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UPPER CAMBRIAN TRILOBITES FROM WESTERN WYOMING

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ABSTRACT—The Upper Cambrian trilobites from three measured sections in the Gros Ventre and Wind River Mountains, Wyoming, are described. Collections include 22 named species and 26 named genera, of which 22 forms are new to Wyoming. Representatives of the *Cedaria*, *Crepicephalus*, *Elvina*, *Conaspis* and *Ptychaspis-Prosaukia* zones are present as well as two cranidia probably assignable to the Trempealeauan stage.

New species described are *Apachia convexa*, *Dellea saginata*, *Iddingsia occiaentalis* and *Meteoraspis boulderensis*.

INTRODUCTION

THIS article is based upon part of a thesis submitted in September 1954, by the senior author to the Department of Geology and the Graduate School of the University of Wyoming in partial fulfillment of the requirements for the degree of Master of Arts. The full details of the stratigraphy will be published separately by the senior author, although columnar sections based on this work and a statement of the stratigraphic nomenclature involved have already been published (Shaw & DeLand, 1955). The junior author, who revised and edited the original manuscript for publication wishes to acknowledge the assistance of a grant-in-aid from the Graduate Research Council, University of Wyoming, under which the photographs on the accompanying plates were printed and the final manuscript typed by Mrs. G. C. Hertzfeldt.

STRATIGRAPHIC SUMMARY

Although the stratigraphic terminology used herein has been published, the publication is probably not accessible to many readers, so it is reviewed here; it is also summarized in Table 1. Basically, the old Gallatin and Gros Ventre "formations" have been raised to the rank of groups, and the readily mappable units that were formerle classed as members have been raised to thy rank of formations. Where local names are available they have been used, but the names Park shale and Wolsey shale have been imported from Montana and northwestern Wyoming, and the name Open Door limestone (new in Shaw & DeLand, 1955) is applied to the top of the old Gallatin.

Gallatin group.—The elevation of the old "Gallatin formation" to the status of a group was first suggested by Deiss (1936, p. 1340–1341; 1938, p. 1103–1104) and has been formally proposed by Shaw (1954a). The recognition of the Gallatin as a group allows the continued use of the name for the entire upper carbonate sequence in western Wyoming, in the sense that is is now current and at the same time permits recognition

TABLE 1.—STRATIGRAPHIC NOMENCLATURE FOR THE CAMBRIAN OF WESTERN WYOMING

Gros Ventre Mountains and northern and central Wind River Mountains	Southern Wind River Mountains
Gallatin group	Gallatin group
Open Door limestone	Open Door limestone
Dry Creek shale member	Dry Creek shale member
DuNoir limestone	DuNoir limestone
Gros Ventre group	Gros Ventre formation
Park shale	
Death Canyon limestone	
Wolsey shale	
Flathead sandstone	Flathead sandstone

of the mappable formations within the Gallatin where that is deemed desirable.

Open Door limestone.—The name "Open Door limestone" has been proposed (Shaw & DeLand, 1955) for the carbonate sequence formerly known as the "Upper Gallatin limestone." The type section lies below the pillar of Bighorn dolomite known as "The Open Door" in Granite Canyon, SW¼, sec. 5, T. 39 N., R. 113 W., Teton Co., Wyoming. The name is used to include the Dry Creek shale member and all rocks above it to the top of the Gallatin group, regardless of age. Names previously applied to these rocks or to parts of them have required a knowledge of the fauna before the proper name could be applied; names so based are here rejected as unworkable for the practical field geologist.

Dry Creek shale member.—Lochman (1950) thoroughly discussed the Dry Creek shale, which forms the basal member of the Open Door limestone wherever the DuNoir limestone lies below it to separate it from the Park shale or the Gros Ventre formation.

DuNoir limestone.—The DuNoir limestone is ubiquitous in western Wyoming, the name for it having been introduced by Miller (1936, p. 125) in the northeastern Wind River Mountains.

Gros Ventre group.—The Gros Ventre "formation" of most authors is here regarded as a group in those areas where the Death Canyon limestone is present and as a formation where the disappearance of the Death Canyon leaves an unbroken clastic sequence between the Flathead sandstone and the Gallatin group, as at Sweetwater Canyon.

Park shale.—The name Park shale (Montana) is here applied to the shaly unit previously called the "upper shale member of the Gros Ventre formation." The Middle-Upper Cambrian boundary lies in the upper part of the Park shale in most sections in Wyoming.

Death Canyon limestone.—The Death Canyon limestone, named by Miller (1936, p. 119–120) as a member of the Gros Ventre formation is here regarded as a formation in the Gros Ventre group.

Wolsey shale.—The name Wolsey shale is brought down from Montana and applied to its equivalents, the "lower Gros Ventre shale."

These nomenclatural changes have been outlined by DeLand (1954), Shaw (1954b) and Shaw & DeLand (1955) as applicable widely in Wyoming; further detailed discussion of them will be presented elsewhere.

THE SECTIONS

During the Summer of 1953 the senior author measured and collected the Cambrian sequence at Granite Falls, Gros Ventre Range, at Steele Butte, west of the main mass of the Wind River Mountains, and at Sweetwater Canyon in the southern Wind River Mountains. A detailed list of localities is appended below. Although the entire Cambrian section was measured and sampled at each place, time did not permit the study of the Middle Cambrian collections; these will be described at a later date. Preliminary fossil lists have been given by Shaw & DeLand (1955).

Locality Register

The numbering system used at the University of Wyoming for fossil localities in Wyoming is fractional, with the numerator formed of the township and range in which the collection was made. The denominator contains the section number, a letter designating the specific collection, and a number indicating stratigraphic position. Thus, collections from Granite Falls, made in SW¼, sec. 5, T. 39 N., R. 113 W., Teton Co., have the general number 39113/5A, with the individual samples ranging from 39113/5A1, at 25.3 feet above the base of the Park shale to 39113/5A6 at 13.8 feet above the base of the Open Door limestone. Middle Cambrian collections are not listed.

Granite Falls.—Location given above.

39113/5A6— 13.8 feet above the base of the Open Door limestone
Camaraspis plana Frederickson
Elvinia sp. indet.

39113/5A5— 12.7 feet above the base of the Open Door limestone
Elvinia sp. indet.

Steele Butte.—Collections were made near the north end of the hill called Steele Butte, southeast of Boulder, in SW¼, sec. 20, T. 32 N., R. 107 W., Sublette County. The general locality number is 32107/20B. Individual collections are:

32107/20B25—33.0–33.6 feet above the base of the Open Door limestone

Camaraspis plana
Elvinia sp. indet.
32107/20B24—25–30 feet above the base of the Open Door limestone
Burnetia alta
Camaraspis plana
Dellea cf. *D. butlerensis*
D. suada?
Elvinia sp. indet.
32107/20B23—8–9 feet below the top of the Du-Noir limestone
Coosia dakotensis
Coosia connata?
32107/20B22—2.2–2.7 feet below the top of the Park shale
Arapahoia butleri
Blountia carlotta
Cedaria milleri
Meteoraspis elongata
Bynumia sp. indet.
Modocia sp. indet.
32107/20B20—10.5–10.6 feet below the top of the Park shale
Modocia centralis
Arapahoia sp. indet.
"*Cedarina*" sp. indet.
Leiocoryphe sp. indet.
Meteoraspis sp. indet.
32107/20B19—20.4–20.6 feet below the top of the Park shale
Arapahoia levis
Blountia carlotta
Meteoraspis boulderensis
Kingstonia sp. indet.
32107/20B15—44.0–44.4 feet below the top of the Park shale
Kingstonia spicata
Kormagnostus sp. indet.
Cranidium A.
32107/20B14—47.8–48.2 feet below the top of the Park shale
Kingstonia spicata
Pygidium A.

Sweetwater Canyon.—Two collections were made in Sweetwater Canyon. The first was from SW¼, sec. 27, T. 29 N., R. 97 W., Fremont County, and is designated 2997/27A. The second, from NE¼, sec. 34, is designated 2997/34A. Individual collections from the former are:

2997/27A14—184.0–185.0 feet above the base of the Open Door limestone
Cranidium B
Cranidium C
2997/27A12—83.5–84.0 feet above the base of the Open Door limestone
Idahoia sp. indet.
Monocheilus? sp. indet.
2997/27A11—53.0–54.0 feet above the base of the Open Door limestone
Taenicephalus cordillerensis
2997/27A10—1.0–1.5 feet above the base of the Open Door limestone
Apachia convexa
Burnetia
Cliffia latagenae
Deadwoodia duris
Dellea saginata
Housia vacuna?

EXPLANATION OF PLATE 63

All specimens on this plate from the *Cedaria* zone of the upper Park shale at Steele Butte (Loc. 32107/20B).

FIG. *1*—*Arapahoia butleri* (Stoyanow), 1936. Cranidium. Length 20.0 mm. UW A10904a. Loc. 32107/20B22. (p. 546)

2—*Arapahoia* sp. indet. Immature cranidium. Length 3.1 mm. UW A10899. Loc. 32107/20B20. (p. 547)

3–8—*Blountia carlotta* Lochman, 1944. *3,4*, Smooth cranidium provisionally assigned to species. UW A10902c. Length 8.1 mm. Loc. 32107/20B19. *5*, Small cranidium. Length 5.2 mm. UW A10894. *6,7*, Larger, more typical cranidium. Length of glabella 7.0 mm. UW A10902d. *8*, Assigned pygidium. Maximum length 3.6 mm. UW A10902a. Fig. 5–8 from Loc. 32107/20B22. (p. 548)

9–11—*Bynumia* sp. indet. Dorsal, anterior and lateral views of cranidium. Length of cranidium 9.5 mm. UW A10900b. Loc. 32107/20B22. (p. 549)

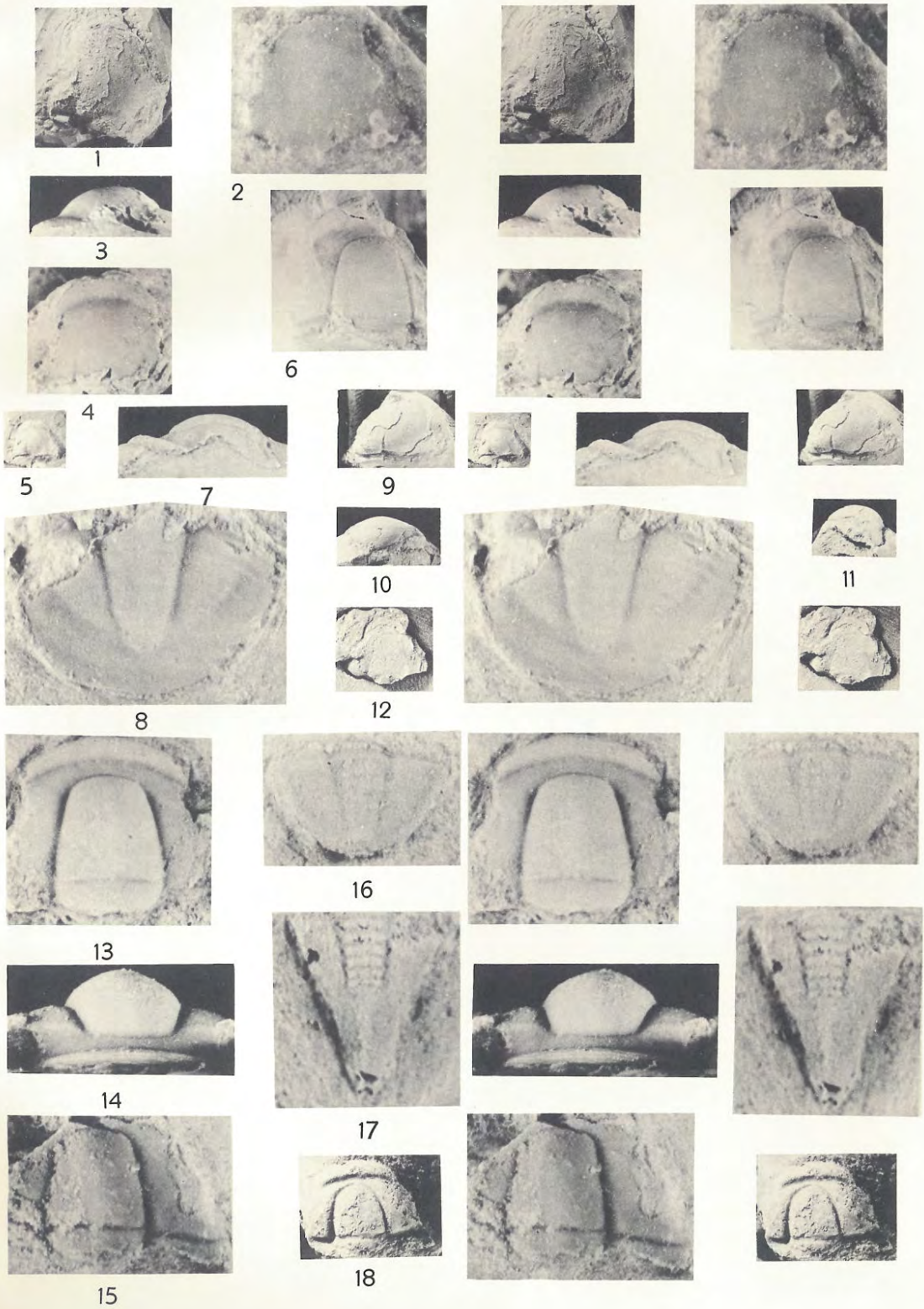
12—*Arapahoia levis* Miller, 1936. Cranidium. Length 10.9 mm. UW A10895. Loc. 32107/20B19. (p. 547)

13–15—*Cedaria milleri* Resser, 1937. *13,14*, Largest cranidium. Length 2.5 mm. UW A10930a. *15*, Smaller cranidial fragment preserving posterior limb. Length of glabella 3.2 mm. UW A10930b. Both specimens from Loc. 32107/20B22. (p. 549)

16—*Kingstonia* sp. indet. Unassigned pygidium. Length 2.3 mm. UW A10892. Loc. 32107/20B19. (p. 557)

17—*Kingstonia spicata* Lochman, 1940. Best preserved pygidium. Maximum width 4.8 mm. UW A10888a. Loc. 32107/20B15. (p. 556)

18—*Meteoraspis boulderensis* DeLand, n. sp. Dorsal view of holotype cranidium (See Pl. 64, fig. 4,5.) Length 11.1 mm. UW A10891a. Loc. 32107/20B19. (p. 557)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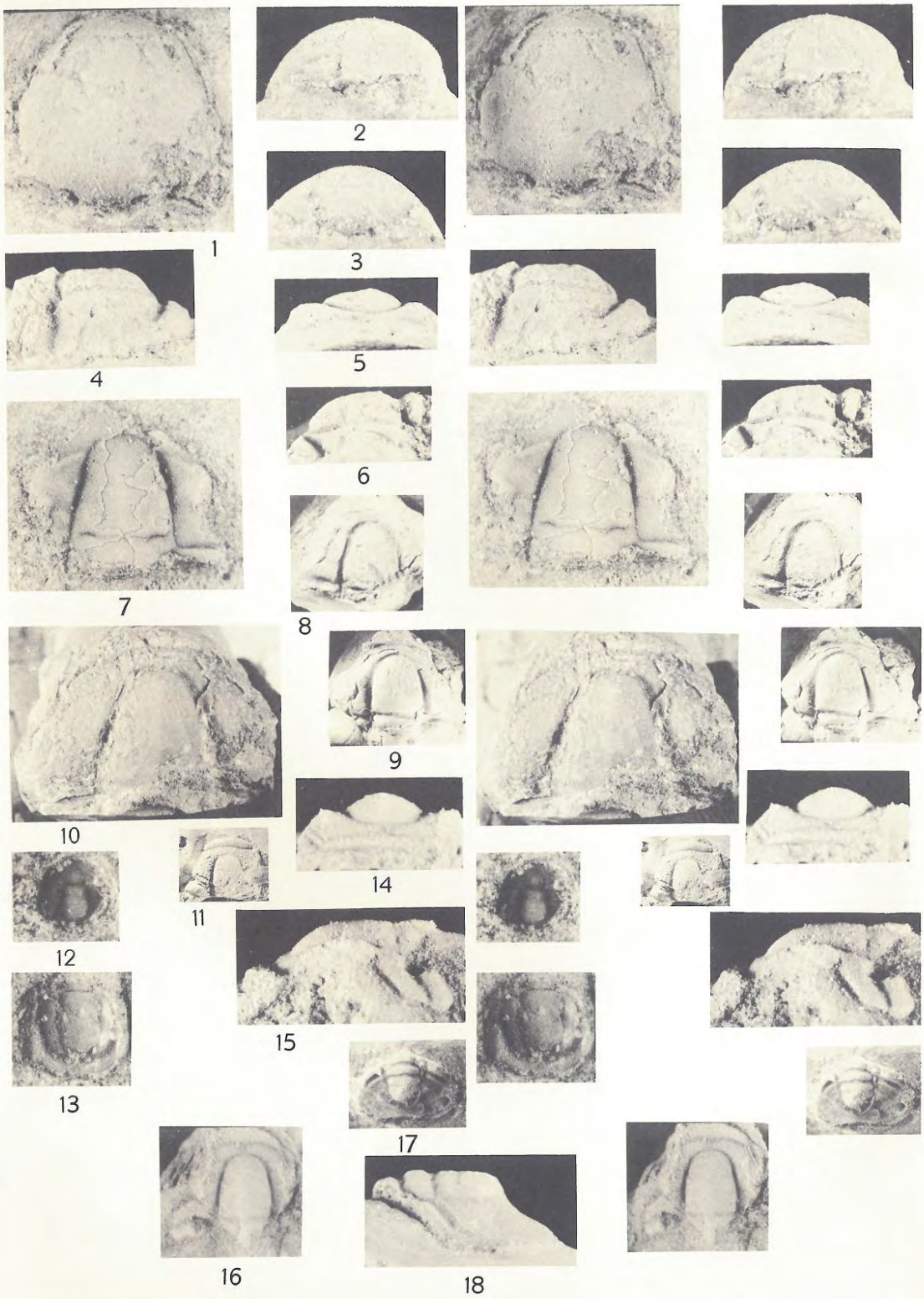
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Iddingsia occidentalis
Irvingella aff. *I. flohri*
Xenocheilos cf. *X. spineum*
Elvinia sp. indet.

Individual collections from the latter are:

2997/34A2— 131.6–131.7 feet above the base of the Open Door limestone
Ellipsocephaloides sp. indet.

2997/34A1— 80.3–80.7 feet above the base of the Open Door limestone
Taenicephalus cordillerensis

FAUNAL SUMMARY

Five of the standard Upper Cambrian faunal zones have been recognized in the collections described here: the *Cedaria*, *Crepicephalus*, *Elvinia*, *Conaspis* and *Ptychaspis-Prosaukia* zones. In addition, two unidentified cranidia from Trempealeauan equivalents have not yet been assigned to any zone. Lists of forms identified in each zone follow:

Cedaria zone:
Arapahoia butleri
A. levis
A. sp. indet.
Blountia carlotta
Bynumia sp. indet.
Cedaria milleri
"*Cedarina*" sp. indet.
Kingstonia spicata
K. sp. indet.
Kormagnostus sp. indet.
Leiocoryphe sp. indet.
Meteoraspis boulderensis
M. elongata
M. sp. indet.
Modocia centralis
M. sp. indet.
Cranidium A
Pygidium A

Crepicephalus zone:
Coosia connata?
C. dakotensis

Elvinia zone:
Apachia convexa
Burnetia alta
Camaraspis plana
Cliffia latagenae
Deadwoodia duris
Dellea cf. *D. butlerensis*
D. saginata
D. suada?
Elvinia sp. indet.
Housia vacuna?
Iddingsia occidentalis
Irvingella aff. *I. flohri*
Xenocheilos cf. *X. spineum*

Conaspis zone:
Taenicephalus cordillerensis

Trempealeauan (zone unknown):
Cranidium B
Cranidium C

EXPLANATION OF PLATE 64

All specimens from the *Cedaria* zone of the upper Park shale at Steele Butte (Loc. 32107/20B).

FIG. *1–3*—*Leiocoryphe* sp. indet. Dorsal, lateral and anterior views of cranidium. Length of cranidium 3.9 mm. UW A10897. Loc. 32107/20B20. (p. 557)

4–6—*Meteoraspis boulderensis* DeLand, n. sp. *4,5*, Lateral and anterior views of holotype cranidium (see Pl. 63, fig. 18). UW A10891a. *6*, Lateral view of paratype cranidium, showing undamaged profile. Length 10.9 mm. UW A10891b. Loc. 32107/20B19. (p. 557)

7—Cranidium A. Dorsal view of unidentified cranidium. Length of glabella 4.4 mm. UW A10889. Loc. 32107/20B15. (p. 552)

8—*Meteoraspis* sp. indet. Cranidium ×1. UW A10898. Loc. 32107/20B20. (p. 558)

9—*Meteoraspis elongata* Lochman, 1944. Cranidium. Length 17.6 mm. UW A10903. Loc. 32107/20B22. (p. 558)

10—*Modocia centralis* (Whitfield), 1877. Cranidium. Length 14.7 mm. UW A10896a. Loc. 32107/20B20. (p. 558)

11—*Modocia* sp. indet. Fragmentary cranidium ×1. UW A10901. Loc. 32107/20B22. (p. 559)

12–13—*Kormagnostus* sp. indet. Fragmentary cephalon and pygidium. Length of posterior glabellar segment 0.8 mm. Length of pygidium 2.0 mm. UW A10890b,c. Loc. 32107/20B15. (p. 557)

14–16—"*Cedarina*" sp. indet. Anterior, lateral and dorsal views of unique cranidium. Length of glabella, excluding occipital ring 2.2 mm. UW A10936. Loc. 32107/20B20. (p. 550)

17–18—Pygidium A. Dorsal and lateral views. Length 8.0 mm. UW A10886. Loc. 32107/10B14. (p. 561)

DESCRIPTION OF SPECIES

Genus APACHIA Frederickson, 1949

APACHIA CONVEXA DeLand, n. sp.

Pl. 65, fig. 4–6

Description.—Cranidium quadrate, highly convex. Glabella very highly convex, conical, smoothly rounded anteriorly, no glabellar furrows. In longitudinal profile, the greatest convexity of the glabella is immediately anterior to the occipital furrow. In transverse profile, the gently convex sides of the glabella rise steeply from the dorsal furrow to the smoothly rounded crest. Occipital furrow broad and deep at the axis of the cranidium, shallower near dorsal furrow. Occipital ring broad, somewhat flattened, untapered. Dorsal furrow broad and deep at sides of glabella, less deeply impressed anteriorly. Brim convex, posterior part forming a narrow, downsloping platform which merges laterally with fixed cheeks; anterior rolled sharply down to a nearly vertical position at the marginal furrow, which is wide, deep and gently curved. Border convex, about same length as brim, nearly horizontal at marginal furrow. Fixed cheeks about one-half as wide as glabella, regularly convex in all directions. Palpebral lobe about one-third the length of the glabella, narrow, gently curved, depressed, centered slightly forward of the center of the glabella. Palpebral furrow faint, nearly straight. No ocular ridge. Posterior limb triangular, convex, steeply depressed laterally, marginal furrow wide and deep at lateral extremity, shallow at junction with dorsal furrow.

Facial suture cuts anterior margin on a line with the dorsal furrow, curves gently out and back to marginal furrow, trends nearly straight back and slightly inward to anterior end of palpebral lobe, curves gently around the lobe, indents slightly, and then curves out and back on an increasingly convex course to cut the posterior margin within the genal angle.

Outer surface of test very finely granulated.

Free cheeks, thorax and pygidium unknown.

Remarks.—The holotype is a single, nearly complete cranidium, 3.2 mm. long and 3.4 mm. wide. In addition to its slightly smaller size it differs from *A. trigonis* in the following respects:

Feature	*Apachia trigonis*	*Apachia convexa*
Occipital ring	Convex	Flattened
Brim	Gently convex. Descends from dorsal furrow at nearly same angle as front of glabella.	Strongly convex. Posterior portion forms downsloping platform, anterior portion nearly vertical.
Border	Rises at 45° angle from marginal furrow.	Nearly horizontal at marginal furrow.
Fixed cheeks	Flat in transverse profile.	Convex in transverse profile.

Locality and formation.—Sweetwater Canyon collection 2997/27A10, 1.0–1.5 feet above the base of the Open Door limestone. *Elvinia* zone.

Figured specimen.—UW A10924a.

Genus ARAPAHOIA Miller, 1936

ARAPAHOIA BUTLERI (Stoyanow), 1936

Pl. 63, fig. 1

Hesperaspis butleri STOYANOW, 1936, Geol. Soc. Am. Bull., vol. 47, p. 469, pl. 1, fig. 8.

Arapahoia butleri (Stoyanow). RESSER, 1937, Smithsonian Misc. Coll., vol. 95, no. 22, p. 2.

Arapahoia reesidei RESSER, 1942, Smithsonian Misc. Col., vol. 103, no. 5, p. 44–45, pl. 7, fig. 5–9.

Diagnosis.—*Arapahoia* with stubby posterior limbs, eyes noticeably removed from the dorsal furrow, and the glabella faintly outlined, even on the exterior of the test.

Description.—Cranidium spatulate, convex in both directions. Glabella conical, bluntly rounded in front. Broad shallow concavities opposite the eyes and in the posterior quarter of the glabella may be glabellar furrows, but they are poorly defined. Glabella evenly convex longitudinally and transversely; little change in convexity

across the dorsal furrows to the rest of the cranidium. Occipital furrow broad, shallow, deflected anteriorly in the middle; furrow not well marked on either inside or outside of test. Occipital ring broad, triangular, nearly flat in longitudinal profile, and apparently equipped with a slender spine. Dorsal furrow faint all around. Brim flatly convex, downsloping nearly in the same curve as the glabellar profile, smooth. Fixed cheeks one-third to one-quarter as wide as glabella, opposite the eyes. Palpebral lobes nearly horizontal, gently arched longitudinally, one-third as long as the glabella excluding the occipital ring, centered about opposite the middle of the cranidium, excluding the occipital spine. No ocular ridge. Posterior limbs less wide than usual for the genus, being slightly over half as wide as the occiptal ring. Marginal furrow well defined. Facial suture trends slightly outward in front of the eyes and bows outward in a regular curve behind.

Surface and inside of test smooth.

Free cheeks, thorax and pygidium not collected, but figured by Resser (1942, pl. 7, fig. 5)

Remarks.—This species is very close to *Arapahoia convexa* Duncan, 1944 (=*A. polita* and *A. prolixa* Resser, 1942) in the stubby posterior limbs and in the configuration of the eyes, but it differs in having dorsal furrows. Probably the difference is no more than subspecific.

There seem to be two divisions of the genus *Arapahoia*, one, with eyes set close to the glabella and virtually rising from the dorsal furrow as in *A. spatulata* Miller, 1936, and the other, with eyes separated from the furrow by one-fifth to one-third of the glabellar width, as in *A. typa*. These two divisions may, on further study, warrant subgeneric separation.

This is the largest *Arapahoia* thus far found in Wyoming.

Locality and formation.—Two cranidia from the Steele Butte collection 32107/20B22, 2.7–4.2 feet below the top of the Park shale. *Cedaria* zone.

Plesiotypes.—UW A10904.

Arapahoia levis Miller, 1936
Pl. 63, fig. 12

Arapahoia levis Miller, 1936, Jour. Paleont., vol. 10, p. 25, pl. 8, fig. 3,4.

Description.—Cranidium nearly smooth, flat. Glabella undifferentiated on outer surface, slightly longer than wide, low and flat, scarcely elevated above fixed cheeks, no glabellar furrows. Occipital furrow wide and shallow, nearly obsolete at axis, directed backward laterally. Occipital ring narrower than base of glabella, flat, tapers posteriorly into a broad spine of unknown length. Dorsal furrow obsolete on outer surface, narrow and shallow but complete on exfoliated specimens. Preglabellar area one-third as long as glabella, undifferentiated on outer surface. On exfoliated specimens a faint, narrow marginal furrow divides the preglabellar area subequally into a convex, arcuate border and a nearly flat brim. Fixed cheeks flat, horizontal, less than one-half as wide as glabella. Palpebral lobes of medium length, crescentiform, slightly elevated, situated opposite anterior third of the glabella. Palpebral furrow obsolete. No ocular ridge. Posterior limbs triangular, moderately depressed, about one-half as wide as base of glabella; marginal furrow wide and deeper than any of the other cranidial furrows.

Anterior course of facial suture broadly curved in front, then directed nearly straight back to front of palpebral lobe, curving widely around and indented behind palpebral lobe; directed out and back at an angle of about 45° and then abruptly back to cut posterior margin.

Free cheeks, thorax and pygidium unknown.

Remarks.—*Arapahoia levis* differs from *A. typa* in the rounded anterior margin of the cranidium and the smoother surface. It differs from *A. butleri* in its smaller size, wider posterior limbs, rounded anterior margin and in its effacement.

Locality and formation.—Three fragmentary cranidia and one complete, but weathered, exfoliated cranidium from Steele Butte collection 32107/20B19, 20.4–20.6 feet below the top of the Park shale. *Cedaria* zone.

Plesiotypes.—UW A10893, A10895.

Arapahoia sp. indet.
Pl. 63, fig. 2

Description.—Cranidium smooth, length two-thirds the width across posterior limbs, in longitudinal profile regularly and gently

convex. Glabella flatly keeled, not differentiated from brim and fixed cheeks, faintly demarcated from posterior limbs by shallow, incomplete dorsal furrow. Occipital furrow wide and shallow. Occipital ring wide, flat, apparently unspined. Brim and border undifferentiated, flat; preglabellar area continues the anterior slope of the glabella. Fixed cheeks flat, downsloping, continuing the lateral slope of the glabella. Palpebral lobes large, curved, raised very slightly above the fixed cheeks, situated opposite anterior end of glabella. Posterior limbs triangular, slightly longer than wide, flat, downsloping. The marginal furrow is broad and more deeply impressed than the occipital furrow.

Anterior facial suture broadly rounded across the front of the cranidium then directed straight back to anterior end of palpebral lobe; curves around and is indented at posterior end of palpebral lobe, thence nearly straight and directed at an angle of about 45° with the axis to cut the posterior margin.

Surface covered with faint, fine granules arranged in irregular longitudinal lines except on the border where the lines are transverse.

Remarks.—This specimen is immature, and it is impossible to assign it to a species with certainty, but it is possible that it may be a young *A. levis*; the smooth surface suggests this.

Locality and formation.—Steele Butte collection 32107/20B20, 10.5–10.6 feet below the top of the Park shale. *Cedaria* zone.

Figured specimen.—UW A10899.

Genus Blountia Walcott, 1916
Blountia carlotta Lochman, 1944
Pl. 63, fig. 3–8

Blountia carlotta Lochman, 1944, in Lochman & Duncan, Geol. Soc. Am. Spec. Pap. 54, p. 84–85, pl. 11, fig. 28–31.

There is nothing to add to the full description of this species given by Lochman.

Remarks.—Specimens identified with this species have been found at two levels in the Park shale (see below). Most of the specimens (Pl. 63, fig. 5–7) seem to be typical of the species, but one of the younger specimens (Pl. 63, fig. 3,4) is smoother and has a narrower marginal furrow. These differences do not now seem sufficient to warrant exclusion of the cranidium from the species.

Locality and formation.—Steele Butte collections 32107/20B19 (one cranidium) and 32107/20B22 (2 cranidia, 1 pygidium), 20.4–20.6 and 2.7–4.2 feet below the top of the Park shale, respectively. *Cedaria* zone.

Plesiotypes.—UW A10894, A10902a–d.

Genus Burnetia Walcott, 1924
Burnetia alta Resser, 1942
Pl. 65, fig. 1–3

Burnetia alta Resser, 1942, Smithsonian Misc. Coll., vol. 103, no. 5, p. 80–81, pl. 17, fig. 12–14.

Burnetia alta Resser. Wilson, 1951, Jour. Paleont., vol. 25, p. 626.

Description.—Cranidium elongate, moderately to highly convex. Glabella highly convex in holotype, less so in Wyoming specimens; sides gently tapered, slightly curved; anterior rounded. Two pairs of glabellar furrows; anterior pair reduced to short notches; posterior pair longer, curved backward, deep on internal molds and on young individuals, shallow on the exterior of larger cranidia. Occipital furrow narrow but well defined, nearly straight across the middle half of the glabella, then swinging forward on both ends. Occipital ring of nearly uniform width throughout; no spine present. Dorsal furrows impressed all around glabella, but not deep; faint anteriorly, deeper laterally. Brim reduced medially to a strip scarcely a millimeter wide between the dorsal and marginal furrows. Marginal furrow well defined, curved and nearly tangent to dorsal furrow at center, directed nearly straight and obliquely back laterally. Border flat and downsloping, about one-third the length of glabella, anterior broadly rounded. Fixed cheeks transversely convex, upsloping from dorsal furrow, downsloping at lateral margin, about one-third as wide as glabella; ocular ridge strong and oblique. Palpebral lobes and posterior limbs unknown.

Free cheek broadly rectangular. Ocular platform regularly convex. Marginal furrow wide and well impressed, posterior marginal furrow most deeply impressed. Border about one-half as wide as ocular platform, smoothly concave, extended posteriorly into a long, sharp spine.

Facial suture describes smooth curve about antero-lateral corner of cranidium and converges slightly from opposite marginal furrow toward palpebral lobe. Further course unknown.

Outer surface irregularly covered with coarse pustules which are smaller and fewer on border than on rest of cranidium. Ocular platform also pustulose.

Pygidium semicircular, length about one-half width. Axis extends nearly full length of pygidium, highly convex, tapered; four axial rings and a posterior segment separated by distinct furrows. Dorsal furrow narrow and well impressed. Pleural platform moderately convex with an abrupt deflection down to the concave border. Border and pleural platform about equal in width at sides of pygidium. Pleural lobes marked by four segments which bend back slightly at marginal furrow and extend across border. Interpleural grooves distinct; pleural furrows wider and deeper than interpleural grooves on anterior three segments. Marginal furrow shallow.

Remarks.—This species differs from *B. urania*, as Wilson has pointed out, in the shortness of the border.

Locality and formation.—Steele Butte collection 32107/20B24, 25.0–30.0 feet above the base of the Open Door limestone (4 cranidia, 2 free cheeks, 1 pygidium). Sweetwater Canyon collection 2997/27A10, 1.0–1.5 feet above the base of the Open Door limestone (1 pygidium). *Elvinia* zone.

Plesiotypes.—UW A10908a,b, A10910a–c, A10911, A10926.

Genus BYNUMIA Walcott, 1924
BYNUMIA sp. indet.
Pl. 63, fig. 9–11

Description.—Cranidium broadly triangular, length about one-half width across posterior limbs, no furrows visible on outer surface of test, anterior bluntly pointed; posterior margin between posterior limbs gently convex. Cranidium is regularly convex in transverse profile except for faint flattening of the posterior limbs. In longitudinal profile, cranidium is nearly hemispherical with a slight increase in convexity near both anterior and posterior margins. Only posterior part of glabella well defined, even on exfoliated specimens. Dorsal furrow on the inside of the test broad and shallow at posterior margin, becomes more shallow and narrow anteriorly and is straight across the front end of the glabella. Occipital furrow marginal, broad and shallow, on interior of test only. Posterior limb approximately same width as glabella at occipital furrow, sharply triangular with a broad shallow marginal furrow present only on the inner surface. Fixed cheeks, brim and border undifferentiated. Palpebral lobes missing.

Outer surface of test microscopically granulated, inner surface finely punctate.

Remarks.—This species seems to differ from other described species in having a stubbier glabella and in being blunter anteriorly, but until more specimens are found it seems unwise to propose a new name.

Locality and formation.—Steele Butte collection 32107/20B22, 2.7–4.2 feet below the top of the Park shale (2 cranidia). *Cedaria* zone.

Plesiotypes.—UW A10900a,b.

Genus CAMARASPIS Ulrich & Resser, 1924
CAMARASPIS PLANA Frederickson, 1948
Pl. 66, fig. 13

Camaraspis plana FREDERICKSON, 1948, Jour. Paleont., vol. 22, p. 799, pl. 123, fig. 14–15.

The Wyoming specimens add nothing to Frederickson's original description.

Remarks.—The bifurcation of the occipital furrow, mentioned by Frederickson, was observed faintly or not at all on the Wyoming specimens, all of which are exfoliated cranidia, but lateral widening of the occipital furrow may indicate the position at which the occipital furrow bifurcates on the outer surface of the test.

Location and formation.—Granite Falls collection 39113/5A6, 13.8 feet above the base of the Open Door limestone. Steele Butte collections 32107/20B24 and 32107/20B25, 25.0–30.0 and 33.0–33.6 feet above the base of the Open Door limestone, respectively. *Elvinia* zone.

Plesiotypes.—UW A10908a,b, A10909a–d, A10911, A10914, A10917.

Genus CEDARIA Walcott, 1924
CEDARIA MILLERI Resser, 1937
Pl. 63, fig. 13–15

Cedaria aff. *C. prolifica* Walcott. MILLER, 1936, Jour. Paleont., vol. 10, p. 28–29, pl. 8, fig. 18.

Cedaria milleri RESSER, 1937, Smithsonian Misc. Coll., vol. 95, no. 22, p. 5.

Description.—Cranidium, excluding the posterior limbs, quadrate, longer than wide. Glabella conical, moderately and regularly convex, anterior smoothly rounded, length about equal to width, no glabellar furrows. Occipital furrow of medium width, well impressed except at junction with dorsal furrow. Occipital ring wide at center, tapered laterally, flat, with a median node. Dorsal furrow narrow, sharply but not deeply impressed. Preglabellar area about two-fifths as long as glabella, sub-equally divided into a nearly straight, gently downsloping brim and a flattened-convex, tapered border by the wide, shallow, gently curved marginal furrow. Fixed cheeks slightly convex and gently downsloping, a little more than one-half as wide as glabella. Palpebral lobes small, crescentic, slightly elevated above fixed cheeks, situated slightly anterior to glabellar mid-line. Palpebral furrow of medium width, shallow. Ocular ridge prominent, broadly curved from anterior end of palpebral lobe to antero-lateral corner of glabella. Posterior limbs strap-like, nearly as wide as occipital ring, laterally depressed, wider at lateral extremity than at junction with fixed cheek, posterior margin directed gently backward; marginal furrow wide and well-impressed, becoming more shallow and curving forward at outer end.

Facial suture cuts anterior margin slightly inside a line extended forward from the eyes, curves smoothly back to marginal furrow, converges noticeably toward the anterior end of the eye, swings around and indents behind the palpebral lobe, then runs outward nearly normal to axis of cranidium, curving abruptly backward to truncate the outer end of the posterior limb and cut the posterior margin within the genal angle.

Outer surface covered with small but distinct granules.

Free cheeks, thorax and pygidium unknown.

Remarks.—The two small, fragmentary cranidia are well preserved in limestone and add to the understanding of the species which previously was known only from the holotype. Apparently this species is rather restricted geographically. It was first collected by Miller near DuNoir, Wyoming, about 65 miles from where these two specimens were collected at Steele Butte.

Locality and formation.—Steele Butte collection 32107/20B22, 2.7–4.2 feet below the top of the Park shale. *Cedaria* zone.

Figured specimens.—UW A10930a,b.

Genus CEDARINA Lochman, 1940
"CEDARINA" sp. indet.
Pl. 64, fig. 14–16

Description.—Cranidium elongate, moderately convex. Glabella conical, tapered, angular in transverse profile, smoothly convex in longitudinal profile; two pairs of straight glabellar furrows are faintly indicated; anterior smoothly rounded. Occipital furrow shallow at axis, more deeply impressed at sides. Occipital ring flat and tapered, prolonged into a slender, flat-lying spine. Dorsal furrow complete, wide and shallow around anterior end of glabella, deeper along sides of glabella. Preglabellar area two-fifths as long as glabella; brim gently convex and downsloping except for a narrow axial groove on the mid-line of the brim. Border slightly convex, horizontal, arcuate, almost twice as long at center as brim. Marginal furrow wide and prominent, broadly curved with a slight posterior inbend opposite the axial groove. Fixed cheeks a little more than one-third as wide as glabella, nearly flat and considerably upsloping from dorsal furrow. Palpebral lobe of medium length, gently bowed, situated on median line of glabella and above the fixed cheek; palpebral furrow faint. Ocular ridge broad and low, curved from anterior end of palpebral lobe to the antero-lateral corner of the glabella. Posterior limb strap-like, as wide or wider than occipital ring, posterior margin directed obliquely backward; marginal furrow wide and deep.

Facial suture intramarginal nearly to center, curved smoothly out and back to marginal furrow, apparently directed straight back to palpebral lobe about which it curves and indents at the posterior end. Directed outward nearly parallel to posterior margin then swings abruptly back to cut the posterior margin.

Outer surface of test minutely granulated.

Free cheeks, thorax and pygidium unknown.

Remarks.—This species, known from a

single cranidium, probably represents a new genus and is placed in *Cedarina* only for convenience. Its distinctive features include the oblique, rearward direction of the posterior margin, the axial groove in the brim, and the elevated, close-set eyes. However, one specimen is not sufficient basis upon which to erect a new genus.

Locality and formation.—Steele Butte collection 32107/20B20, 10.5–10.6 feet below the top of the Park shale. *Cedaria* zone.

Figured specimen.—UW A10936.

Genus CLIFFIA Wilson, 1951
CLIFFIA LATAGENAE (Wilson), 1949
Pl. 65, fig. 11–12

Acrocephalites latagenae WILSON, 1949, Jour. Paleont., vol. 23, pl. 31, pl. 10, fig. 14.
Cliffia latagenae (Wilson). WILSON 1951, Jour. Paleont., vol. 25, p. 633, pl. 90, fig. 18–24.

The Wyoming specimens add nothing to Wilson's original description.

This species is represented in the collections by a nearly complete pygidium and a fragmentary cranidium on the same block of limestone with *Apachia convexa* DeLand and *Xenocheilos* cf. *X. spineum* Wilson, 1951. The pygidium is 1.3 mm. long with seven axial rings and a posterior segment. The axial lobe is nearer one-third the width of the pygidium than one-fourth which may be a function of the small size of the specimen. The cranidium is too fragmentary to add anything to the description of the species.

Locality and formation.—Sweetwater Canyon collection 2997/27A10, 1.0–1.5 feet above the base of the Open Door limestone. *Elvinia* zone.

Figured specimens.—UW A10924b,c.

Genus COOSIA Walcott, 1911
COOSIA CONNATA (Walcott), 1890?
Pl. 67, fig. 6

Ptychoparia connata WALCOTT, 1890, U. S. Nat. Mus. Proc., vol. 13, p. 272, pl. 21, fig. 2.
Coosia connata (Walcott). RESSER, 1937, Smithsonian Misc. Coll., vol. 95, no. 22, p. 7.
Coosia connata (Walcott). LOCHMAN & DUNCAN, 1944, Geol. Soc. Am. Spec. Pap. 54, p. 46, pl. 6, fig. 7,8.

Remarks.—One fragmentary cranidium is tentatively referred to this species. In all of the preserved features it appears to be identical to previously illustrated specimens, but because of the fragmentary condition, the specific identification is questioned.

Locality and formation.—Steele Butte collection 32107/20B23, 8.0–9.0 feet below the top of the DuNoir limestone. *Crepicephalus* zone.

Plesiotype.—UW A10906.

COOSIA DAKOTENSIS Resser, 1942
Pl. 67, fig. 5

Coosia dakotensis RESSER, 1942, Smithsonian Misc. Coll., vol. 103, no. 5, p. 74, pl. 13, fig. 29–31.
Coosia grandis LOCHMAN in Lochman & Duncan, 1944, Geol. Soc. Am. Spec. Paper 54, p. 47–48, pl. 6, fig. 23–31.
Coosia dakotensis Resser. LOCHMAN & DUNCAN, 1949, Jour. Paleont., vol. 23, p. 439. Suppress *C. grandis* as a synonym.

The descriptions and figures by Lochman & Duncan and Resser fully characterize the species. The specimen from Steele Butte resembles the holotype in exhibiting a slight glabellar keel.

Locality and formation.—Steele Butte collection 32107/20B23, 8.0–9.0 feet below the top of the DuNoir limestone. *Crepicephalus* zone.

Figured specimen.—UW A10905.

Genus DEADWOODIA Resser, 1938
DEADWOODIA DURIS (Walcott), 1916
Pl. 65, fig. 7–10

Asaphiscus? duris WALCOTT, 1916, Smithsonian Misc. Coll., vol. 64, no. 5, p. 392, pl. 63, fig. 8,8a.
Dunderbergia? declivita MILLER, 1936, Jour. Paleont., vol. 10, p. 30, pl. 8, fig. 37,38.
Deadwoodia duris (Walcott). WILSON, 1948, Jour. Paleont., vol. 22, p. 33, 34, pl. 8, fig. 9–17.

Remarks.—Wilson has restudied this species and given a full description of it.

This species was one of the most prominent members of the *Elvinia* fauna at Sweetwater Canyon where nine identifiable cranidia were collected. These cranidia differ from the holotype in possessing a slightly steeper brim, which may be a function of preservation.

Locality and formation.—Sweetwater Canyon collection 2997/27A10, 1.0–1.5 feet above the base of the Open Door limestone. *Elvinia* zone.

Plesiotypes.—UW A10919a–i, A10928.

Genus DELLEA Wilson, 1949, emend. Wilson, 1951

DELLEA cf. D. BUTLERENSIS Frederickson, 1949

Pl. 66, fig. 1–3

Description.—Cranidium elongate, rectangular, moderately convex. Glabella conical, moderately convex, rounded anteriorly; two pairs of glabellar furrows visible on outer surface of test, anterior pair faint, short, oblique; posterior pair longer and bent sharply backward. Occipital furrow broad and bowed forward over axis; narrower, deeper and curved forward laterally. Occipital ring slightly convex. Dorsal furrow narrower than occipital furrow, well impressed, complete. Brim gently curved, continuing the slope of the anterior part of the glabella, slightly longer than the convex, arcuate border. Marginal furrow deep and broadly curved; radius of curvature about equal to length of cranidium. Fixed cheeks moderately convex, slightly more than one-third the width of the glabella; palpebral lobes one-fourth the length of the glabella, moderately curved, situated behind the glabellar median line and slightly below the dorsal furrow; palpebral furrow wide and shallow. Ocular ridge absent, but fixed cheek and border form rounded angle where ridge normally lies. Posterior limb short, triangular, slightly more than one-half as wide as the occipital ring; marginal furrow present but character is unknown.

Facial suture cuts anterior margin halfway between the axis and the corner of the cranidium, curves gently back to marginal furrow, converges slightly toward anterior end of palpebral lobe, swings out around lobe and then is directed nearly straight out at an angle of about 45° to cut the posterior margin.

Free cheeks, thorax and pygidium unknown.

Remarks.—Two fragmentary cranidia are similar to the *Dellea butlerensis* but differ in having an anterior axial flexure in the occipital furrow and in having a slightly narrower brim. Without more specimens the importance of these differences cannot be evaluated.

Locality and formation.—Steele Butte collection 32107/20B24, 25.0–30.0 feet above the base of the Open Door limestone. *Elvinia* zone.

Plesiotypes.—UW A10912a,b.

DELLEA SAGINATA DeLand, n. sp.

Pl. 66, fig. 4–7

Description.—Cranidium subquadrate, but damage to the antero-lateral angles make specimens appear subtriangular. Cranidium highly convex, length about two-thirds the

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EXPLANATION OF PLATE 65

All specimens from the *Elvinia* zone of the Open Door limestone at Loc. 2997/27A10, except as noted.

FIG. *1–3—Burnetia alta* Resser, 1942. *1*, Damaged cranidium associated with cranidium of *Camaraspis plana* Frederickson, 1948 and pygidium of *Elvinia* sp. indet. Width of border at marginal furrow 18.7 mm. UW A10908a. *2*, Clay impression of assigned pygidium. ×1. UW A10926. *3*, Assigned free cheek. ×1. UW A10910a. *1* and *3* from Loc. 32107/20B24. (p. 548)

4–6—Apachia convexa DeLand n. sp. *4,6*, Dorsal and anterior views of holotype, associated with *Xenocheilos* cf. *X. spineum*. Length of cranidium 3.2 mm. *5*, Lateral view, lighted to demonstrate eccentric profile of glabella. UW A10924a. (p. 546)

7–10—Deadwoodia duris (Walcott), 1916. *7,10*, Anterior and dorsal views of cranidium. Length of glabella, excluding occipital ring, 5.8 mm. UW A10919a. *8,9*, Dorsal and lateral views of cracked cranidium preserving palpebral lobe and showing granular surface. Length of cranidium 9.5 mm. UW A10919b. (p. 551)

11,12—Cliffia latagenae Wilson, 1949. Cranidium and assigned pygidium. Length of glabella, excluding occipital ring, 1.4 mm. Pygidial length 1.1 mm. UW A10924b,c, (p. 551)

13—Xenocheilos cf. *X. spineum* Wilson, 1951. Cranidium. Length 2.0 mm. UW A10924 (see fig. 4 and 6 above). (p. 560)

14—Iddingsia occidentalis DeLand & Shaw, n. sp. Holotype cranidium. Length 10.0 mm. UW A10920b. (p. 555)

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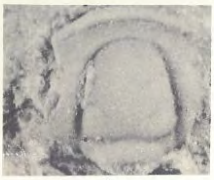
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posterior width. Glabella highly convex, conical, anterior margin smoothly rounded, stands high above fixed cheeks, length slightly greater than or equal to width. In longitudinal profile, the glabella rises abruptly above occipital ring, then is smoothly convex with convexity increasing slightly toward the anterior end. Three pairs of faint glabellar furrows normal to the dorsal furrow distally and sharply curved back mesially; furrows not visible on all specimens even when coated or exfoliated. Occipital furrow broad and deep on inner surface of test, bowed forward slightly at center and at sides of glabella. Occipital ring short, convex, tapered and directed forward at the sides. Dorsal furrow broad, deep, complete. Preglabellar area from one-third to slightly more than two-fifths as long as glabella. Brim length ranges from slightly longer than border to twice as long as border with the smaller specimens possessing proportionately shorter brims than the larger. Brim moderately convex, nearly horizontal at dorsal furrow then steeply depressed to the deep, V-shaped marginal furrow. Radius of curvature of marginal furrow about two-thirds length of cranidium. Border arcuate, tapered, flat and slightly upsloping from marginal furrow. Fixed cheeks slightly convex, horizontal, about one-third width of glabella. Palpebral lobes gently curved, situated medially with respect to glabella. Palpebral furrow shallow. Ocular ridge faint, oblique, more prominent on small specimens. Posterior limb incomplete on all specimens collected, but at least two-thirds as wide as occipital ring, sharply depressed, marginal furrow broad and shallow on exfoliated specimens.

Facial suture cuts anterior margin about on a line with the palpebral lobes, curves sharply around antero-lateral corner of cranidium and trends straight back and inward to the anterior end of the palpebral lobe, which it rounds. Posterior course unknown.

Outer surface of test apparently smooth.

Free cheeks, thorax and pygidium unknown.

Remarks.—Variations in cranidial proportions exist within the population; the brim-border ratio varies from about 1.2 in the smallest specimen (glabella 2.4 mm. long) to 2.0 in the largest (the holotype, glabella 3.8 mm. long). The ratio of glabella length to width varies from 1.1 to 1.0 and is independent of glabellar length in the specimens measured.

This species differs from the genotype, *Dellea suada* (Walcott), 1890, in the higher convexity of glabella and brim and wider fixed cheeks. The glabellar convexity of *D. saginata* distinguishes it from other species of *Dellea* except *D. butlerensis* Frederickson, 1949, from which it varies in the greater convexity of the brim, higher brim-border ratio in mature specimens, wider fixed cheeks and longer radius of curvature of marginal furrow.

Locality and formation.—Seven cranidia from Sweetwater Canyon collection 2997/27A10, 1.0–1.5 feet above the base of the Open Door limestone. *Elvinia* zone.

Holotype.—UW A10918a.

Paratypes.—UW A10918b–g, A10921.

EXPLANATION OF PLATE 66

All specimens are from the *Elvinia* zone of the Open Door limestone.

FIG. *1–3—Dellea* cf. *D. butlerensis* Frederickson, 1949. Three views of best cranidium. Length of cranidium 5.0 mm. UW A10912a. Loc. 32107/20B24. (p. 552)

4–7—Dellea saginata DeLand, n. sp. *4–6*, Three views of holotype cranidium. Length, excluding occipital ring 5.3 mm. UW A10918a. *7*, Exfoliated paratype cranidium. Length 5.1 mm. UW A10918c. Loc. 2997/27A10. (p. 552)

8,9—Dellea suada (Walcott), 1890? Dorsal and anterior views of cranidium. Length 5.6 mm. UW A10925. Loc. 32107/20B24. (p. 554)

10–12—Irvingella aff. *I. flohri* Resser, 1942. Three views of immature cranidium. Glabella, including occipital ring, 1.85 mm. UW A10922. Loc. 2997/27A10. (p. 556)

13—Camaraspis plana Frederickson, 1948. Three cranidia. ×0.865. UW A10909a. Loc. 32107/20B24. (p. 549)

14—Housia vacuna (Walcott), 1890?. Unique, fragmentary pygidium. ×2⅓. UW A10923. Loc. 2997/27A10. (p. 555)

DELLEA SUADA (Walcott), 1890?
Pl. 66, fig. 8,9

Dellea suada (Walcott). WILSON, 1951, Jour. Paleont., vol. 25, p. 636–638, pl. 91, fig. 4–10,18, 20–23,25,26. (Complete synonymy to date)

A single cranidium seems to belong to *Dellea suada* or at least to be closely related to it as the species was revised by Wilson in 1951. One noticeable difference is the narrowness of the border in which the present specimen most closely approaches Wilson's fig. 6–8. A second difference is that *D. suada* has a finely granulated surface whereas the present specimen is punctate; the significance of this difference is not understood at present.

Distribution.—Steele Butte collection 32107/20B24 25–30 feet above the base of the Open Door limestone. *Elvinia* zone.

Plesiotype.—UW A10925.

Genus ELLIPSOCEPHALOIDES
Kobayashi, 1935
ELLIPSOCEPHALOIDES sp. indet.
Pl. 67, fig. 1

Description.—Cranidium transversely ovate, length about two-thirds width. Glabella cylindrical, convex, extending nearly the full length of the cranidium; anterior broadly rounded, two pairs glabellar furrows, anterior pair narrow, shallow and straight, posterior pair represented by deep pits on sides of the glabella. Occipital furrow straight, narrow and deep. Occipital ring long and flat at median axis, tapered laterally. Dorsal furrow rather narrow, well impressed. Brim very short, one-sixteenth length of glabella, nearly vertical. Width of fixed cheeks about one-third the glabellar width. Fixed cheeks slightly convex, nearly horizontal. Palpebral lobes broad, slightly curved, a little more than one-fourth of the glabellar length. Palpebral furrow broad and shallow. Ocular ridge well defined, marginal, merging with the brim at the anterior end, demarcated by a shallow furrow that connects posteriorly with the palpebral furrow. Posterior limb narrow, sharply depressed along the posterior margin.

Facial suture apparently intramarginal to the center since there is no trace of a border; directed sharply outward to and around the palpebral lobe, nearly normal to cranidial axis immediately posterior to palpebral lobe, then directed backward and outward to cut the posterior margin at a distance equal to one-fourth the width of the occipital ring from the dorsal furrow.

Outer surface of test covered with a network of fine subpolygonal ridges.

Free cheeks, thorax and pygidium unknown.

Remarks.—One nearly complete cranidium, 1.9 mm. long, undoubtedly representing an immature individual, is assigned to *Ellipsocephaloides*. It most closely resembles *E. montis* Resser, 1942, but differs in possessing a shorter brim, as would be expected in an immature cranidium, but specific identification based on a single juvenile specimen would be hazardous.

Locality and formation.—Sweetwater Canyon collection 2997/34A2, 131.6–131.7 feet above the base of the Open Door limestone. *Ptychaspis-Prosaukia* zone.

Figured specimen.—UW A10932.

Genus ELVINIA Walcott, 1924
ELVINIA sp. indet.
Pl. 67, fig. 9,10

Description.—Cranidium quadrate without posterior limbs, only slightly convex. Glabella conical, moderately convex, width slightly greater than length, anterior subtruncate, broadly rounded; one pair of moderately impressed, oblique glabellar furrows connected across the axis by a wide furrow. Occipital furrow wide and deep, bowed forward axially, shallower and directed forward laterally. Occipital ring moderately convex, directed forward laterally. Dorsal furrow complete, wide and deep. Brim about one-fifth as long as glabella, gently convex and downsloping; anterior part forms narrow, horizontal platform. Marginal furrow wide and deep, nearly straight. Border narrow, convex, nearly straight. Fixed cheeks nearly two-thirds as wide as the glabella, gently convex, downsloping; palpebral lobe unknown. Ocular ridge wide and strong, accentuated by the depression of the lateral extremities of brim. Posterior limbs unknown.

Outer surface slightly roughened.

Free cheek and thorax unknown.

Pygidium semicircular, length about one-half width, nearly flat except for high axis. Axis very slightly tapered, convex, extends

nearly full length of the pygidium; first three axial rings well defined by sharply incised furrows, fourth axial ring faintly demarcated from terminal segment. Dorsal furrow deep anteriorly, blends into marginal furrow at posterior end of axis. Pleural platform narrower than axial lobe, slightly convex; four segments, defined by deep interpleural grooves, extend to marginal furrow which is wide and deep. Border narrow, sharply upturned to a nearly vertical position.

Remarks.—This species was collected from the base of the Open Door limestone in all three of the sections discussed here. Collections consisted mostly of fragmentary cranidia or nearly complete pygidia; the most complete are illustrated. Unfortunately, none of the cranidia collected were complete enough to make specific identification possible.

Locality and formation.—Granite Falls collections 39113/5A5 (cranidium) and 39113/5A6 (cranidium and pygidium), 12.7 and 13.8 feet above the base of the Open Door limestone, respectively. Steele Butte collections 32107/20B24 (2 cranidia, 4 pygidia) and 32107/20B25 (pygidium), 25.0–30.0 and 33.0–33.6 feet above the base of the Open Door limestone, respectively. Sweetwater Canyon collection 2997/27A10 (cranidium, 2 pygidia), 1.0–1.5 feet above the base of the Open Door limestone. *Elvinia* zone.

Plesiotypes.—UW A10907a, A10908a, A10913, A10915, A10916, A10927, A10928.

Genus HOUSIA Walcott, 1924
HOUSIA VACUNA (Walcott), 1890?
Pl. 66, fig. 14

Ptychoparia vacuna WALCOTT, 1890, U. S. Nat. Mus. Proc., vol. 13, p. 275, pl. 21, fig. 8–12.
Housia vacuna (Walcott). RESSER, 1936, Smithsonian Misc. Coll., vol. 95, no. 4, p. 23.
Housia vacuna (Walcott). WILSON, 1951, Jour. Paleont., vol. 25, p. 643–644, pl. 93, fig. 5–13.

Remarks.—The single pygidium tentatively assigned to this species has the anterior pleural segment with its diagnostic short spine still attached, although poorly preserved, and is marked by the characteristic fracture where the segment commonly separates from the pygidium.

Locality and formation.—Sweetwater Canyon collection 2997/27A10, 1.0–1.5 feet above the base of the Open Door limestone. *Elvinia* zone.

Figured specimen.—UW A10923.

Genus IDAHOIA Walcott, 1924
IDAHOIA sp. indet.
Pl. 67, fig. 2

Description.—Pygidium semicircular, length about one-half width; axis no more than one-half the length of the pygidium; three axial rings and a flat posterior segment separated by wide, deep furrows. A downsloping ramp leads from the posterior segment to the concave border in a smooth curve. This ramp is not as wide as the posterior segment and is smoothly convex transversely. Pleural platform slightly convex, outer margin downsloping, three wide segments demarcated by broad, deep furrows. Posterior axial border concave, smooth, rest of border and marginal furrow unknown.

Locality and formation.—One pygidium and two cranidial fragments from Sweetwater Canyon collection 2997/27A12, 83.5–84.0 feet above the base of the Open Door limestone. *Ptychaspis-Prosaukia* zone.

Plesiotypes.—UW A10929, A11201.

Genus IDDINGSIA Walcott, 1924
IDDINGSIA OCCIDENTALIS DeLand & Shaw, n. sp.
Pl. 65, fig. 14

Description.—Glabella subcylindrical, evenly rounded in front, length slightly greater than width; in transverse profile, semicircular; in longitudinal profile, entire glabella is gently convex and raised above the occipital ring, convexity slightly greater along anterior one-third of glabella. Two pairs of glabellar furrows; anterior pair faint, oblique; posterior pair longer, well impressed, also oblique and curved posteriorly. Occipital furrow moderately wide and deep, deeper and curved forward laterally. Occipital ring slightly convex, tapered laterally, possessing a faint occipital node. Dorsal furrow wide and deep except immediately anterior to glabella where it is noticeably more shallow. Preglabellar area one-third length of cranidium divided subequally into a flat, horizontal border and a convex, downsloping brim by a wide shallow marginal furrow. A central swelling of the brim causes the marginal furrow to bow forward

centrally from its broadly curved course. Fixed cheeks about one-third width of glabella, faintly convex, sharply upsloping from dorsal furrow. Palpebral lobes one-half as long as glabella, broadly curved, posterior end opposite posterior end of glabella. Palpebral furrow well impressed. Ocular ridge prominent, oblique, reaches glabella well back of antero-lateral corner.

Facial suture apparently cuts anterior margin about on line with dorsal furrow, curves widely out and back to marginal furrow, then curves gently inward to the anterior end of the palpebral lobe, around which it curves. Further course not known.

Outer surface of test minutely granulose.

Remarks.—This species is much like *I. anatina* Resser, 1942, but differs in several minor, but consistent respects: (1) The sides of the glabella are parallel and not bowed as in *P. anatina*; (2) the occipital furrow is sharp and well incised rather than faint and shallow; (3) there is no occipital spine but only a barely perceptible node; (4) the border is shorter than in *I. anatina*; (5) the eyes are longer and less sharply curved; and (6) the convexity of the glabella is greater. In some respects this species resembles *I. simplicatus* Resser, 1942, too, but it differs in the glabellar convexity and shape, length of border and the lack of an occipital spine.

Locality and formation.—Sweetwater Canyon collection 2997/27A10, 1.0–1.5 feet above the base of the Open Door limestone. *Elvinia* zone.

Holotype.—UW A10920b.

Paratypes.—UW A10920a,c, A10921.

Genus Irvingella Ulrich & Resser, 1924
Irvingella aff. I. flohri Resser, 1942
Pl. 66, fig. 10–12

Description.—Cranidium semicircular, length about two-thirds width. Glabella stands high above fixed cheeks, very slightly tapered, width about three-fourths length, anterior broadly rounded. In longitudinal profile the posterior two-thirds of the glabella is flat and elevated above occipital ring; anterior one-third regularly convex. One moderately deep, oblique glabellar furrow is continuous across the glabella. Dorsal furrow complete, narrow and shallow. Occipital furrow narrow and deep; less deeply impressed and directed forward laterally. Occipital ring of normal length, convex, longest at center. Brim about one-tenth the length of the glabella, nearly flat and horizontal at dorsal furrow, rolled abruptly down at margin; anterior margin nearly straight. No border present. Fixed cheeks nearly as wide as glabella, convex and downsloping. Palpebral lobe widely curved about fixed cheek from opposite the occipital furrow to opposite anterior end of glabella, depressed below fixed cheek. No ocular ridge. Posterior limb short, narrow, bluntly triangular; marginal furrow broad and deep.

Facial suture intramarginal to center, indented slightly in front of palpebral lobe, broadly curved around palpebral lobes and directed sharply out and back to cut posterior margin within genal angle.

Outer surface of test finely granulated.

Remarks.—The single cranidium of this species is 2.1 mm. long and probably is an immature specimen. It most closely resembles *I. richmondensis* Resser, 1942, which seems to be based on young individuals of *I. adamsensis* and *I. flohri*; for these three "species" we choose the name *I. flohri* regarding the others as synonyms.

A comparison with specimens of *I. gibba* Miller, 1936, from North Fork Popo Agie River shows that *I. gibba* has a wider glabella and narrower fixed cheeks at a comparable cranidial size.

Locality and formation.—Sweetwater Canyon collection 2997/27A10, 1.0–1.5 feet above the base of the Open Door limestone. *Elvinia* zone.

Figured specimen.—UW A10922.

Genus Kingstonia Walcott, 1924
Kingstonia spicata Lochman, 1940
Pl. 63, fig. 17

Kingstonia spicata Lochman, 1940, Jour. Paleont. vol. 14, p. 34, pl. 4, fig. 1–9.

The pygidia in the present collection agree fully with the original description.

Locality and formation.—Steele Butte collection 32107/20B14 (2 pygidia) and 32107/20B15 (2 pygidia), 47.8–48.2 and 44.0–44.4 feet below the top of the Park shale, respectively. *Cedaria* zone.

Plesiotypes.—UW A10887, A10888a–d.

KINGSTONIA sp. indet.
Pl. 63, fig. 16

Description.—Pygidium semicircular, width slightly less than twice the length. Axial lobe two-thirds length of pygidium, narrow, slightly tapered, nearly flat, 6 narrow segments faintly demarcated by very shallow, wide, furrows. Dorsal furrow broad, shallow, faint around posterior margin of axial lobe. Pleural lobes slightly wider than axial lobe, gently convex, unsegmented except for broad anterior marginal furrow. Marginal furrow broad and shallow laterally, indistinguishable along the posterior axial margin. Border narrow, horizontal at furrow and rolled down abruptly to nearly vertical.

Outer surface smooth.

Remarks.—A single pygidium, complete except for the articulating ring, 3.8 mm. wide and 2.3 mm. long, is assigned to the genus *Kingstonia*. The lack of relief and the presence of what appears to be a marginal furrow may be due to crushing.

Locality and formation.—Steele Butte collection 32107/20B19, 20.4–20.6 feet below the top of the Park shale. *Cedaria* zone.

Figured specimen.—UW A10892.

Genus KORMAGNOSTUS Resser, 1938
KORMAGNOSTUS sp. indet.
Pl. 64, fig. 12,13

Remarks.—The fragmentary nature of the two pygidia and single cranidium collected preclude complete description. The following features, however, make the assignment of the specimens to *Kormagnostus* almost certain according to Lochman's (1940, p. 24) emended description:

(1) " . . . glabella convex, conical, consisting of a large posterior lobe and a small, low, sub-circular anterior lobe; . . . "
(2) " . . . dorsal furrow wide, deep along sides of posterior lobe, joining the deep transverse furrow across front of lobe; dorsal furrow narrow, shallow, faint to obsolete around anterior lobe. . . . "
(3) "Pygidium strongly convex; axial lobe wider than pleural lobes, expanding slightly on posterior half, extending to marginal furrow; anterior portion of axial lobe with a small central mode and marked by traces of two shallow furrows; . . . "

Locality and formation.—Steele Butte collection 32107/20B15, 44.0–44.4 feet below the top of the Park shale. *Cedaria* zone.

Plesiotypes.—UW A10890a–c.

Genus LEIOCORYPHE Clark, 1924
LEIOCORYPHE sp. indet.
Pl. 64, fig. 1–3

Description.—Cranidium subhemispherical, highly convex, exfoliated but without a trace of any furrow, width greater than length but since posterior limbs are missing, the lateral extent of the cranidium in unknown. Posterior margin gently rounded, anterior margin semicircular. In longitudinal profile, the convexity of the cranidium increases posteriorly with the posterior margin of the cranidium vertical. In transverse profile the greatest convexity is along the median axis with the convexity decreasing toward the lateral margins. No trace of palpebral lobe.

Outer surface of test unknown; inner surface very finely punctate.

Locality and formation.—Steele Butte collection 32107/20B20, 10.5–10.6 feet below the top of the Park shale. *Cedaria* zone.

Figured specimen.—UW A10897.

Genus METEORASPIS Resser, 1935
METEORASPIS BOULDERENSIS DeLand, n. sp.
Pl. 63, fig. 18; Pl. 64, fig. 4–6

Description.—Cranidium subquadrate, length four-fifths width across posterior limbs. Glabella broadly conical, moderately convex, distinctly keeled, width at occipital ring slightly greater than length. Three pairs of shallow glabellar furrows, the posterior pair arcuate. Occipital furrow narrow and deep laterally, shallower on median line of glabella. Occipital ring narrow, convex, wider at axis than at extremities. Dorsal furrow narrow and deep, less deeply impressed in front of glabella. Preglabellar area about one-third glabellar length. Border twice as long at center as brim, moderately convex, arcuate. Brim sharply con-

vex, nearly vertical immediately behind deep marginal furrow. Two shallow pits within the marginal furrow in line with lateral dorsal furrows. Fixed cheeks about one-third width of glabella, moderately convex. Palpebral lobe of medium length, crescentiform. Palpebral furrow broad and deep. No trace of ocular ridge. Posterior limb almost as wide as occipital ring, triangular, depressed. Marginal furrow narrow and deep at junction with the dorsal furrow, becoming shallower laterally.

Facial suture appears to cut anterior margin about on line with dorsal furrow, moderately curved back to marginal furrow, then converges slightly to anterior corner of palpebral lobe, rounds palpebral lobe and curves gently out and back, curvature increases near lateral extremity to cut the posterior margin within the genal angle.

Outer surface finely granulated.

Free cheek, thorax and pygidium unknown.

Remarks.—This species differs from other described species of *Meteoraspis* in possessing a glabella which is wider than long and in the extremely narrow, nearly vertical brim; it is closely related to *M. keeganensis* Duncan, 1944, but differs in its stouter glabella.

Locality and formation.—Steele Butte collection 32107/20B19, 20.4–20.6 feet below the top of the Park shale. *Cedaria* zone.

Holotype.—UW A10891a.

Paratypes.—UW A10891b, A10895.

METEORASPIS ELONGATA Lochman, 1944
Pl. 64, fig. 9

Meteoraspis elongata LOCHMAN, 1944, in Lochman & Duncan, Geol. Soc. Am. Spec. Pap. 54, p. 98, pl. 9, fig. 4–7.

The original description is adequate, but the figured specimen displays the posterior limb for the first time.

Supplementary description.—Posterior limbs triangular, rather short, about three-fourths as wide as occipital ring, downsloping, nearly straight except for a faint upward flexure near the lateral extremity; posterior margin directed slightly backward laterally. Marginal furrow broad and deep.

Posterior to the palpebral lobe, the facial suture curves gently outward and backward, curvature increases toward the lateral extremity to give the posterior limb a sharply tapered appearance.

Remarks.—The single exfoliated cranidium belonging to this species has a suggestion of one pair of glabellar furrows represented by a flattening of the sides of the glabella opposite the posterior end of the palpebral lobe.

Locality and formation.—Steele Butte collection 32107/20B22, 2.7–4.2 feet below the top of the Park shale. *Cedaria* zone.

Figured specimen.—UW A10903.

METEORASPIS sp. indet.
Pl. 64, fig. 8

Description.—Glabella broadly conical, keeled, rounded anteriorly, no trace of glabellar furrows. Occipital furrow narrow and deep at sides. Occipital ring unknown. Dorsal furrow of medium width, deeper at sides than around anterior of glabella, complete. Brim about one-fourth length of glabella, slightly convex. Marginal furrow and border unknown. Fixed cheeks about one-fourth width of glabella, convex. Palpebral lobe medium length, slightly arcuate. Palpebral furrow medium width, well impressed. Ocular ridge broad, faint, obliquely directed toward a point well back of the anterior lateral corner of the glabella. Posterior limb triangular, depressed, about three-fourths as wide as glabella on same line, bears a broad, moderately well impressed marginal furrow. Surface of test covered with small irregularly spaced granules.

Remarks.—The proportions of the glabella and fixed cheeks resemble *M. elongata*, but because of the incompleteness of the single cranidium, specific identification is impossible.

Locality and formation.—Steele Butte collection 31207/20B20, 10.5–10.6 feet below the top of the Park shale. *Cedaria* zone

Figured specimen.—UW A10898.

Genus MODOCIA Walcott, 1924
MODOCIA CENTRALIS (Whitfield), 1877
Pl. 64, fig. 10

Modocia centralis (Whitfield). SHAW, 1956, Jour. Paleont., vol. 30, p. 141–144, fig. 1–4. Complete synonymy.

This species has been discussed by Shaw and a full synonymy given. Comparison of the present specimens with the data al-

ready presented shows that they belong in *M. centralis*.

Locality and formation.—Two cranidia from Steele Butte collection 32107/20B20, 10.5–10.6 feet below the top of the Park shale. *Cedaria* zone.

Plesiotypes.—UW A10896.

MODOCIA sp. indet.
Pl. 64, fig. 11

A single fragmentary cranidium is referred to the genus *Modocia*. It is probably *M. centralis*, but it is too fragmentary to permit measurement or comparison.

Locality and formation.—Steele Butte collection 32107/20B22, 2.7–4.2 feet below the top of the Park shale. *Cedaria* zone.

Figured specimen.—UW A10901.

Genus MONOCHEILUS Resser, 1937
MONOCHEILUS? sp. indet.
Pl. 67, fig. 2

Description.—Glabella slightly tapered, truncate anteriorly, bearing a median keel. Two pairs of shallow arcuate glabellar furrows of nearly equal length mark the middle third of the glabella. Dorsal furrows well impressed. Frontal limb convex, slightly downsloping, only slightly wider than the glabella; no distinguishable brim or border. Fixed cheeks apparently narrow. Palpebral lobes not preserved, but their roots suggest that they were rather long, somewhat over half the glabellar length. Surface apparently smooth. Other features unknown.

Remarks.—A single cranidial fragment could be assigned either to *Monocheilus* or to *Stigmacephalus*, for the distinctive palpebral lobes and posterior limbs are not preserved, but the poorly preserved inner edges of the free cheeks suggest long eyes like those of *Monocheilus*. The identification is extremely doubtful. Regardless of the generic assignment the specimen appears to represent a new species, for none of the species of either genus has such well developed glabellar furrows as this individual. No name is proposed, however, pending discovery of better preserved material.

Locality and formation.—Sweetwater Canyon collection 2997/27A12, 83.5–84.0 feet above the base of the Open Door limestone. *Ptychaspis-Prosaukia* zone.

Plesiotype.—UW A11201.

Genus TAENICEPHALUS Ulrich & Resser, 1924
TAENICEPHALUS CORDILLERENSIS Miller, 1936
Pl. 67, fig. 3,4

Taenicephalus cordillerensis MILLER, 1936, Jour. Paleont., vol. 10, p. 33–34, pl. 8, fig. 40, 41.
Taenicephalus cordillerensis Miller. RESSER 1942, Smithsonian Misc. Coll., vol. 103, no. 5, p. 101, pl. 19, fig. 33.
Taenicephalus holmesi RESSER, 1942, op. cit., p. 100, pl. 19, fig. 24–27.
Taenicephalus speciosus RESSER, 1942, loc. cit., pl. 20, fig. 19.
Taenicephalus wyomingensis RESSER, 1942, op. cit., p. 106–107, pl. 21, fig. 32.

Miller's original description of the cranidium is adequate.

Supplementary description.—Pygidium transverse, length about two-fifths width. Axis broad, slightly tapered, extends nearly full length of pygidium; four axial rings and a posterior segment separated by wide, deep furrows. Dorsal furrow wide and well defined. Pleural lobe triangular, convex, slightly downsloping at dorsal furrow, steeply deflexed at lateral extremities; the three segments do not extend onto narrow concave border. Interpleural grooves wide and deep. Marginal furrow absent, its position indicated only by a change in convexity.

Outer surface minutely granulated.

Remarks.—Resser has named several new species of *Taenicephalus* from Wyoming; these appear to be synonymous with *T. cordillerensis* in our present interpretation of the species. *T. holmesi* was characterized by bowed palpebral lobes and equal brim and border while *T. wyomingensis* had lower eyes and the brim longer than the border. These differences seem to be due to flattening of *T. wyomingensis*, which depressed the palpebral lobes and extended the frontal area. *T. speciosus* is based on a larger cranidium than the others and the distinctive features are those of *T. wyomingensis*. All of the characteristics mentioned by Resser can be regarded as due to preservation and not of taxonomic importance.

Locality and formation.—Four fragmentary cranidia and one incomplete pygidium are present in collection 2997/27A11, 53.4–54.0 feet above the base of the Open Door limestone at Sweetwater Canyon (UW

A10934). A single fragmentary cranidium which is tentatively assigned to this species occurs in collection 2997/34A1, 80.3–80.7 feet above the base of the Open Door limestone (UW A10933). *Conaspis* zone.

Plesiotypes.—UW A10933, A10934a–e.

Genus XENOCHEILOS Wilson, 1949
XENOCHEILOS cf. X. SPINEUM Wilson, 1951
Pl. 65, fig. 4,6,13

Xenocheilos spineum WILSON, 1951, Jour. Paleont., vol. 25, p. 649, pl. 95, fig. 15–17.

Description.—Cranidium quadrate, moderately convex. Glabella subcylindrical, width about 7/10 length, very slightly tapered anteriorly, broadly keeled, anterior smoothly rounded; no glabellar furrows. Occipital furrow of moderate width, deep, V-shaped, wider and directed forward at lateral extremities. Occipital ring convex, tapered laterally, stands above posterior portion of glabella, bears a low central node. Dorsal furrow wide, deep, and V-shaped except at postero-lateral corners and around anterior end of glabella where it is broad and shallow. Brim very gently convex and slightly downsloping, three times as long as the concave, arcuate border; marginal furrow indicated by change in convexity only. Fixed cheeks convex and upsloping which gives the glabella a sunken appearance. Width of fixed cheek and palpebral lobe unknown. Ocular ridge faint, at antero-lateral corner of glabella nearly normal to longitiudinal axis. Posterior limb depressed laterally and posteriorly, margins unknown. Marginal furrow deeper than any part of the dorsal furrow.

Facial suture appears to cut anterior margin well out from the center, curves sharply about antero-lateral corner of cranidium and is directed nearly straight back to anterior end of palpebral lobe. Further course unknown.

Outer surface of test smooth.

Free cheeks, thorax and pygidium unknown.

Remarks.—A single incomplete cranidium, 2.0 mm. long, closely resembles *Xenocheilos spineum* in proportions and convexity, but differs in the following respects:

(1) *X. spineum* has three pairs of glabellar furrows of which two pairs are usually visible. No furrows were observed on this cranidium.
(2) On *X. spineum* the anterior dorsal furrow is deeper than the posterior portion. On this specimen the anterior dorsal furrow is shallower.
(3) The ocular ridge is prominent on *X. spineum*, but it is faint on the figured head.

These differences might all be within the range of intraspecific variation. Only the collection of a number of specimens could establish whether a new species is warranted or not.

Locality and formation.—Sweetwater Canyon collection 2997/27A10, 1.0–1.5 feet above the base of the Open Door limestone. *Elvinia* zone.

Figured specimen.—UW A10924.

Genus and species undetermined
Cranidium A
Pl. 64, fig. 7

Description.—Glabella conical, abruptly tapered, length about equal to width at occipital furrow, gently convex anterior smoothly rounded; in longitudinal profile, posterior half flat, anterior gently convex; no glabellar furrows. Occipital furrow of medium width, shallow over axis of glabella, more deeply impressed at sides. Occipital ring broad, flat, bearing a median node. Dorsal furrow narrow and deep, less deeply impressed anteriorly. Brim nearly horizontal, very slightly convex. Relative length of brim unknown as are the features of the marginal furrow and border. Fixed cheeks flat, sharply upsloping from the dorsal furrow; width at anterior end of eye about three-fifths width of glabella, palpebral lobes about one-third the length of the glabella, gently curved, situated slightly posterior to glabellar median line and in the same horizontal plane as the crest of the glabella. Palpebral furrows faint. Broad ocular ridge directed obliquely from anterior end of palpebral lobe to antero-lateral corner of glabella. Extent of posterior limb unknown. Posterior margin directed slightly backward and gently downward. Marginal furrow deep and narrow.

Remarks.—This species, represented by a single fragmentary cranidium, appears to be

closely related to the genus *Bolaspidella* but differs from the genotype primarily in possessing narrower fixed cheeks. It may possess affinities to—"a *Deissella*-like genus"—mentioned by Howell & Duncan (1939, p. 3,4) as present in the lowermost Upper Cambrian of the Big Snowy Mountains, Montana. *Deissella* is considered congeneric with *Bolaspidella* by the present writers.

Locality and formation.—Steele Butte collection 32107/20B15, 44.0–44.4 feet below the top of the Park shale. *Cedaria* zone.

Figured specimen.—UW A10889.

Cranidium B
Pl. 67, fig. 7,8

Description.—Glabella quadrate, nearly as wide as long, very slightly tapered anteriorly, highly convex laterally, less so longitudinally, broadly rounded anteriorly. One pair of glabellar furrows, nearly straight, short, appear as triangular notches on the near vertical sides of the glabella. Occipital furrow broad and shallow axially, deeper and directed forward laterally. Occipital ring wide, convex, directed forward laterally but maintains equal length throughout. Dorsal furrow broad and deep at sides of glabella, less deeply impressed anteriorly. Brim, nearly horizontal immediately anterior to glabella, turning down abruptly to near vertical position. Marginal furrow and border unknown. Fixed cheeks unknown. Posterior limb about one-fifth wider than occipital ring, depressed posteriorly, bears a broad, straight, shallow marginal furrow.

Outer surface very finely granulated.

Free cheeks, thorax and pygidium unknown.

Remarks.—This species is represented by a single fragmentary cranidium. It resembles *Ptychaspis*, but the glabellar furrows of this specimen do not form transverse lobes as in *Ptychaspis*.

Locality and formation.—Sweetwater Canyon collection 2997/27A14, 184.0–185.0 feet above the base of the Open Door limestone. Trempealeauan, but faunal zone unknown.

Plesiotype.—UW A10931.

Cranidium C
Pl. 67, fig. 11–13

Description.—Cranidium subquadrate, nearly smooth, moderately convex, length about three-fourths width across palpebral lobes. In transverse profile cranidium is smoothly convex. In longitudinal profile the cranidium is regularly convex. Glabella very slightly raised above fixed cheeks, tapered, anterior margin undifferentiated; no glabellar furrows. Occipital furrow wide and shallow on inner surface of test. Occipital ring low, about as long as width of occipital furrow, apparently untapered. Dorsal furrow wide and shallow, not observable on anterior one-third of glabella. Preglabellar area not differentiated from glabella. Fixed cheeks about one-third the width of the glabella, continuing the glabellar convexity; palpebral lobes moderate in size, curved, situated slightly anterior to transverse median line of cranidium, palpebral furrow faint, no ocular ridge. Outer end of posterior limbs unknown, apparently strap-like; marginal furrow wide and shallow.

Outer surface of test smooth.

Free cheeks, thorax and pygidium unknown.

Locality and formation.—Four fragmentary cranidia from Sweetwater Canyon collection 2997/27A14, 184.0–185.0 feet above the base of the Open Door limestone. Trempealeauan, but faunal zone unknown.

Plesiotypes.—UW A10935a–d.

Pygidium A
Pl. 64, fig. 17,18

Description.—Pygidium transversely ovate, length three-fifths width, maximum width on a transverse line immediately posterior to axial lobe. Axis high, cylindrical, width three-fourths length, first two axial segments well defined by broad, deep furrows, third segment faintly demarcated from terminal segment. Dorsal furrow broad and shallow on outer surface of test but present only at sides. Pleural platform slightly convex, downsloping, three and possibly four segments separated by broad shallow pleural furrows, first furrow most deeply impressed. Border smooth, gently concave, nearly horizontal at margins, indented at posterior axial margin. Position of marginal furrow indicated on outer surface of test only by change in convexity.

Outer surface covered with minute granules.

Remarks.—A single, nearly complete specimen with the axial lobe exfoliated represents this species. Lacking associated cranidia, it cannot be referred with certainty to any genus although it resembles some species of such genera as *Uncaspis* or *Coosella* or some of the pygidia described from the Levis conglomerate by Rasetti.

Locality and formation.—Steele Butte collection 32107/20B14, 48.2–47.8 feet below the top of the Park shale. *Cedaria* zone.

Figured specimen.—UW A10886.

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MANUSCRIPT RECEIVED JULY 13, 1955.

EXPLANATION OF PLATE 67

FIG. *1*—*Ellipsocephaloides* sp. indet. Unique cranidium. Width of glabella in front of occipital furrow 1.3 mm. UW A10932. Loc. 2997/34A2. (p. 554)

2—*Monocheilus?* sp. indet. and *Idahoia* sp. indet. Slab with fragmentary cranidia. ×1.1. UW A11201. Loc. 2997/27A12. (p. 557 & 555)

3,4—*Taenicephalus cordillerensis* Miller, 1936. *3*, Cranidium. Length of glabella, excluding occipital ring, 3.7 mm. UW A10934b. *4*, Assigned pygidium. Length (sag.) 4.1 mm. UW A10934c. Loc. 2997/27A11. (p. 559)

5—*Coosia dakotensis* Resser, 1942. Unique cranidium. ×1. UW A10905. Loc. 32017/20B23. (p. 551)

6—*Coosia connata* (Walcott), 1890? Fragment of cranidium. ×3½. UW A10906. Loc. 32107/20B23. (p. 551)

7,8—Cranidium B. Dorsal and antero-lateral oblique views of unique cranidial fragment. Sagittal length 4.2 mm. UW 10931. Loc. 2997/27A14. (p. 561)

9,10—*Elvinia* sp. indet. *9*, Dorsal view of clay squeeze of cranidial fragment. ×1. UW A10915. Loc. 39113/5A5. *10*, Pygidium. ×1. UW A10907a. Loc. 32107/20B24. (p. 554)

11–13—Cranidium C. Three views of best cranidium. Length 5.0 mm. UW A10935d. Loc. 2997/27A14. (p. 561)

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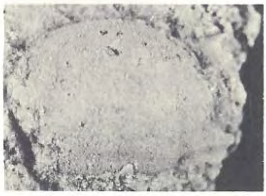
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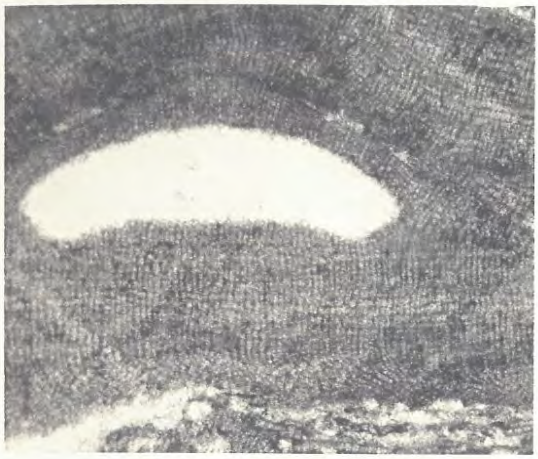

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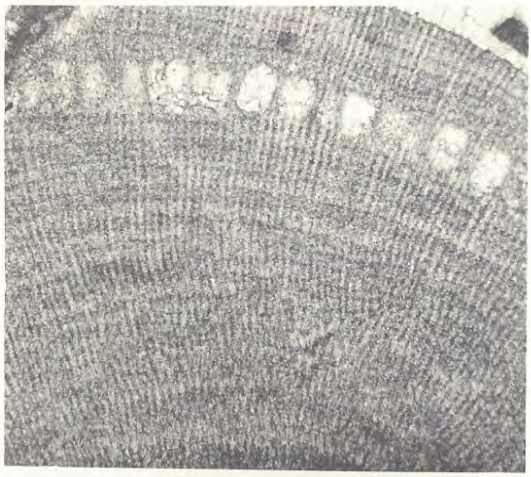

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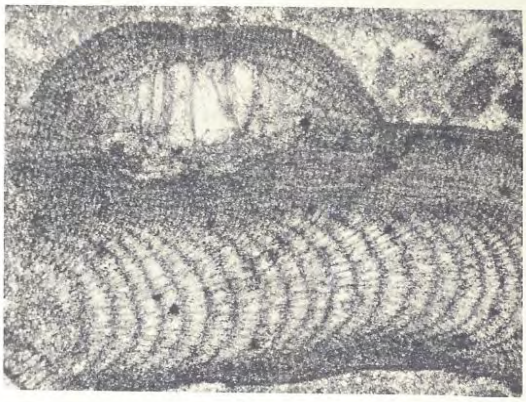

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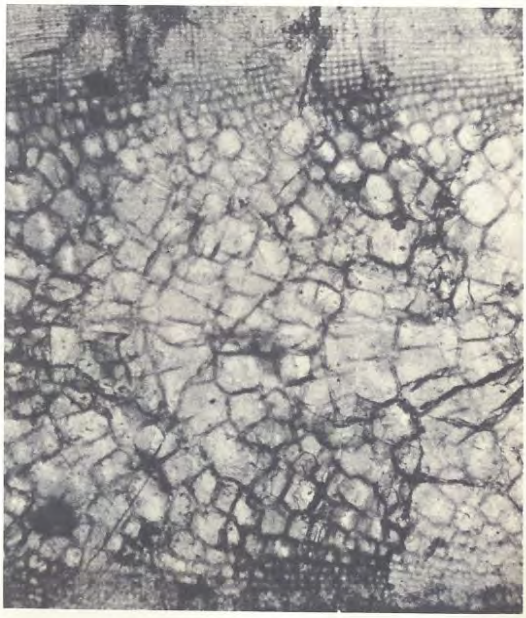

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