPTION: Cranidium strongly convex in longitudinal section. Glabellar furrows absent. Occipital furrow well defined.

Brim nearly one-third length of cranidium. Rim narrower than preglabellar area, slightly elevated. Marginal furrow strong, exhibits two pairs of elongate depressions in front of antero-lateral angles of glabella, curves forward in front of glabella.

Fixed cheeks raised to approximately half the height of glabella, flat. Dorsal furrow deep, rounded in cross section, entire. Eye lines moderate.

Pygidium rounded in posterior outline. Pleural lobe slightly convex. Posterior end of axis low, acutely rounded. Border moderately defined, gently inclined.

REMARKS: Meteoropolus discrepans, n. sp. differs from M. primus, n. sp. in possessing a less convex glabella, a narrow rim, a convex preglabellar area, flat raised fixed cheeks, and a deep dorsal furrow; from M. nitidus, n. sp. in having a narrow slightly elevated rim, a convex preglabellar area, a deep marginal furrow which exhibits two pairs of elongate depressions and curves forward in front of glabella, flat raised fixed cheeks, and a deep dorsal furrow; and from M. latus, n. sp. in having a convex rim, flat fixed cheeks and a marginal furrow which curves forward in front of the glabella.

The pygidium of M. discrepans, n. sp. differs from M. primus, n. sp.

in that the posterior end of the axis is low and rounded, and the pleural lobes are slightly convex; and from M. nitidus, n. sp. in that the pleural lobes are slightly convex and the posterior end of the axis is low and narrow.

NAME: Latin, discrepans, different, referring to the moderately elevated fixed cheeks.

OCCURRENCE: Park shale (43-4), Crowfoot Ridge, Yellowstone National Park.

HOLOTYPE 204, PARATYPES 171, 205, Montana State University.

Meteoropolus latus, n. sp.

Plate 3, figs. 15-17.

DESCRIPTION: Glabellar furrows absent. Occipital furrow broad, shallow. Rim flat, gently elevated, narrower than preglabellar area. Marginal furrow narrow, deep, straight.

Fixed cheeks elevated approximately one-half height of glabella. Dorsal furrow deep, rounded in cross section, entire. Eye lobes not preserved in specimens studied. Eye lines moderate.

Pygidium rounded in posterior outline. Pleural lobe flat. Posterior end of axis low, but well defined; slightly truncate. Border flat, faint.

REMARKS: Meteoropolus latus, n. sp. differs from M. primus, n. sp. in possessing a broad cranidium, a narrow rim, a straight marginal furrow, raised fixed cheeks, and a deep dorsal furrow; from M. nitidus, n. sp. in having a narrow gently elevated rim, a deep marginal furrow, raised fixed cheeks, and a deep dorsal furrow. The pygidium of

M. latus, n. sp. differs from all other species in having flat pleural lobes.

NAME: Latin, latus, broad, referring to the cranidium.

OCCURRENCE: Park shale (43-4), Crowfoot Ridge, Yellowstone National Park.

HOLOTYPE 214, PARATYPES 166, 222, Montana State University.

Meteoropolus nitidus, n. sp.

Plate 3, figs. 18-20.

DESCRIPTION: Cranidium strongly convex. Glabellar furrows absent. Occipital furrow deep, narrow.

Rim subequal in width to preglabellar area, depressed. Marginal furrow narrow, distinct.

Fixed cheeks slightly convex, depressed laterally. Dorsal furrow narrow, moderate, rounded in cross section, entire. Eye lobes not preserved on holotype. Eye lines moderate.

Pygidium rounded in posterior outline. Pleural lobe strongly convex. Posterior end of axis high, rounded. Border faintly defined, steeply inclined posteriorly.

REMARKS: Meteoropolus nitidus, n. sp. differs from M. primus, n. sp. in possessing a strongly convex cranidium, a depressed convex rim, a moderate narrow dorsal furrow, and a narrower marginal furrow which does not curve forward directly in front of glabella. The pygidium of M. nitidus, n. sp. differs from that of M. primus, n. sp. in being strongly convex and having a rounded high axis and a steeply inclined faintly defined posterior border.

NAME: Latin, nitidus, trim, referring to the trim features of the genus.

OCCURRENCE: Park shale (43-4), Crowfoot Ridge, Yellowstone National Park.

HOLOTYPE 215, PARATYPES 135, 179, Montana State University.

Meteoropolus primus, n. sp.

Plate 4, figs. 1-3.

DESCRIPTION: Glabella two-thirds or more length of cranidium, strongly convex in transverse and longitudinal sections. Extremely faint color markings indicate position of glabellar furrows. Occipital ring narrow, deep.

Rim slightly convex, elevated, narrower than preglabellar area. Marginal furrow narrow, strong, curves slightly forward in front of glabella, exhibits a pair of shallow, elongate depressions in front of antero-lateral angles of glabella.

Fixed cheeks depressed laterally, slightly convex. Dorsal furrow strong, uniform, rounded in cross section. Eye lobes not preserved in any specimens studied. Eye lines moderate.

Pygidium rounded in posterior outline. Pleural lobe moderately convex. Posterior end of axis subtruncate. Border moderately inclined, poorly defined.

REMARKS: Meteoropolus primus, n. sp. is compared with M. nitidus, n. sp.; M. latus, n. sp.; M. discrepans, n. sp.; M. crassus, n. sp.; M. bilobatus, n. sp.; and M. anulatus, n. sp.; in remarks on each.

NAME: Latin, primus, first, referring to this species as the type of the genus.

OCCURRENCE: Park shale (43-4), Crowfoot Ridge, Yellowstone National Park.

HOLOTYPE 217, PARATYPES 168, 221, Montana State University.

Genus NEOPLAGIURELLA, n. gen.

DIAGNOSIS: Cranidia strongly convex; average 2 mm. in length. Facial sutures converge in front of eyes; directed obliquely backward behind eyes forming broad postero-lateral limbs. Postero-marginal furrow faint, narrow.

Glabella convex, long, broad, subparallel sided to tapered; anterior end broadly or acutely rounded. Glabellar furrows absent. Occipital ring widened medially; well defined by faint, narrow furrow.

Brim narrow; consists of well developed rim, narrow shallow marginal furrow, and narrow poorly defined preglabellar area. Rim depressed, narrowed laterally by convergence of anterior ends of facial sutures. Marginal furrow confluent with dorsal furrow in front of glabella.

Fixed cheeks broad, sharply depressed laterally. Dorsal furrows narrow, faint. Eye lobes and eye lines absent.

REMARKS: Neoplagiurella, n. gen. differs from Parasolenopleurella, n. gen. in possessing convergent anterior parts of facial sutures, a broadly or acutely rounded glabella, a depressed rim, narrow faint but persistent marginal dorsal and occipital furrows, no glabellar furrows or eye lines, and relatively wider and shallower furrowed

postero-lateral limbs; and from Plagiurella (Resser 1937, p. 22) in having a broad anteriorly rounded glabella, a laterally narrowed depressed rim, narrow shallow dorsal marginal and occipital furrows, and no eye lines, eye lobes, glabellar furrows and occipital node.

GENOTYPE: Neoplagiurella typica, n. gen. and n. sp.

NAME: Greek, νεος, new, Plagiurella, referring to its close affinities to the genus Plagiurella.

Neoplagiurella gigas, n. sp.

Plate 4, figs. 4, 5.

DESCRIPTION: Glabella moderately tapered; anterior end broadly rounded.

REMARKS: Neoplagiurella gigas, n. sp. differs from N. typica, n. sp. in possessing a moderately tapered glabella with anterior end broadly rounded, and a deeper stronger marginal furrow; and from N. parallela, n. sp. in having a wider glabella, stronger and wider occipital ring and furrow, and deeper marginal furrow.

NAME: Latin, gigas, giant, referring to the large size of the cranidium.

OCCURRENCE: Park shale (38-1), Dry Wolf Creek, Little Belt Mountains.

HOLOTYPE 78, PARATYPE 141, Montana State University.

Neoplagiurella immatura, n. sp.

Plate 4, figs. 6, 7.

DESCRIPTION: Glabella subparallel sided; broadly rounded

anteriorly. Dorsal, marginal, and occipital furrows extremely faint.

REMARKS: Neoplagiurella immatura, n. sp. differs from the other species of this genus in that marginal dorsal and occipital furrows are extremely faint.

NAME: Latin, immatura, referring to the immature appearance of the cranidium in that it lacks dorsal, marginal and glabellar furrows.

OCCURRENCE: Park shale (43-4), Crowfoot Ridge, Yellowstone National Park.

HOLOTYPE 184, PARATYPE 120, Montana State University.

Neoplagiurella parallela, n. sp.

Plate 4, figs. 8, 9.

DESCRIPTION: Glabella subparallel sided; anterior end broadly rounded. Marginal furrows strong. Rim well defined. Dorsal and occipital furrows narrow but well defined.

REMARKS: Neoplagiurella parallela, n. sp. differs from N. typica, n. sp. in possessing a subparallel sided glabella with anterior end broadly rounded, and a slightly narrower occipital ring and furrow.

NAME: Latin, parallelus, parallel, referring to the subparallel sided glabella.

OCCURRENCE: Park shale (43-4), Crowfoot Ridge, Yellowstone National Park.

HOLOTYPE 92, PARATYPE 143, Montana State University.

Neoplagiurella typica, n. sp.

Plate 4, figs. 10, 11.

DESCRIPTION: Glabella strongly tapered; anterior end acutely rounded.

REMARKS: *Neoplagiurella typica*, n. sp. is compared with *N. parallela*, n. sp.; *N. gigas*, n. sp.; and *N. immatura*, n. sp. in remarks on each.

OCCURRENCE: Park shale (43-4), Crowfoot Ridge, Yellowstone National Park.

HOLOTYPE 185, PARATYPE 182, Montana State University.

Genus OLENOIDES Meek, 1877

Olenoides, Meek, 1877, Geol. Expl. Fortieth Par., vol. 4, pt. 1, p. 23.

Olenoides, Walcott, 1866, Geol. Survey Bull., no. 30, p. 180.

Olenoides, Kobayashi, 1935, Tokyo. Imperial University. Faculty of Science. Journal, Section II.--Geology, etc., p. 152.

GENOTYPE: *Olenoides nevadensis* (Meek) 1877.

Olenoides? elongatus, n. sp.

Plate 4, figs. 12, 13.

DESCRIPTION: Species known from pygidium only. Pygidium elongate, flatly convex. Axis subparallel sided, convex, long, one-third width of pygidium exclusive of marginal spines, exhibits three faint furrows; posterior end rounded. Pleural lobe slightly convex, faintly furrowed; extended posteriorly and laterally into four narrow, obliquely directed spines subequal in length to pygidium. Anterior spines fragmentary.

REMARKS: Olenoides? elongatus, n. sp. differs from all known species in possessing abnormally long slender spines.

NAME: Latin, elongus, long, referring to the long spines of the pygidium.

OCCURRENCE: Park shale (46-1), Nixon Gulch, Three Forks area.

HOLOTYPE 2, PARATYPE 1, Montana State University.

Genus OXYPOLUS, n. gen.

DIAGNOSIS: Cranidium convex. Facial sutures diverge in front of eyes, directed laterally back of eyes forming short postero-lateral limbs. Postero-marginal furrow narrow.

Glabella long, convex, smooth, tapered; anterior end acutely rounded. Occipital ring narrow, uniform in width; well defined by narrow shallow occipital furrow.

Rim narrow, slightly convex, depressed, narrowed laterally by convergence of anterior ends of facial sutures. Marginal furrow broad, well defined. Preglabellar area flat, depressed.

Fixed cheeks convex laterally depressed. Dorsal furrows well defined. Eye lines absent. Eyes moderate, located opposite middle third of glabella.

Associated pygidium convex, transversely elongate. Axis two-thirds length of and approximately one-fourth width of pygidium; convex, moderately tapered, elevated above pleural lobes. Anterior axial furrow faint. Dorsal furrows absent.

Pleural lobe strongly convex, exhibits well defined anterior pleural furrow and several faint posterior furrows. Border narrow,

faint, gently inclined.

REMARKS: Oxypolus, n. gen. differs from Parkia, n. gen. in possessing a convex cranidium, a tapered acutely rounded glabella, a narrow medially widened depressed rim, convex depressed fixed cheeks and moderate eyes. The pygidium differs from that of Parkia, n. gen. in being subelliptical and possessing strongly convex pleural lobes, faint pleural furrows, and a wider relatively shorter axis which is more highly elevated and dorso-ventrally tapered.

GENOTYPE: Oxypolus primus, n. gen. and n. sp.

NAME: Greek, οξυς , sharp, πολος, axis, referring to the tapered glabella.

Oxypolus primus, n. sp.

Plate 4, figs. 14, 15.

DESCRIPTION: The generic description gives the essential characteristics of the species.

NAME: Latin, primus, first, referring to this species as the type of the genus.

OCCURRENCE: Park shale (46-1), Nixon Gulch, Three Forks area.

HOLOTYPE 66, PARATYPE 20, Montana State University.

Genus PARKIA, n. gen.

DIAGNOSIS: Cranidium flatly convex. Facial sutures diverge in front of eyes; directed laterally back of eyes forming narrow postero-lateral limbs. Postero-marginal furrow narrow, well defined.

Glabella two-thirds length of cranidium; convex, smooth, sub-parallel sided; anterior end broadly rounded. Occipital ring narrow,

width uniform; well defined by narrow shallow occipital furrow.

Rim half or less width of preglabellar area; flat, elevated, uniform in width. Marginal furrow broad shallow. Preglabellar area flat depressed.

Fixed cheeks flat, less than half width of glabella. Dorsal furrows narrow well defined. Eye lines absent. Eyes half length of and located opposite middle third of glabella.

Pygidium transversely elongate, strongly to flatly convex. Axis long, smooth slender; acutely rounded posteriorly. Dorsal furrows faint anteriorly, obsolete posteriorly.

Pleural lobes strongly to flatly convex, exhibits three or four faint pleural furrows extended to lateral edge. Border absent.

REMARKS: Parkia, n. gen. differs from Coelorhis, n. gen. in having a more convex cranidium, a deeper marginal furrow, a narrower rim, a flat preglabellar area, and facial sutures which diverge normally in front of the eyes.

GENOTYPE: Parkia prima, n. gen. and n. sp.

NAME: This genus is named for its occurrence in the Park shale.

OCCURRENCE: Park shale (46-1), Nixon Gulch, Three Forks area.

Parkia? minuta, n. sp.

Plate 4, fig. 16.

DESCRIPTION: Species known from pygidium only. Pygidium subelliptical, strongly convex. Axis narrow, length half that of pygidium, moderately tapered, appears smooth. Pleural lobe flatly concave, steeply inclined, exhibits three straight obliquely directed

furrows. Border absent.

REMARKS: The pygidium of Parkia? minuta, n. sp. differs from the pygidium of Parkia plana, n. sp. in being relatively much longer and in having a short axis and steeply inclined flatly concave pleural lobes.

NAME: Latin, minimus, small, referring to the small size of the pygidium.

OCCURRENCE: Park shale (46-1), Nixon Gulch, Three Forks area.

HOLOTYPE 29, Montana State University.

Parkia plana, n. sp.

Plate 4, figs. 17, 18.

DESCRIPTION: Glabella flatly convex. Rim slightly elevated. Pygidium flatly convex. Pleural lobe flat or slightly concave.

REMARKS: Parkia plana, n. sp. differs from P. prima, n. sp. in possessing a flatly convex cranidium and glabella, a slightly elevated rim, and weaker marginal and dorsal furrows. The associated pygidium differs from that of P. prima, n. sp. in having flat pleural lobes.

NAME: Latin, planus, flat, referring to the flat fixed cheeks.

OCCURRENCE: Park shale (46-1), Nixon Gulch, Three Forks area.

HOLOTYPE 63, PARATYPE 32, Montana State University.

Parkia prima, n. sp.

Plate 4, figs. 19-22.

DESCRIPTION: The description of the genus gives all the essential

characteristics except that the pygidium is strongly convex, the pleural lobes are flatly convex adjacent to the sides of the axis and steeply inclined laterally and posteriorly away from the axis.

NAME: Latin, primus, first, referring to this species as the type of the genus.

OCCURRENCE: Park shale (46-1), Nixon Gulch, Three Forks area.

HOLOTYPE 57, PARATYPES 10, 13, 60, Montana State University.

Genus PARASOLENOPLEURELLA, n. gen.

DIAGNOSIS: Cranidium strongly convex; 2 mm. to 3 mm. in length. Facial sutures subparallel and directed downward in front of eyes; directed obliquely backward behind eyes forming broad postero-lateral limbs. Postero-marginal furrow broad, relatively deep.

Glabella strongly convex; long, broad, moderately to strongly tapered; anterior end truncate. Occipital ring widened medially; well demarcated by wide relatively deep furrow.

Brim narrow, depressed, consists of well developed rim, exceptionally strong marginal furrow, and narrow poorly defined preglabellar area. Rim horizontal or elevated, narrowed laterally by convergence of anterior ends of facial sutures. Marginal furrow strong, deep or shallow; confluent with dorsal furrow in front of glabella.

Fixed cheeks broad, sharply depressed laterally. Dorsal furrows broad, faint. Eye lobes absent. Eye lines present or absent.

REMARKS: Parasolenopleurella, n. gen. differs from Solenopleurella (Poulsen, 1927, p. 269) in being much smaller and in possessing a smaller more tapered glabella; laterally narrowed weaker rim; no eye

lobes; and much weaker dorsal and glabellar furrows.

GENOTYPE: Parasolenopleurella drywolfensis, n. gen. and n. sp.

NAME: Greek, παρα, near, Solenopleurella, referring to its close affinities to Solenopleurella.

Parasolenopleurella crowfootensis, n. sp.

Plate 4, fig. 23.

DESCRIPTION: Glabella strongly tapered. Glabellar furrows strong. Rim upturned. Marginal furrow broad, deep. Eye lines moderate, slightly curved.

REMARKS: Parasolenopleurella crowfootensis, n. sp. differs from P. drywolfensis, n. sp. in possessing a narrower marginal furrow and a strongly tapered glabella with well defined glabellar furrows.

NAME: The species is named for Crowfoot Ridge, Yellowstone National Park.

OCCURRENCE: Park shale (43-4), Crowfoot Ridge, Yellowstone National Park.

HOLOTYPE 192, Montana State University.

Parasolenopleurella drywolfensis, n. sp.

Plate 4, figs. 24, 25.

DESCRIPTION: Glabella moderately tapered. Glabellar furrows faint. Rim upturned. Marginal furrow broad, deep. Eye lines moderate, slightly curved.

REMARKS: Parasolenopleurella drywolfensis, n. sp. is compared

with P. crowfootensis, n. sp.; and P. obscura, n. sp. in remarks on each.

NAME: This species is named for its occurrence in Dry Wolf Creek, Little Belt Mountains.

OCCURRENCE: Park shale (38-1), Dry Wolf Creek, Little Belt Mountains.

HOLOTYPE 108, PARATYPE 109, Montana State University.

Parasolenopleurella obscura, n. sp.

Plate 4, figs. 26, 27.

DESCRIPTION: Glabella moderately tapered. Glabellar furrows faint. Rim horizontal. Marginal furrow narrow shallow. Eye lines absent.

REMARKS: Parasolenopleurella obscura, n. sp. differs from P. drywolfensis, n. sp. and P. crowfootensis, n. sp. in possessing a narrower brim, a horizontal rim, and a narrow shallow marginal furrow and in addition from P. crowfootensis in having a moderately tapered glabella with faint furrows.

NAME: Latin, obscura, indistinct, referring to the shallow marginal furrow and poorly demarcated rim.

OCCURRENCE: Park shale (38-1), Dry Wolf Creek, Little Belt Mountains.

HOLOTYPE 107, PARATYPE 100, Montana State University.

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Contains the generic diagnosis of Deissella.

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U. S. Geol. Survey, Geol. Atlas folio, no. 1, 4 p., columnar sec.

Contains columnar section of Cambrian rocks in which the Obolella shale (Park) is given as a member of the Flathead formation and is thus assigned to the Middle Cambrian.

Kobayashi, Teiichi (1935) The Cambro-Ordovician formations and faunas of South Chosen, Part III, Cambrian faunas of South Chosen with a special study on the Cambrian trilobite genera and families, Tokyo. Imperial University. Faculty of Science. Journal, Section II.--Geology, etc., p. 49-343, pls. 1-24, text-figs. 1-33.

Contains many illustrations and descriptions of Cambrian trilobites. Has a good historical summary and description of the genus Olenoides.

Knopf, Adolph (1913) Ore deposits of the Helena mining district, Montana, U. S. Geol. Survey Bull. 527, 143 p., 7 pls., 4 figs.

Quotes an unpublished manuscript of Weed's concerning the Cambrian rocks near Helena.

Meek, F. B. (1877) Description of Fossils, Silurian species, Geol. Expl. Fortieth Par., vol. 4, pt. 1, p. 1-25.

Contains the original description of the genotype of Olenoides, Paradoxides? nevadensis.

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Contains a brief summary table of the formations in the Three Forks section in which the Cambrian rocks were assigned to the Gallatin sandstones and overlying Gallatin limestones.

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----- (1896) Description of the Three Forks sheet, U. S. Geol. Survey, Geol. Atlas folio, no. 24, 5 p.

Contains a description of the Cambrian formations as in Peale's earlier paper but in his columnar section the Obolella shales were assigned to the Flathead instead of to the Gallatin formation.

Poulsen, Christian (1927) The Cambrian, Ozarkian and Canadian faunas of northwest Greenland, Meddel. Grønland, vol. 70, p. 240-343, pls. 14-21.

Contains a classification and a discussion of the relationships of many Cambrian and Ordovician trilobites. Gives generic diagnosis of the Middle Cambrian genus Solenopleurella.

Reeves, Frank (1931) Geology of the Big Snowy Mountains, Montana, U. S. Geol. Survey, Prof. Pap. 165-D, p. 135-149, pls. 35-38, fig. 9.

Contains complete descriptions of the Cambrian rocks in the area described.

Resser, C. E. (1937) Third contribution to nomenclature of Cambrian trilobites, Smithsonian Misc. Coll., vol. 95, no. 22, 29 p.

A paper on synonymy of Cambrian trilobites. New genera are named and defined.

Walcott, C. D. (1886) Cambrian faunas of North America, U. S. Geol. Survey Bull. 30, 369 p., 33 pls., 10 figs.

Contains descriptions and relationships of many Cambrian trilobites, including the genotype of Olenoides.

----- (1891) Correlation papers, Cambrian, U. S. Geol. Survey, Bull. 81, 447 p., 3 pls., 5 figs.

A discussion of the Cambrian formations in the Three Forks area as prepared by Peale. The term Obolella shale appears for the first time in the Cambrian literature and is incorrectly assigned to the Upper Cambrian formation, Gallatin limestones.

----- (1916a) Relations between the Cambrian and pre-Cambrian formations in the vicinity of Helena, Montana, Smithsonian Misc. Coll., vol. 64, p. 259-301, pls. 39-44, figs. 10-13.

Contains two sections of Cambrian rocks, one in the Big Belt Mountains and the other in the Big Snowy Mountains.

----- (1916b) Cambrian trilobites, Smithsonian Misc. Coll., vol. 64, p. 302-456, pls. 45-67.

Describes and illustrates many Cambrian trilobites. Contains the generic diagnosis of the Upper Cambrian trilobite Blountia.

Weed, W. H. and Pirsson, L. V. (1896) Geology of the Castle Mountain mining district, Montana, U. S. Geol. Survey, Bull. 139, 162 p., 17 pls., 11 figs.

Contains a description of the Cambrian rocks which are assigned to the Flathead formation and overlying Gallatin limestones. The Obolella shale was assigned to the Flathead formation.

Weed, W. H. (1899a) Description of the Fort Benton quadrangle, U. S. Geol. Survey, Geol. Atlas folio, no. 55, 7 p.

Contains a description of the Cambrian rocks which were all assigned to one formation, the Barker.

----- (1899b) Description of the Little Belt Mountains quadrangle, U. S. Geol. Survey, Geol. Atlas folio, no. 56, 9 p.

Describes the Cambrian rocks as belonging to two formations containing seven members.

----- (1900) Geology of the Little Belt Mountains, Montana, U. S. Geol. Survey, 20th Ann. Rept., pt. 3, p. 257-459, pls. 37-73, figs. 38-72.

The Cambrian rocks were described as belonging to seven formations. The term Park shale for the first time was designated a formation and was correlated with the Obolella shale of adjacent quadrangles.

DESCRIPTION OF PLATE 1

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showing narrow convex rim and wide preglabellar area. Montana State University number 112.

9. Paratype, X 3. Pygidium, showing post-axial ring blending posteriorly with steeply inclined border. Montana State University number 163.

10. Paratype, X 3. Pygidium, showing variation in size of pygidia. Montana State University number 145.

Park shale (38-1), Dry Wolf Creek, Little Belt Mountains.

11. Holotype, X 3. Cranidium, showing moderately tapered glabella and laterally depressed fixed cheeks. Montana State University number 122.

12. Paratype, X 3. Cranidium, showing broadening and deepening of marginal furrow on lateral parts of brim. Montana State University number 131.

13. Paratype, X 3. Pygidium, showing distinct post-axial ring. Montana State University number 146.

14. Paratype, X 3. Pygidium, showing evenly convex pleural lobes and moderately inclined border. Montana State University number 156.

Park shale (38-1), Dry Wolf Creek, Little Belt Mountains.

15. Holotype, X 3. Complete cranidium, showing elevated, convex fixed cheeks. Montana State University number 129.

16. Paratype, X 3. Complete cranidium, showing wide well defined marginal furrow exhibiting pair of elongate depressions opposite antero-lateral angles of glabella. Montana State University number 120.

Park shale (38-1), Dry Wolf Creek, Little Belt Mountains.

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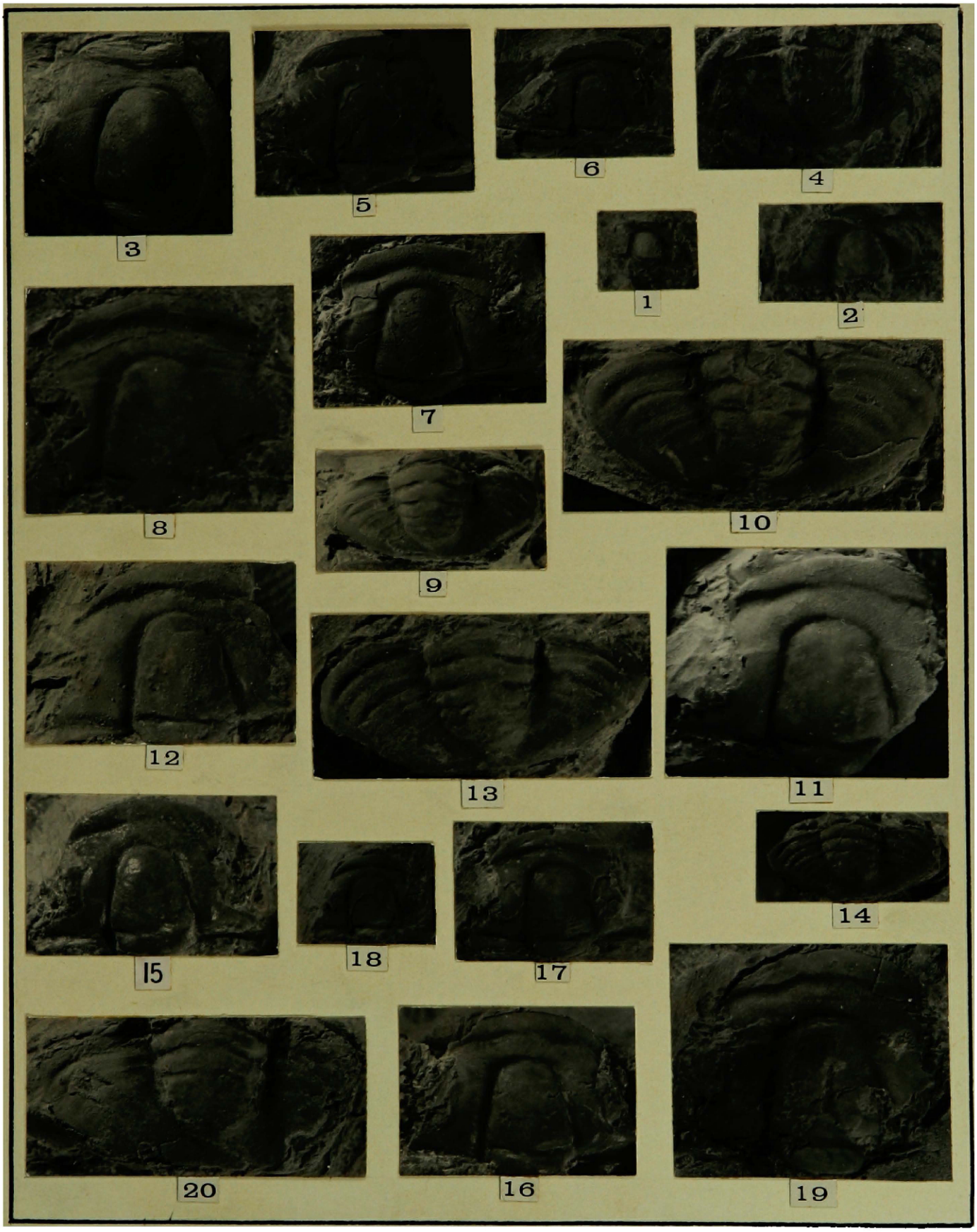
Plate 1



DESCRIPTION OF PLATE 2

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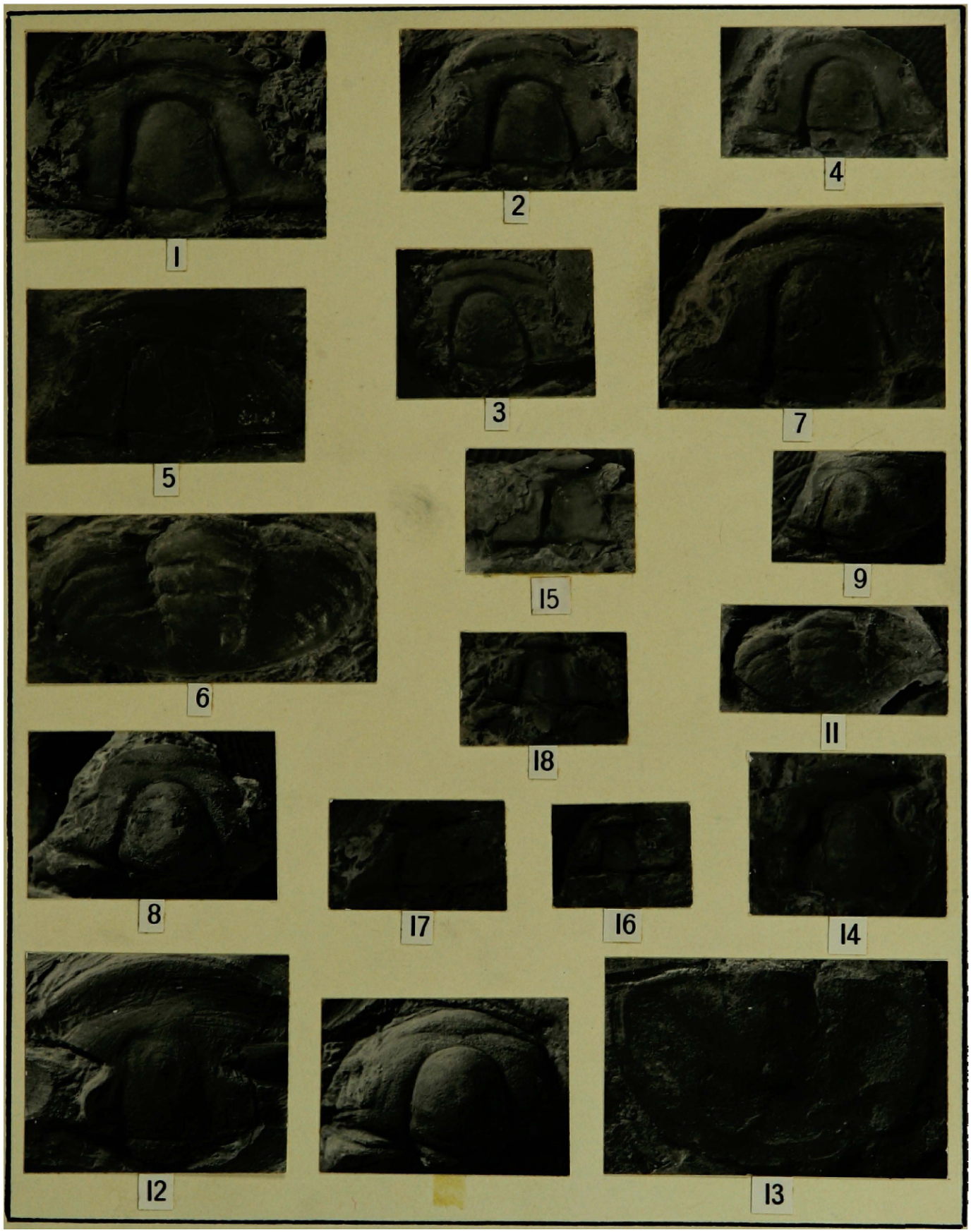
PLATE 2



DESCRIPTION OF PLATE 3

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Park shale (38-1), Dry Wolf Creek, Little Belt Mountains.

9. Holotype, X 3. Cranidium, showing laterally depressed fixed cheeks and strong eye lines. Montana State University number 224.

10. Paratype, X 3. Cranidium, showing broad strong occipital furrow and strongly elevated rim. Montana State University number 208.

11. Paratype, X 3. Well preserved pygidium, showing moderately high, acutely rounded posterior end of axis. Montana State University number 147.

Park shale (43-4), Crowfoot Ridge, Yellowstone National Park.

12. Holotype, X 3. Cranidium, showing deep dorsal furrows and moderate eye lines. Montana State University number 204.

13. Paratype, X 3. Cranidium, showing narrow slightly elevated rim. Montana State University number 205.

14. Paratype, X 3. Poorly preserved pygidium, showing low acutely rounded posterior end of axis. Montana State University number 171.

Park shale (43-4), Crowfoot Ridge, Yellowstone National Park.

15. Holotype, X 3. Cranidium, showing narrow flat rim. Montana State University number 214.

16. Paratype, X 3. Cranidium, showing narrow deep marginal furrow. Montana State University number 222.

17. Paratype, X 3. Pygidium, showing flat pleural lobes and low but well defined posterior end of axis. Montana State University number 166.

Park shale (43-4), Crowfoot Ridge, Yellowstone National Park.

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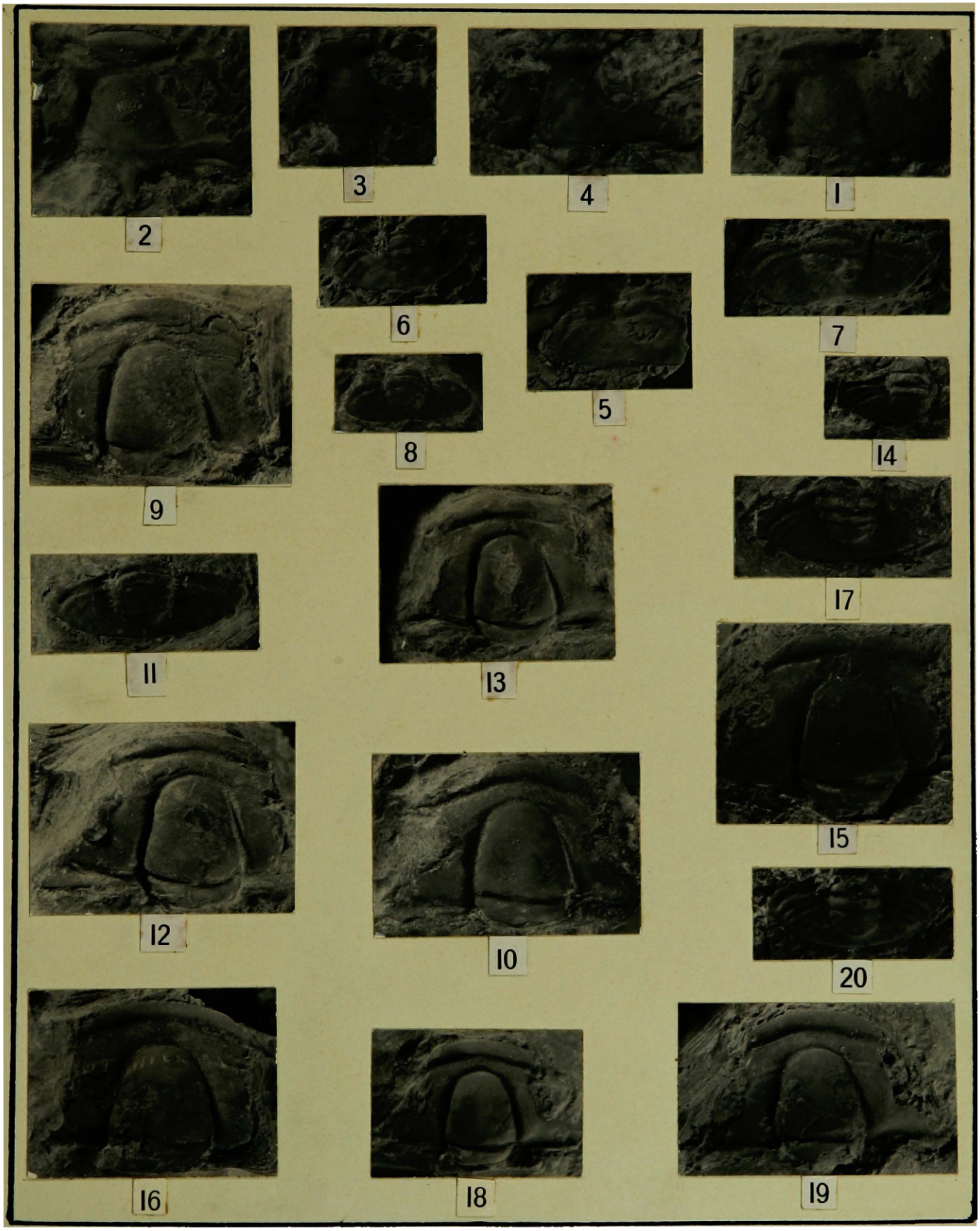
18. Holotype, X 3. Cranidium, showing narrow distinct marginal furrow and laterally depressed fixed cheeks. Montana State University number 215.

19. Paratype, X 3. Cranidium, showing moderate eye lines. Montana State University number 135.

20. Paratype, X 3. Associated pygidium, showing strongly convex pleural lobes and high rounded posterior end of axis. Montana State University number 179.

Park shale (43-4), Crowfoot Ridge, Yellowstone National Park.

Plate 3



DESCRIPTION OF PLATE 4

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9. Paratype, X 5. Cranidium, showing strong marginal furrow. Montana State University number 143.

Park shale (38-1), Dry Wolf Creek, Little Belt Mountains.

10. Holotype, X 5. Cranidium, showing strongly tapered glabella which is acutely rounded anteriorly. Montana State University number 185.

11. Paratype, X 5. Cranidium, showing narrow but well defined dorsal and marginal furrows. Montana State University number 182.

Park shale (43-4), Crowfoot Ridge, Yellowstone National Park.

12. Holotype, X 3. Pygidium, showing long obliquely directed spines. Montana State University number 2.

13. Paratype, X 1. Crushed and severely weathered pygidium, showing outline of long subparallel axis. Montana State University number 1.

Park shale (46-1), Nixon Gulch, Three Forks area.

14. Holotype, X 3. Poorly preserved cranidium, showing depressed fixed cheeks and medially widened rim. Montana State University number 66.

15. Paratype, X 3. Pygidium, showing transverse elongate shape of pygidium. Montana State University number 20.

Park shale (46-1), Nixon Gulch, Three Forks area.

16. Holotype, X 3. Pygidium, showing narrow short axis and flatly concave steeply inclined pleural lobes. Montana State University number 29.

Park shale (46-1), Nixon Gulch, Three Forks area.

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Park shale (38-1), Dry Wolf Creek, Little Belt Mountains.

26. Holotype, X 4. Cranidium, showing shallow marginal furrow and poorly demarcated rim. Montana State University number 107.

27. Paratype, X 4. Cranidium, showing moderately tapered truncate glabella. Montana State University number 100.

Park shale (38-1), Dry Wolf Creek, Little Belt Mountains.

Plate 4