SMITHSONIAN MISCELLANEOUS COLLECTIONS
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NEW UPPER CAMBRIAN TRILOBITES

(With 21 Plates)

BY
CHARLES E. RESSER
Curator, Division of Invertebrate Paleontology and Paleobotany
U. S. National Museum

(Publication 3693)

CITY OF WASHINGTON
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INTRODUCTION

Soon after 1878 when Dr. C. D. Walcott centered his main efforts on the study of the Cambrian system, he conceived the idea of a monograph series, each of which should contain descriptions of all Cambrian fossils representing a major animal group. With this in mind he published new genera from time to time, frequently accompanied by descriptions of only one species, because the others were left for the monograph. Thus, for example, brachiopod genera were established and in 1912 the monograph of this group appeared. Likewise trilobite genera were described with the view of producing such a monograph in due course. For this reason practically all the genera then known from the older beds were described in 1891.[1]

By 1920 it was clear that a monograph by him on Cambrian trilobites, like that on the brachiopods, was not feasible. Nevertheless he continued segregating specimens and in 1924 and 1925 published more generic descriptions.[2] In the two years remaining before his death in 1927 Dr. Walcott set aside some of the specimens here presented, and less than 2 weeks before his passing he urged me to carry on and describe species as rapidly as possible so that they would become available for use.

Since 1925 there has been increased activity in the study of Cambrian geology. Numerous papers describing many new genera have

[1] Walcott, C. D.:
1891. Fauna of the Lower Cambrian or *Olenellus* zone. 10th Ann. Rep. U. S. Geol. Surv. 1891, pp. 507-774.
1916. Cambrian trilobites. Smithsonian Misc. Coll., vol. 64, No. 3, pp. 157-258, pls. 24-38.
1916. Cambrian trilobites. Ibid., vol. 64, No. 5, pp. 303-456, pls. 45-67.

[2] Walcott, C. D.:
1924. Cambrian and Lower Ozarkian trilobites. Smithsonian Misc. Coll., vol. 75, No. 2, pp. 53-60, pls. 9-14.
1925. Cambrian and Ozarkian trilobites. Ibid., vol. 75, No. 3, pp. 61-146, pls. 15-24.

appeared, but in most cases they also included only one or two species in addition to the genotype. This situation leaves many of the genera inadequately portrayed and also fails to make available the species needed for stratigraphic purposes. Hundreds of undescribed species contained in the National Museum collections need to be described, both to improve the concept of genera and to supply species for stratigraphic work. Many of them cannot appropriately be included in faunal or regional studies and are therefore best described in papers of this type.

Only a few of the genera represented by species described in this paper can be referred to higher taxonomic categories. It would be a simple matter to assign old family names or apply new ones to genera that bear superficial resemblances to one another, but such action would perpetuate existing errors and introduce new ones. Trilobites cannot yet be satisfactorily classified, and to attempt to do so merely adds to the confusion now existing.

DESCRIPTION OF GENERA AND SPECIES

KOMASPIDAE Kobayashi, 1935

Kobayashi established this family to include *Komaspis* Kobayashi, *Chariocephalus* Hall, *Irvingella* Ulrich and Resser, *Irvingelloides* Kobayashi, and *Bathynotus* Hall. Komaspidae was a poor selection as the family name, for both *Chariocephalus* and *Irvingella* are far more characteristic of the family than the obscure *Komaspis*. More than 50 species of *Chariocephalus* and *Irvingella* now studied show that the genotype of *Chariocephalus* is nowhere near the median point of the generic limits, and that *Chariocephalus, Irvingella,* and several other genera intergrade to the extent that arbitrary lines of separation must be drawn. No question regarding family relationships of these two genera can be raised, but there is no certainty that they belong with *Komaspis*.

Why Kobayashi should have assigned *Bathynotus* to this family, even tentatively, is difficult to understand. It was evidently done because of its large eyes, but there is not the remotest relationship with the Komaspidae expressed thereby.

In 1938 Kobayashi added *Dartonaspis* Miller to the family, at the same time erecting two subgenera, *Irvingellina* and *Parairvingella,* which are discussed on a later page. Also, he added the genus *Komaspidella* based on *Agraulos* (*?*) *thea* Walcott. The latter species, however, is a *Kingstonia* and therefore belongs in a different family. The type of *Dartonaspis* belongs to *Chariocephalus,* and hence this name becomes a synonym.

On the other hand the subgenus *Parairvingella,* based on *Chariocephalus (?) tumifrons* Walcott (not Hall and Whitfield) deserves generic rank. Kobayashi's other subgenus *Irvingellina* based on Hall and Whitfield's species falls in *Irvingella,* as subsequently discussed.

It is doubtful whether *Irvingelloides,* which is based on a single incomplete cranidium, belongs in the family. The new genus, *Drumaspis,* is added to the family Komaspidae.

The family Komaspidae is characterized by a large, more or less quadrate glabella which extends almost the full length of the cranidium. Occipital furrow is deep and wide, and three pairs of glabellar furrows are usually developed. The real pair, generally deep, may or may not be interrupted in the center, and the next pair, if visible, consists of short lateral indentations while the anterior pair is always faint and situated far forward. Fixigenes essentially confined to palpebral lobes. Brim narrow, usually simple, but may have a narrow rim. Eyes large, in some species longer than the glabella. Libragenes usually rather narrow. Pygidium has a wide well-segmented axis; pleural lobes fused, pleural furrows deep. Border flattened or concave.

I recently discussed the relation of *Chariocephalus* and *Irvingella,* but now that many more species are determined, further remarks will be in order. As the matter now stands this family contains the following genera.

Komaspis Kobayashi, 1935

Glabella subconical; brim concave with slight rim; eyes moderate in length; anterior fixigenes developed.

Middle Cambrian, Asia.

Chariocephalus Hall, 1863

Glabella quadrate or expanded slightly forward; brim a simple bar; eyes moderately to extremely long; libragenes large; anterior fixigenes reduced or absent.

Upper Cambrian (upper Franconia zones), North America.

Irvingella Ulrich and Resser, 1924

Glabella quadrate to subconical; eyes always large; anterior fixigenes present; brim simple or slightly rimmed; libragenes very narrow; pygidium like *Chariocephalus.*

Upper Cambrian (lower and middle Franconia zones), North America.

Parairvingella Kobayashi, 1938

Glabella subconical to quadrate; eyes moderately large; brim concave, with rim and preglabellar area; anterior fixigenes present.

Upper Cambrian (Franconia zones), Nevada and Novaya Zemlya.

Drumaspis, new genus (genotype, D. walcotti, new species)

Glabella quadrate or subconical; eyes smallest in family; brim always has well-developed rim; anterior fixigenes very narrow, relatively wide rearward.

Upper Cambrian (middle Franconia zones), North America.

CHARIOCEPHALUS HALL, 1863

Chariocephalus HALL, 16th Ann. Rep. New York State Cab. Nat. Hist., p. 175, 1863; Trans. Albany Inst., vol. 5, p. 165, 1867.—ZITTEL, Handbook Pal., Bd. 2, p. 603, Munich, 1885.—MILLER, N. A. Geol. Pal., p. 538, 1889.—GRABAU and SHIMER, N. A. Index Foss., vol. 2, p. 279, 1910.—RESSER, Smithsonian Misc. Coll., vol. 97, No. 10, p. 28, 1938.

Dartonaspis MILLER, Journ. Pal., vol. 10, No. 1, p. 29, 1936.

Now that a large number of species is available, the distinction between *Chariocephalus* and *Irvingella* disappears, for the gap between the genotypes is bridged by a series of species, so that it becomes necessary to draw an arbitrary line of separation. As the line has been drawn in this paper, *Chariocephalus* occupies a slightly higher stratigraphic position than *Irvingella,* and thus far the two genera have not been found together at any locality. The stratigraphic position of *Chariocephalus* seems to be in the beds of upper Franconia age.

In view of the arbitrary separation now necessary between *Chariocephalus* and *Irvingella,* a new generic diagnosis is presented, taking into account the features added by study of the many additional species. It will be noted that the relative size and position of the eye has become a less diagnostic criterion.

Chariocephalus is characterized by its very large, essentially quadrate glabella that occupies nearly the full cranidial length. It may be slightly expanded forward, and in rare instances constricted near the midpoint. Anterior angles are usually well rounded, and the front outline may be gently curved, straight, or even slightly indented. If present on the outer surface, the glabellar furrows are wide and shallow, but most exfoliated specimens show three pairs of prominent furrows. The rear pair may be united but usually is interrupted. If present, the third pair is situated so far forward that the short depressions arise from the rounded anterior angles. Dorsal furrow usually deep and wide even on the outer surface. A wide occipital furrow is

apparently visible on most unexfoliated cranidia. Occipital ring heavy and of nearly even width throughout. Brim consists of a simple bar of even width throughout, and never as long as the glabella is wide. It may be somewhat thickened and has various attitudes with respect to the horizontal plane. Eyes always very large, strongly bowed, and set off by a clearly defined palpebral furrow. Fixigenes confined to the large palpebral lobes between the eyes and dorsal furrow. Because the eyes usually extend far forward, they continue part way around the anterior angles. At the rear they may extend behind the ends of the occipital furrow, but if not, only very narrow and short posterolateral limbs are formed.

Libragenes narrow and long. Ocular platform narrow, long, and curved somewhat less than the eye. Outer rim usually clearly defined, increasing in width toward the genal angle. Genal spines present. They vary from short to long slender spines several times the cranidial length. They are usually directed outward at a considerable angle to the axis. Some Wisconsin species, however, appear to have long curved genal spines which cross over the thorax to the extent that their outer extremities overlap.

Hypostoma nearly circular in outline, large, and characterized by a large central lobe. The alate portions are upturned toward the edges.

Pygidium ovate, with about half the area of the cranidium. The well-segmented axis is wide and long but tapers little. From two to four rings are defined and the terminal lobe may have faint impressions of others. The pleural platforms are convex, usually less than half the axial width at the same point, and drop off into a narrow flattened border.

Surface smooth.

Genotype.—C. whitfieldi Hall.

The fragment described by Raymond as *Chariocephalus peloris* (Bull. Geol. Soc. Amer., vol. 48, No. 8, p. 1119, pl. 3, fig. 12, 1937) is excluded from the genus by its small eye, and the direction and depth of the glabellar furrows.

As stated above, Kobayashi's *Irvingella* (*Irvingellina*) *protuberans* (Jap. Journ. Geol. Geogr., vol. 5, Nos. 3-4, p. 176, pl. 15, figs. 1*a-c*, 2, 1938) falls into *Chariocephalus*.

CHARIOCEPHALUS TENERUS, new species

PLATE 1, FIGURES 1-3

This moderately small species, represented by a single almost entirely exfoliated cranidium, is the only example of the genus found in this collection.

The glabella is slightly expanded and the anterior angles are rounded off. Because it is exfoliated, the three pairs of furrows show clearly, the wide posterior pair continuing across the glabella. On the test this glabellar furrow is very shallow and possibly interrupted in the middle. The brim is of moderate width and slightly upturned. Exclusive of the wide dorsal furrow the palpebral lobes, which also are the fixigenes, are nearly half the width of the glabella and maintain most of their width to the occipital furrow. The eyes measured in a straight line from end to end are almost as long as the glabella and, of course, measured around their outer edge are longer than that. The eyes extend from the occipital furrow to a point about one-sixth the width of the glabella beyond the lateral dorsal furrow. This leaves a narrow fixigene slightly exceeding the width of the eye band at the forward end of the eye. The glabella is rather evenly convex both laterally and longitudinally, with a moderate curvature. As can be seen in the front view, the libragenes are rather sharply and evenly curved, first rising considerably above the bottom of the dorsal furrow.

Honey Creek limestone; (loc. 37t) 4 miles southeast of Hennepin, Arbuckle Mountains, Oklahoma.

Holotype.—U.S.N.M. No. 108631.

CHARIOCEPHALUS BELLUS, new species

PLATE 1, FIGURES 4-6

This species, represented by cranidia only, is associated with *C. bulla*.

C. bellus is characterized by its quadrate glabella. Although the front of the glabella and the anterior angles have the aspect of a quadrate form, the illustration shows that both are definitely rounded. In addition to the occipital furrow, there are the usual three pairs of glabellar furrows, the posterior pair being connected across the middle by a faint depression while the anterior pairs are very shallow throughout. Brim convex and turned down slightly. The fixigenes at their widest point are about one-third the width of the glabella. The exceedingly long eyes extend forward well beyond the lateral dorsal furrow. The glabella is evenly convex laterally. It is highly convex longitudinally, the curvature being concentrated in the forward third. The fixigenes are only slightly curved in cross section and slope down from the relatively shallow dorsal furrow at about the same angle as the lateral slopes of the glabella. Surface punctate.

Honey Creek limestone; (loc. 37v) West Timbered Hills, Arbuckle Mountains, Oklahoma.

Holotype.—U.S.N.M. No. 108632.

CHARIOCEPHALUS BULLA, new species

PLATE 1, FIGURES 7-11

Several cranidia and a pygidium are placed in this moderate-sized species. *C. bulla* is a large-eyed form and hence resembles *C. bellus* and *C. tenerus*.

The glabella is essentially quadrate, with rather strongly marked furrows on the exfoliated holotype. The anterior outline is nearly straight between the broadly rounded anterior corners, and the narrow brim is only slightly thickened. Fixigenes are confined to the palpebral lobes and at their widest point are a little less than half the width of the glabella. The long eyes do not reach the posterior furrow, and in front, they end exactly at the outer edge of the dorsal furrow, and hence are relatively shorter than in *C. bellus* or *C. tenerus*. The glabella is convex laterally with the greatest curvature near the dorsal furrow. Longitudinally the greatest curvature is toward the anterior end. Fixigenes are considerably curved and slope downward from the moderately deep dorsal furrow. The pygidium is somewhat narrow and rather convex, with the axis standing wholly above the pleural lobes. As a whole the pygidium slopes rearward at a moderate rate, terminating with an abrupt slope. In fact, the rear end of the axis slightly overhangs the border. The pleural lobes form triangular platforms that drop off to the slightly flattened border, which becomes rather narrow at the rear of the axis.

Honey Creek limestone; (loc. 37v) West Timbered Hills, Arbuckle Mountains, Oklahoma.

Holotype.—U.S.N.M. No. 108633a; paratype, No. 108633b.

CHARIOCEPHALUS TERES, new species

PLATE 1, FIGURES 12, 13

This large-eyed species, resembling *C. tenerus*, is represented by a few cranidia, none of which is complete. The illustrated holotype is partially exfoliated and the anterior portion of the glabella abraded.

The glabella is somewhat ovate, owing more to the rounded front margin and rounded anterior angles than to the slight constriction toward the rear. The furrows are developed normally but may be fainter than the average species from the region. Incomplete preservation prevents an exact description of the brim but it seems to be wide and slightly upturned, though not thickened. The fixigenes are nearly half the width of the glabella. Eyes are very long, extending from the occipital furrow well beyond the lateral course of the facial suture, and therefore exceed the glabella in length. Surface punctate.

Honey Creek limestone; (loc. 37v) West Timbered Hills, Arbuckle Mountains, Oklahoma.

Holotype.—U.S.N.M. No. 108634.

CHARIOCEPHALUS AFFINIS, new species

PLATE 1, FIGURES 14-20

This species, represented by a number of examples of all parts, is perhaps most closely allied to *C. bulla*.

The glabella is well rounded at the anterior angles, but has parallel sides and only two pairs of furrows. It is convex, having an even curvature laterally, but longitudinally its greatest curvature is in the anterior third. The nearly flat fixigenes, a little more than a third the width of the glabella at their widest point, slant downward from the shallow dorsal furrow at a smaller angle than the lateral slope of the glabella. The eyes are long, extending forward beyond the lateral dorsal furrow. An associated libragene and a pygidium are assigned to this species. The pygidium is transverse and the axis does not rise wholly above the pleural lobes. The pleural lobes form very narrow platforms, which are elongate rather than triangular, and which slope into a broad concave border with a thickened, slightly upturned rim.

Honey Creek limestone; (loc. 37u) West Timbered Hills, Arbuckle Mountains, Oklahoma.

Cotypes.—U.S.N.M. Nos. 108635a-c.

CHARIOCEPHALUS AGRARIUS, new species

PLATE 1, FIGURES 21-28

In present collections this moderately large-eyed form is the most common *Chariocephalus* species at the locality. It is represented by all cranidial parts and the pygidium.

The wide glabella expands only slightly, standing entirely above the fixigenes. It is very convex laterally, with a slightly flattened profile. Longitudinally it is also strongly convex, with the greatest amount of curvature in the front half. The front outline is rounded, and the dorsal furrow is relatively shallow. The brim is very slightly thickened and is turned up to a nearly horizontal position. The fixigenes at their widest point are nearly half the width of the glabella. The eyes extend from a short distance forward of the occipital furrow to the dorsal furrow. Exfoliated specimens show normal depth for glabellar furrows. The fixigenes are only slightly convex and slope down from the rather broad and shallow dorsal furrow. Distinct pits are developed at the anterior angles in the dorsal furrow. The libra-

gene selected for this species is of ordinary shape and dimensions. The rarely found hypostoma is here preserved. It is characterized by a tumid central lobe and a relatively narrow upturned alate portion.

The pygidium assigned to the species has a wide axis with three well-defined rings, and stands completely above the pleural platforms. Pleural lobes form an elongate platform which slopes abruptly to the horizontal, slightly thickened border.

Honey Creek limestone; (loc. 37v) West Timbered Hills, Arbuckle Mountains, Oklahoma.

Holotype.—U.S.N.M. No. 108636a; paratypes, Nos. 108636b-e.

CHARIOCEPHALUS ANGUSTATUS, new species

PLATE 1, FIGURES 35-40

This is one of the smaller species and in several respects approaches closer to the genotype than most Oklahoma forms. It is represented by several cranidia, together with a pygidium assigned to it.

The slightly expanded glabella is rather long and has three pairs of furrows visible. It is highly arched transversely. Longitudinally it stands completely above the fixigenes, but the convexity in that direction is confined almost entirely to the anterior fourth. The occipital furrow is exceptionally wide and deep. The brim consists of a simple bar. Pits are present at the anterior angles in the dorsal furrow, which is wide but not as deep as usual. The fixigenes are considerably less than half the glabellar width, and are flatly convex, as a whole sloping only slightly downward from the dorsal furrow. Rather long eyes are bowed most strongly anterior to the middle of the glabella, which causes the species to have the aspect of the genotype.

The associated pygidium assigned to the species has a moderately high axis and relatively narrow pleural platform. The border is also relatively narrow with slightly thickened edge.

Honey Creek limestone; (loc. 37v) West Timbered Hills, Arbuckle Mountains, Oklahoma.

Holotype.—U.S.N.M. No. 108637a; paratype, No. 108637b.

CHARIOCEPHALUS GRACILENS, new species

PLATE 1, FIGURES 29-31

This is the smallest species in the Wichita Mountains collections, and as far as brim structure is concerned conforms rather closely to the genotype.

The glabella is quadrate, being rounded slightly at the anterior corners. The dorsal furrow is wide and rather deep and has pits at the anterior angles. The occipital furrow is wide and deep, but the glabellar furrows are faint, the rear pair showing only as faint depressions. The fixigenes are slightly less than half the width of the glabella. The eyes extend far forward, terminating about a half millimeter behind the dorsal furrow pits. The brim consists of a slightly thickened narrow bar.

Honey Creek limestone (*Ptychaspis* beds) ; (loc. 9y) 2 miles southeast of Canyon Creek, Wichita Mountains, Oklahoma.

Holotype.—U.S.N.M. No. 108638.

CHARIOCEPHALUS MONTIS, new species

PLATE 1, FIGURES 32-34

Only a few cranidia of this small species have been located.

The glabella is practically rectangular in outline with the anterior corners rounded. In the exfoliated holotype the furrows are so shallow that they presumably did not show on the exterior surface. The brim consists of a rather stout, slightly thickened bar. The dorsal furrow is wide and fairly deep. The fixigenes at their widest point are a little more than one-third the glabellar width, while the anterior fixigenes are about as wide as the eye band. The eyes are very long, extending from the occipital furrow to a point beyond the sides of the glabella, and are highly bowed with a fairly even curvature. The glabella is rather evenly curved laterally, and longitudinally the rate of curvature increases from the rear pair of the glabellar furrows forward. The fixigenes are rather flat, sloping slightly downward from the dorsal furrow.

Honey Creek limestone (*Ptychaspis* beds) ; (loc. 91q) 8 miles southeast of Mountain View, Wichita Mountains, Oklahoma.

Holotype.—U.S.N.M. No. 108639.

CHARIOCEPHALUS WICHITAENSIS, new species

PLATE 2, FIGURES 1-8

This is one of the larger species and is represented by several cranidia and other parts. The cranidium expands slightly and is rounded at the anterior corners to the straight front outline. In fact, the front of the glabella is slightly indented. The occipital furrow is deep, but only the rear pair of glabellar furrows shows on the exterior, while the other two pairs are faint on exfoliated specimens. The glabella stands above the level of the fixigenes and its convexity laterally is produced by a gently curving top and relatively steeply

sloping sides. Longitudinally the moderate convexity is practically confined to the anterior lobe. The brim consists of a narrow band in a slightly upturned position. The fixigenes at their widest point are about half the width of the glabella and the long eyes have a nearly circular curvature. They extend forward to the dorsal furrow and back practically to the occipital furrow. The narrow libragene has a long, slender, straight genal spine which extends outward at a considerable angle to the axis. The pygidium is characterized by a wide tapering axis with three rings and terminal segment. Fusion has not entirely eliminated the pleural grooves. Pleural platforms narrow because of the long slope to the marginal furrow.

Honey Creek limestone (*Ptychaspis* beds); (loc. 91q) 8 miles southeast of Mountain View, Wichita Mountains, Oklahoma.

Holotype.—U.S.N.M. No. 108640a; paratypes, Nos. 108640b-e.

CHARIOCEPHALUS ULRICHI, new species

PLATE 2, FIGURES 9-14

This is another large and well-represented species, similar to *C. wichitaensis*. It fact the two are so similar that a formal description of this species is not needed. *C. ulrichi* differs in several respects, the most notable of which are the presence of a narrow anterior fixigene and greater curvature of the eyes so that the rear portion of the fixigene is relatively more contracted. The increased curvature of the eye is accompanied by a slightly greater relative width of the palpebral lobe making it equal to half the glabellar width.

The associated pygidium of *C. ulrichi* differs considerably from the others found in Oklahoma. Its axis slopes rearward into the dorsal furrow, which grows more shallow in the same direction, so that the rear portion of the axis merges into the pleural lobes. The whole pygidium slopes in all directions from the median point of the anterior axial segment.

Honey Creek limestone (*Ptychaspis* beds); (loc. 9y) 2 miles southeast of Canyon Creek, Wichita Mountains, Oklahoma.

Holotype.—U.S.N.M. No. 108641a; paratypes, Nos. 108641b-d.

CHARIOCEPHALUS MAGNUS, new species

PLATE 2, FIGURES 15-17; PLATE 12, FIGURE 13

This beautiful, large species is represented by the complete holotype and several imperfect cranidia.

The quadrate glabella is slightly constricted in its middle portion. It stands well above the fixigenes and is convex laterally, with a circular profile. Longitudinally the considerable convexity is confined

to the anterior third. The brim is not well preserved, but apparently narrow, with a slightly upturned edge. Fixigenes, confined to the palpebral lobes, at their widest point are less than half the width of the glabella. Anterior fixigenes wanting. The eye, with a nearly circular curvature, extends forward to the dorsal furrow. The palpebral lobes are flat for most of their width, but at the outer margins turn down very sharply so that their anterior portions actually bulge over the eye band. Dorsal furrow wide and deep on exfoliated cranidia, while the first pair of glabellar furrows are wide but shallow. Test smooth. Where partially exfoliated, the remaining thin portion of the test is finely punctate.

Lyell formation; (loc. 20j) Tilted Mountain Brook, 9½ miles east of Lake Louise, Alberta.

Holotype.—U.S.N.M. No. 108642.

CHARIOCEPHALUS BADGERENSIS, new species

PLATE 2, FIGURES 18-20

This species, represented by only a few cranidia, is about normal in size, and in general appearance approaches close to the genotype.

The glabella is quadrangular, with rounded anterior corners. Two pairs of glabellar furrows are faintly indicated, besides the exceptionally wide occipital furrow. Brim relatively wide with an upturned margin. Dorsal furrow wide and deep. Fixigenes at their widest point less than one-third the width of the glabella. Very narrow anterior fixigenes remain. Since the eye does not reach to the occipital furrow, fixigenes remain posterior to the eye and are about equal to one-fourth the glabellar width at that point. The eye extends from a point opposite the forward ends of the occipital furrow on the glabella to the dorsal furrow, and is rather sharply bowed. In longitudinal section the cranidium is moderately convex with the greater portion of the convexity concentrated in the anterior lobe. Laterally the glabella is rather evenly convex and the palpebral lobes moderately convex. Exfoliated surface punctate.

Lyell formation; (loc. 19u) Badger Pass, Johnson Canyon, 8 miles east of Lake Louise, Alberta.

Holotype.—U.S.N.M. No. 108643.

CHARIOCEPHALUS BURLINGI, new species

PLATE 2, FIGURE 21

This is the largest species of *Chariocephalus* found thus far. Although the material is hardly adequate as the basis of a species, yet its description is included because the fauna is very important for

stratigraphic reasons and further collecting is difficult. It is most closely related to *C. badgerensis.*

The incomplete holotype cranidium has a large quadrate glabella, slightly constricted in the middle. The occipital furrow is wide and deep but does not join the dorsal furrow with the same strength. No doubt on the outer surface of the test this furrow was either rather shallow or obscelescent toward its ends. The rear pair of glabellar furrows is somewhat less recurved than in *C. badgerensis.* The fixigenes at their widest point are equal to nearly half the glabellar width. In cross section the entire cranidium is somewhat flat, and the palpebral lobes slope gently from the dorsal furrow. The eyes appear to have been rather long but their anterior ends are not preserved. Both the test and the exfoliated portions are smooth.

Lynx formation; (loc. 190) Iyatunga Mountain, Robson Peak District, British Columbia.

Holotype.—U.S.N.M. No. 108644.

IRVINGELLA ULRICH AND RESSER, 1924

Irvingella Ulrich and Resser, *in* Walcott, Smithsonian Misc. Coll., vol. 75, No. 2, p. 58, 1924.—Walcott, ibid., No. 3, p. 98, 1925.—Walcott and Resser, Rep. Sci. Results Norwegian Exp. Novaya Zemlya, No. 24, Videnskp., p. 10, Kristiania, 1925.—Resser, Smithsonian Misc. Coll., vol. 97, No. 10, p. 33, 1938.

Irvingellina Kobayashi, Jap. Journ. Geol. Geogr., vol. 15, Nos. 3-4, p. 175, 1938.

Relationships between *Irvingella* and the other genera of the Komaspidae have been discussed. Kobayashi erected the subgenus *Irvingellina* on *Chariocephalus tumifrons* Hall and Whitfield. Although the brim of that species is not fully typical of *Irvingella,* owing to the upturned edge forming a rim, its essential structure remains that of a bar and therefore agrees in every respect with *Irvingella.* The other species that Kobayashi assigned to *Irvingellina* are referred as follows: *Irvingella arctica* Walcott and Resser to *Parairvingella; Irvingella gibba* Miller and *I.* (*Irvingellina*) *protuberans* Kobayashi to *Irvingella.*

Even though published descriptions of *Irvingella* are very brief, they continue to be adequate in spite of the addition of many new species.

Genotype.—*I. major* Ulrich and Resser, 1924.

IRVINGELLA SILVESTRIS, new species

Plate 2, Figures 22-27

This average-size plump species is represented at several localities in the Arbuckle Mountains by numerous cranidia.

The wide glabella is constricted to a rounded anterior outline. The occipital and first pair of glabellar furrows are narrow, but clearly defined, and in exfoliated specimens the anterior pair is visible. The dorsal furrow is wide and deep. The glabella, slightly flattened on top, stands wholly above the fixigenes and the dorsal furrow on the sides while in front it overhangs that furrow. Longitudinally the head is highly convex, the glabella curving throughout has its greatest convexity in the anterior half. The brim is narrow, its position continuing the downward trend of the cranidial curvature. At their widest point the fixigenes are a little more than one-third the glabellar width. They contract rearward from their widest point which is situated anterior to the middle of the head. Their anterior portion is about half their average width, but because of high convexity in dorsal view they appear much narrower. Laterally the fixigenes are considerably curved and like the glabella have the greatest curvature at the outer margins where they drop off to a wide palpebral furrow and eye band, which is practically horizontal. Longitudinally the fixigenes rise abruptly from the depressed posterolateral limbs, and then slope gradually until near the forward end of the eye, where they drop off abruptly to meet the depressed brim.

Honey Creek limestone; (loc. 89w) west side of the West Timbered Hills; and (loc. 12p) 4 miles east of Alpers, Arbuckle Mountains, Oklahoma.

Holotype.—U.S.N.M. No. 108645a; paratype, No. 108645b.

IRVINGELLA ARBUCKLÈNSIS, new species

PLATE 2, FIGURES 28-33

This is a very prolific species of average size. The glabella, normal in size and depth of furrows, is constricted toward the front. The dorsal furrow is relatively shallow, but the glabella is well differentiated in cross section because it stands completely above the fixigenes. Laterally the glabella is evenly curved, attaining a height equal to about one-half its width. In the opposite direction the considerable convexity is attained by declivity of the forward moiety. The brim, of normal width, slopes downward from the anterior furrow. The fixigenes are slightly less than half the width of the glabella; thus the eyes are set at a considerable angle to the dorsal furrow. They increase in width from front to back. The anterior portion is flexed downward into a nearly vertical position and so is much wider than appears in dorsal view. The eyes extend from about the occipital furrow forward only to the anterior glabellar furrow, and hence are

the shortest of any species observed. The anterior fixigenes are slightly abnormal owing to the presence of a shallow anterior furrow, which causes them to appear tumid in lateral section. Laterally the fixigenes are only slightly convex, except at their outer edges, and as a whole slope downward from the dorsal furrow. The eye band is upturned a little.

Honey Creek limestone; (loc. 89w) west side of the West Timbered Hills, Arbuckle Mountains, Oklahoma.

Holotype.—U.S.N.M. No. 108646a; paratypes, Nos. 108646b, c.

IRVINGELLA MESLERI, new species

PLATE 2, FIGURES 34-38

This average-size species is represented by a number of cranidia.

The long glabella decreases in width forward to the rounded anterior outline. Occipital and first pair of glabellar furrows deep; two other pairs visible. The dorsal furrow is wide and moderately impressed. The brim is rather wide and thick in the middle, and has a rimlike edge owing to the presence of an incipient anterior furrow. Fixigenes, at their widest point, nearly half the glabellar width. Their anterior portions, which are short owing to the fact that their greatest width occurs far forward, are about as wide as the rim and equally convex. The long eyes extend approximately from the occipital furrow to the brim. Laterally the fixigenes are only moderately convex and slope down slightly from the dorsal furrow.

Honey Creek limestone; (loc. 12n) 7 miles north of Springer, Arbuckle Mountains, Oklahoma.

Holotype.—U.S.N.M. No. 108647a; paratype, No. 108647b.

IRVINGELLA RECURVA, new species

PLATE 2, FIGURES 39-41

The glabella is rather wide and well rounded in front. The glabellar furrows are broad and deep, and the dorsal furrow is particularly wide and, in exfoliated specimens, also deep. In cross section the glabella stands completely above the dorsal furrow, and is flattened slightly on top. Longitudinally the rear third has a nearly straight profile, while the anterior portion bends down sharply to overhang the anterior dorsal furrow. The narrow brim is slightly thickened, and when viewed from the front has a sinuate outline. The fixigenes, which stand vertical, are only about one-fourth the width of the glabella. They are slightly convex and have considerable width in their anterior portions.

Honey Creek limestone; (loc. 12m) 7 miles north of Springer, Arbuckle Mountains, Oklahoma.

Holotype.—U.S.N.M. No. 108648.

IRVINGELLA ALIA, new species

PLATE 2, FIGURES 42-47

This species is represented by a few cranidia which are slightly above average size. The glabella is wide and rounded off at the anterior angles. All furrows are narrow but only moderately impressed. The glabella stands wholly above the dorsal furrow. Laterally it is rather convex with a nearly even curvature, but longitudinally the curvature extends from the rear margin to the front, increasing slowly for half the distance and then more rapidly. The brim is narrow and slightly thickened. Fixigenes narrow, being a little more than one-fourth the glabellar width. Their anterior angles turn down into a vertical position. Laterally the fixigenes are slightly convex, and slope down rather evenly from the dorsal furrow. The eyes are very long, extending from the occipital furrow to the brim.

Honey Creek limestone; (loc. 9p) about 15 miles northwest of Fort Sill, Wichita Mountains, Oklahoma.

Holotype.—U.S.N.M. No. 108649a; paratypes, No. 108649b.

IRVINGELLA DAVISENSIS, new species

PLATE 2, FIGURE 48

The genus *Irvingella* is very poorly represented in the Davis formation of Missouri, this being the only species that can now be described.

The glabella is rather narrow. The occipital furrow is wide and deep, but the glabellar furrows are shallow. Laterally the glabella is strongly convex, but not longitudinally. Brim is relatively wide and convex. The fixigenes at their widest point are more than half the width of the glabella at the same point. The anterior fixigenes are somewhat wider than the brim. They rise slightly from the dorsal furrow toward the eyes, then slope off gradually with increasing convexity toward the outer edges. The posterolateral limbs are sharply, and the anterior angles slightly, depressed. The eyes are of moderate length.

Davis formation; (loc. 22m) Shaw Branch, Davis Creek, Missouri.

Holotype.—U.S.N.M. No. 108650.

IRVINGELLA OTTERTAILENSIS, new species

PLATE 2, FIGURE 49

One imperfect cranidium is available, but the species is described because of the importance of the fauna.

The glabella is rather large, with the occipital and first furrows sharply impressed, but the anterior pairs do not show. Convexity cannot be determined because of the partial compression of the fossils from this locality. The fixigenes are more than half the width of the glabella and the eyes are very long, extending from the occipital furrow around the sharply bowed cheeks to the brim.

"Goodsir" formation; Moose Creek, Ottertail Range, British Columbia.

Holotype.—U.S.N.M. No. 108651.

IRVINGELLA OBLONGA, new species

PLATE 3, FIGURES 1-3

Although this locality has yielded numerous specimens of other *Irvingella,* only this crandium of a small distinctly marked species was found.

The glabella is long and subcylindrical, well rounded in front. Its width equals about three-fourths its length. The occipital furrow and the complete rear glabellar furrow are both deep and approximately parallel. The glabella stands completely above the dorsal furrow, and in cross section has practically vertical sides rounding to the slightly flattened top surface. Longitudinally the high convexity is confined largely to the front half so that the anterior lobe overhangs the brim. Brim narrow and slightly upturned. Fixigenes about one-fourth the width of the glabella, retaining about that width throughout their length. The anterior portion decreases to about half the greatest width. The eyes are long and, because of the rather even width of the fixigenes, are not greatly bowed.

Wilberns formation; (loc. 70) Baldy Mountain, 8 miles northwest of Burnet, Texas.

Holotype.—U.S.N.M. No. 108652.

IRVINGELLA AGRESTIS, new species

PLATE 3, FIGURES 4-6

The glabella tapers, owing to the even convergence of the dorsal furrow from the occipital furrow forward. The occipital and first

glabellar furrows are about equally deep and nearly parallel, and a faint second pair is present. Glabella stands completely above the fixigenes and is moderately and evenly curved laterally. Longitudinally there is considerable curvature which increases in amount from the occipital furrow forward. Brim of moderate width and development; only slightly thickened. Anterior fixigenes a little wider than brim. At their widest point they are about one-fourth the width of the glabella, decreasing in width toward the occipital furrow. Moderately bowed eyes extend forward nearly to the front end of the glabella.

Wilberns formation; (loc. 69) Honey Creek, 8 miles southeast of Llano, Texas.

Holotype.—U.S.N.M. No. 108653.

IRVINGELLA ARDMORENSIS, new species

PLATE 3, FIGURES 7-12

Only one comparatively large species of *Irvingella* occurs at this locality. An unusually wide variation in size has been allowed, for some cranidia are larger, while others are less than one-third the size of the specimens illustrated.

The glabella is nearly quadrangular in outline, tapering slightly forward to a rounded frontal outline in which there is a slight flattening medially. In cross section the glabella has considerable elevation produced by a fairly even curvature. Longitudinally it is also high, as shown by the illustrations. The glabellar profile shows a rise from the rear margin in a shallow curve to the front lobe of the glabella and then a very steep drop to the anterior furrow. Brim narrow and slightly thickened. Anterior fixigenes taper rapidly to the narrow brim, at their widest point being about one-third the glabellar width. The fixigenes have only a slight convexity. The eyes are a little more than half the length of the glabella and are only moderately bowed.

Honey Creek limestone; (loc. 12p) 4 miles east of Alpers, Arbuckle Mountains, Oklahoma.

Holotype.—U.S.N.M. No. 108654a; paratype, No. 108654b.

IRVINGELLA PLENA, new species

PLATE 3, FIGURES 13-15

This species, represented by numerous cranidia, is found in association with several other forms from which it is distinguished by its plumpness.

The cranidium is nearly as wide as long and is well rounded off at the anterior corners. The second pair of glabellar furrows is fairly distinct although they fail to register in the photograph. In cross section the glabella is moderately high with a somewhat flattened top. Longitudinally its profile is rather straight in the rear, dropping off steeply in the anterior fourth. Brim of average width, slightly thickened and situated considerably below the dorsal furrow. Fixigenes very narrow; about the same width as the brim at the anterior angles, and at their widest point they equal about a fourth the glabellar width. They are rather highly arched so that they partly overhang the eye band.

Wilberns formation; (loc. 14b) Cold Creek, opposite north end of Sponge Mountain; (loc. 70) Baldy Mountain, 8 miles northwest of Burnet, Texas.

Holotype.—U.S.N.M. No. 108655.

IRVINGELLA ALTA, new species

PLATE 3, FIGURES 16-18

The wide glabella is only about a fifth longer than wide. The entire cranidium is highly convex in both directions, with the posterolateral limbs depressed almost to a vertical position. The dorsal furrow is narrow. Three pairs of glabellar furrows are visible; both the occipital and the rear pair are relatively narrower and less deep than usual. Laterally the glabella is almost evenly curved, with a tendency toward forming a keel in the middle. The longitudinal profile is circular except in the anterior fourth where the curvature increases until the anterior glabellar lobe overhangs the brim. Brim narrow and compressed closely against the glabella. Fixigenes are less than a third the glabellar width and slope downward at a sharp angle from the dorsal furrow. The eyes are long and somewhat angulated at the widest point of the palpebral lobe. Surface of test evidently smooth.

Honey Creek limestone; (loc. 9p) about 15 miles northwest of Fort Sill, Wichita Mountains, Oklahoma.

Holotype.—U.S.N.M. No. 108656.

IRVINGELLA DECKERI, new species

PLATE 3, FIGURES 19-27

This species is represented by numerous cranidia. Specimens vary considerably in size, but their average is about that for the genus.

Taken as a whole the cranidium has a more ovate shape than many other species. The large glabella is rounded in front. Dorsal furrow

shallow but clearly defined. Occipital furrow narrow. First pair of glabellar furrows continues across center unchanged in width but the anterior pairs are not visible. Laterally the glabella is moderately convex, with concentration of the greatest convexity near the center. Longitudinally the rear half is only slightly convex, but in the anterior portion the convexity increases until the slope becomes vertical. The brim is narrow and slightly thickened, sloping down from the anterior furrow. Fixigenes are about one-third the width of the glabella, their anterior portion measuring about one-third their average width. The eyes are as long as the glabella, extending beyond the line of the lateral dorsal furrow in front. The fixigenes slope downward rather evenly from the dorsal furrow.

Honey Creek limestone; (loc. 89y) West Timbered Hills, Arbuckle Mountains, Oklahoma.

Holotype.—U.S.N.M. No. 108657a; paratypes, Nos. 108657b, c.

IRVINGELLA BURNETENSIS, new species

PLATE 3, FIGURES 28-33

The cranidia representing this species are of average size and, as the illustrations show, are rather typical in form. The cranidium is subcylindrical in shape. The dorsal furrow is wide and relatively deep, as are the other furrows. The glabella, convex in both directions, stands completely above the libragenes. In cross section it has a subcircular outline and longitudinally it is curved throughout, but has nearly all of its convexity in the anterior half. The brim is relatively wide and flat, with rather sharply depressed ends. The fixigenes are about one-third the width of the glabella and their anterior portions are about half of their average width. The eyes are long, extending forward almost the full length of the glabella.

Wilberns formation; (loc. 70) Baldy Mountain, 8 miles northwest of Burnet, Texas.

Holotype.—U.S.N.M. No. 108658a; paratypes, Nos. 108658b, c.

IRVINGELLA BACCA, new species

PLATE 3, FIGURES 34-36

This small, well-defined species is not as abundantly represented as the others found at the locality. The glabella contracts slightly to a rounded front. Occipital and rear glabellar furrows deeply impressed; anterior pair faint and the median pair well developed as shown in side view. The entire cranidium is convex longitudinally, the glabella having its greatest convexity in the anterior half, where it overhangs

the anterior furrow. In cross section it has a distinctly flattened outline, although it stands completely above the fixigenes. The brim is of normal width, slightly thickened, and because of the depressed anterior angles, appears to be sinuate when viewed from the front. Fixigenes, nearly half the width of the glabella, are convex and slope downward from the dorsal furrow at an angle less than the lateral slope of the glabella. They are also arched longitudinally and contract in the anterior portion to a small fraction of their average width. In dorsal view the anterior fixigenes appear narrow, owing to the nearly vertical position of their outer portions.

Wilberns formation; (loc. 14b) Cold Creek Canyon, opposite north end of Sponge Mountain, San Saba County, Texas.

Holotype.—U.S.N.M. No. 108659.

IRVINGELLA ACCINCTA, new species

PLATE 3, FIGURES 37-39

The glabella, clearly defined by a rather deep dorsal furrow, contracts rather strongly in the anterior portion to a rounded front. In the exfoliated holotype the occipital and two pairs of glabellar furrows are well developed, but the anterior pair seems to be lacking. In cross section the glabella is distinctly flattened, and longitudinally has most of its convexity in the anterior third. The brim is rather wide and at its ends considerably depressed. The anterior fixigenes first slope downward toward the front, then upward to meet the down-turned ends of the brim. The fixigenes at their widest point are about half the width of the glabella. They are convex laterally, rising considerably above the bottom of the dorsal furrow and then sloping down more gently, so that the eye is only slightly below the dorsal furrow. The eye band is prominent because of the deep palpebral furrow and the slight thickening of the band. The posterolateral limbs are also curved into a vertical position.

Wilberns formation; (loc. 14b) Cold Creek Canyon, opposite north end of Sponge Mountain, San Saba County, Texas.

Holotype.—U.S.N.M. No. 108660.

IRVINGELLA ABRUPTA, new species

PLATE 3, FIGURES 40-45

Like the other species at the locality, *I. abrupta* is about average size for the genus. It is represented by several cranidia. The glabella is prominent both for its large size and for its convexity, the species deriving its name from the latter feature which serves to distinguish

it from its associates. In the exfoliated holotype the occipital and the three glabellar furrows increase in depth toward the rear of the cranidium. The dorsal furrow is broad and on the outside of the test is indicated only by change of curvature. The glabella is constricted anteriorly by the circular course of the dorsal furrow. Laterally the glabella is highly arched, being only slightly flattened on top. Longitudinally it is very convex so that the front half slopes downward sharply from the horizontal line. The thick brim is sinuate in front view and is slightly up-turned with respect to the anterior furrow. Fixigenes nearly half the width of the glabella, narrowing rapidly forward from their midpoint, to one-fourth average width. Eyes moderately long extending from about the ends of the occipital furrow forward to the anterior angles of the dorsal furrow. In dorsal view the eyes curve only slightly for half their length from the occipital furrow, then more abruptly. Laterally the fixigenes are only slightly convex, except where they are rolled under at their outer edges, and as a whole assume a nearly horizontal position with respect to the base of the cranidium. Longitudinally they conform to the great convexity of the head, but more by means of sloping forward as a whole than by curving. In this respect *I. abrupta* is unique. Test smooth, but exfoliated specimens have the usual strongly punctate surface.

Wilberns formation; (loc. 14b) Cold Creek Canyon, opposite north end of Sponge Mountain, San Saba County, Texas.

Holotype.—U.S.N.M. No. 108661a; paratype, No. 108661b.

IRVINGELLA MEDIA, new species

PLATE 3, FIGURES 46-54

This relatively small, abundant species is wider than the other Texas species and in this respect finds closer relatives in the Canadian Rockies.

The glabella is long, narrow, and considerably constricted toward the front. The occipital furrow and rear glabellar furrows are wide and fairly deep, while the anterior pairs have normal development. Viewed vertically, this species seems to be very broad and flat. From the front it is broad even though the glabella is highly arched. Longitudinally, however, as the side views show, this species is strongly convex. The brim is rather wide and has a somewhat thickened edge and a shallow anterior furrow. The fixigenes at their widest are about half the width of the glabella at the same point. Their rear moiety is nearly rectangular in shape, but the anterior portion decreases rapidly in width, being reduced finally to the width of the

brim. The eyes are long, extending almost from the occipital furrow to a point beyond the anterior angle of the dorsal furrow. They first curve outward from their rear end for about a third of their length, then bend at a rather sharp angle toward the glabella.

Wilberns formation; (loc. 70) Baldy Mountain, 8 miles northwest of Burnet; and (loc. 14b) Cold Creek, opposite north end of Sponge Mountain, San Saba County, Texas.

Holotype.—U.S.N.M. No. 108662a; paratypes, Nos. 108662b, 108663.

IRVINGELLA ALBERTA, new species

PLATE 4, FIGURES 1-3

The wide glabella tapers more rapidly than the average for the genus. The occipital and first pair of glabellar furrows are very deep and wide. The middle pair consists of short, sharply impressed indentations at the sides of the glabella, and the anterior pair appears only as slight depressions. Laterally the glabella stands completely above the dorsal furrow, its outline being slightly flattened on top. Longitudinally it is curved throughout. The brim is evenly convex and of average width. The fixigenes are less than one-third the glabellar width anterior to the eyes, narrowing rapidly to match the rim width. Owing to the sharp depression of the anterior angles and the tapered glabella the entire cranidium narrows perceptibly forward.

Lyell formation; (loc. 19u) Johnson Creek, 8 miles east of Lake Louise, Alberta.

Holotype.—U.S.N.M. No. 108664.

IRVINGELLA RICHMONDENSIS, new species

PLATE 4, FIGURES 4-6

This small species with a wide cranidium has relatively the widest fixigenes of any Nevada species.

The glabella is subcylindrical, tapering slowly forward. The occipital and first pair of glabellar furrows are narrow and their position is more nearly parallel to the rear margin of the glabella than is usually the case. Laterally the glabella has a nearly semicircular outline. Longitudinally it is rather convex, increasing in convexity from the rear margin forward. The brim is relatively large and somewhat thickened, sloping down in line with the declivity of the head. Fixigenes more than half the width of the glabella, decreasing in their anterior portions to the width of the brim. Longitudinally they are

rather tumid in the rear moiety. Laterally they first rise from the broad dorsal furrow, then slope gradually to their outer margins.

Secret Canyon shale; (loc. 60) near Richmond Mine, Eureka District, Nevada.

Holotype.—U.S.N.M. No. 108665.

IRVINGELLA ADAMSENSIS, new species

PLATE 4, FIGURES 7-11

Like the other species at this locality, *I. adamsensis* has a relatively slender glabella and wide cranidium. It is represented by a number of cranidia.

The glabella is constricted toward the truncated front. The furrows are developed about as usual, but a peculiar feature is found in the slight depression in the sides of the ridge between the occipital and first glabellar furrows. In cross section the glabella has a flattened curvature, and longitudinally it curves with the cranidial convexity. The rather wide and thickened brim is striated in the middle. The fixigenes are about half the width of the glabella, a width they maintain with little change in the rear half, but in the anterior portion gradually contract to the width of the brim. Laterally the fixigenes are rather convex, rising from a fairly deep glabellar furrow.

Secret Canyon shale; (loc. 60) near Richmond Mine, Eureka District, Nevada.

Holotype.—U.S.N.M. No. 108666a; paratype, No. 108666b.

IRVINGELLA FLOHRI, new species

PLATE 4, FIGURES 12-14

This well-represented species is large compared to its associates.

The glabella tapers forward to a rather straight front margin, and the furrows are developed about as usual. Laterally the convexity of the glabella is greatly reduced, though longitudinally it curves at an even rate. The brim is of normal width, slightly rolled. The fixigenes are about half the width of the glabella in their rear half, while the anterior portion is very convex, overhanging the eyes at the anterior angles. The eyes are very long, and the eye band is conspicuously developed.

The specific name is given in recognition of Dr. M. C. Flohr, who was my assistant at the time when some of the fossils were collected.

Secret Canyon shale; (loc. 60) near Richmond Mine, Eureka District, Nevada.

Holotype.—U.S.N.M. No. 108667.

IRVINGELLA TUMIFRONS (Hall and Whitfield)

PLATE 4, FIGURES 42, 43

Chariocephalus tumifrons HALL and WHITFIELD, U. S. Geol. Expl. 40th Par., vol. 4, p. 224, pl. 2, figs. 38, 39, 1877.
Irvingella tumifrons RESSER, Smithsonian Misc. Coll., vol. 97, No. 10, p. 33, 1938.
Irvingella (Irvingellina) tumifrons KOBAYASHI, Jap. Journ. Geol. Geogr., vol. 15, Nos. 3-4, p. 175, 1938.

The present study has led to the conclusion that this species belongs in *Irvingella.* Several additional cranidia, distorted in other directions than in the holotype, allow a reconstruction. It will be observed in figure 43 that on the left side of the specimen, as mounted, an anterior furrow seems to separate a rim and preglabellar area, but on the other side none appears. From the fact that other specimens also fail to show an anterior furrow, we may conclude that this seeming furrow is merely the result of compression. It is, of course, possible that all species of both *Irvingella* and of *Chariocephalus,* if they have a fairly wide anterior angle, may possess an incipient anterior furrow.

Secret Canyon shale; Pogonip Mountain, White Pine District, Nevada.

Holotype.—U.S.N.M. No. 24561.

PARAIRVINGELLA Kobayashi, 1938

Parairvingella KOBAYASHI, Jap. Journ. Geol. Geogr., vol. 15, Nos. 3-4, p. 175, 1938.

Kobayashi erected *Parairvingella* as a subgenus, based on the Nevada specimen which Walcott erroneously identified as *Chariocephalus tumifrons* Hall and Whitfield, renaming it *Irvingella (Parairvingella) angustilimbatus.* Long ago I recognized the distinctness of this specimen, not only specifically, but generically, and so labeled it. Kobayashi extracted his data from my partially completed notes. Even though there is no striking difference between *Parairvingella* and related genera, there seems to be sufficient difference to raise it to full generic rank. I have referred *Irvingella arctica* Walcott and Resser from Novaya Zemlya to the same genus as Walcott's Nevada specimen, although some doubt of its true generic affinity still remains. At the same time three new species are recognized among the Nevada material.

Parairvingella has the glabellar and eye structure like *Irvingella,* and a brim consisting of a narrow preglabellar area and rim. The distinctive feature is the preglabellar area in which we find a transi-

tional structure between *Drumaspis* on the one hand and *Elvinia* on the other.

Genotype.—*Chariocephalus* (*?*) *tumifrons* Walcott (not Hall and Whitfield).

PARAIRVINGELLA ANGUSTILIMBATA Kobayashi

Plate 4, Figures 18-22

Chariocephalus tumifrons Walcott (not Hall and Whitfield), U. S. Geol. Surv. Monogr. 8, p. 61, pl. 10, fig. 16, 1884.

Irvingella (*Parairvingella*) *angustilimbatus* Kobayashi, Jap. Journ. Geol. Geogr., vol. 15, Nos. 3-4, p. 175, 1938.

This species, represented by a number of cranidia, is recognized at several localities. It is characterized by a wide glabella with furrows of normal development. The glabella stands well above the fixigenes. In cross section it is very steep at the sides but is flattened on top. Longitudinally it has a marked convexity, most of which is in the anterior half. The narrow brim consists of a clearly defined thickened rim and a narrower preglabellar area. The slightly convex fixigenes are almost exactly half the width of the glabella, and slope down from the dorsal furrow. Posterolateral limbs depressed to a vertical position. Anterior fixigenes also sharply depressed. The eyes are long, extending forward almost to the anterior furrow, and are angulated at about the midpoint.

Secret Canyon shale; (locs. 62, 63) north of Adams Hill, Eureka District, Nevada.

Holotype and paratypes.—U.S.N.M. No. 24643; plesiotypes, No. 108672.

PARAIRVINGELLA EUREKENSIS, new species

Plate 4, Figures 15-17

The narrow glabella tapers a little in the anterior third to a rounded front. The occipital and first pair of glabellar furrows are wide and deep, and in the exfoliated holotype the other two pairs are visible. Laterally the glabella is arched above the dorsal furrow. Longitudinally it also has considerable convexity, most of which is attained in the anterior fourth. The fixigenes are slightly more than half the width of the glabella and, since the eyes are not greatly bowed, maintain their maximum width in the posterior two-thirds. Anteriorly the fixigenes contract to about half their greatest width, and are considerably depressed. The eyes are moderately long, and, because of the wide anterior fixigenes, do not reach the line of the dorsal furrow.

Brim rather wide, with a thickened, slightly upturned rim and a preglabellar area of about equal width. Viewed laterally the preglabellar area appears to be merely an extraordinarily wide anterior furrow. That this is not the case is shown in the anterior fixigenes, on which the anterior furrow is clearly seen in normal position.

Secret Canyon shale; (loc. 61) south of the Hamburg Mine, Eureka District, Nevada.

Holotype.—U.S.N.M. No. 108668.

PARAIRVINGELLA INTERMEDIA, new species

PLATE 4, FIGURES 25-31

This is the most common species in the Eureka District. It is characterized by great width, comparable to typical *Irvingella*. The glabella is wide and has a circular outline in front, with the usual furrows clearly defined. It stands completely above the shallow dorsal furrow, and longitudinally attains its convexity in the anterior third. The fixigenes are about half the width of the glabella, contracting in their anterior portions to about half their average width. The long eyes attain their moderate curvature by a sharp bend near their midpoint. The brim is narrow and consists of a thickened upturned rim and a narrow preglabellar area of equal width. The posterolateral limbs are bent down very sharply, while the anterior fixigenes decline into the anterior angles to a lesser degree.

Secret Canyon shale; (loc. 61) south of Hamburg Mine, Eureka District, Nevada.

Holotype and paratypes.—U.S.N.M. No. 27018.

PARAIRVINGELLA HAMBURGENSIS, new species

PLATE 4, FIGURES 23, 24

Development of a wide, vertically striated preglabellar area gives this species somewhat the appearance of *Elvinia*, but for the present it may remain in *Parairvingella*.

The subconical glabella shows the usual furrows. Although not highly convex in cross section it rises above the fixigenes. Longitudinally the rear portion is little curved, but the anterior third curves sharply downward. The brim width is nearly equal to one-fourth the cranidial length and consists of a thickened upturned rim and a preglabellar area of about equal width. The fixigenes average less than half the glabellar width and maintain their width except in the anterior portion where there is a reduction of about a third. The test is granulated and the preglabellar area marked by vertical lines.

Secret Canyon shale; (loc. 61) south of Hamburg Mine, Eureka District, Nevada.

Holotype.—U.S.N.M. No. 108669.

DRUMASPIS, new genus

This beautiful trilobite, represented by numerous species, carries development of the *Chariocephalus-Irvingella* line in a logical direction toward more normal trilobite structure by reducing eye size and enlarging the posterolateral limbs. The brim always has a narrow preglabellar area, but taken as a whole, the departure from the bar structure, characteristic of the other komaspid genera, is not great.

The quadrangular glabella is more or less tapered and usually has rounded anterior angles. Occipital furrow deep. Three pairs of glabellar furrows normally developed, the rear pair generally, and the second pair sometimes, connected across the middle. Dorsal furrow deep throughout. Fixigenes confined very largely to palpebral lobes and posterolateral limbs. Eyes large, varying from less than half to more than two-thirds the cranidial length; usually set at an angle to the cranidial axis. Eye bands wide. Brim narrow, of even width, and its length equals the width of the rear portion of the glabella. Thickened rim about as wide as preglabellar area. Anterior fixigenes narrow. Anterior facial suture usually vertical, but sometimes divergent. Posterolateral limbs fairly large in the smaller-eyed species.

Libragenes small, with thickened rim. Ocular platforms narrow in front, increasing in width posteriorly.

Pygidium not found. Surface usually granulose.

Genotype.—*D. walcotti,* new species.

DRUMASPIS WALCOTTI, new species

PLATE 4, FIGURES 37-41

This species has a long glabella which tapers slightly. Three pairs of glabellar furrows are clearly discernible. The fixigenes vary considerably in width owing to the strong curvature of the eyes. At their widest point they are a little more than a third of the glabellar width. The brim consists of a thickened rim and a slightly narrower preglabellar area. The glabella is slightly arched in cross section, and longitudinally curves considerably more, particularly in the anterior portion. The conspicuously wide eye bands at once set the species off from others found in the vicinity.

St. Charles formation; (locs. 4y, 5e) Two Mile Canyon, Wasatch Mountains, Idaho.

Holotype.—U.S.N.M. No. 108670a; paratype, No. 108670b.

DRUMASPIS IDAHOENSIS, new species

PLATE 4, FIGURES 32-36

This species is represented by many cranidia. The glabella tapers slightly. Peculiar structure is shown by the occipital furrow, which is narrow next to the dorsal furrow, then widens suddenly, maintaining that width to the similar point on the opposite side. The rear pair of glabellar furrows is interrupted in the middle both by growing shallow and by making a reversed forward curve. The anterior pairs show on exfoliated specimens. In cross section the glabella is rather flat but stands completely above the dorsal furrow. In longitudinal section it curves gently for most of its length, then turns down sharply at the front. The narrow brim consists of a rim in horizontal position. The fixigenes are a little less than one-third the glabellar width and in their anterior portion decrease to about the width of the anterior dorsal furrow. They slope downward rather evenly from the dorsal furrow, their declivity increasing in the rear to meet the sharply depressed posterolateral limbs, and anteriorly to join the rim. The moderately bowed eyes attain a length equal to about half the length of the glabella.

St. Charles limestone; (loc. 4y) Two Mile Canyon, 2 miles south of Malad, Wasatch Mountains, Idaho.

Holotype.—U.S.N.M. No. 108671a; paratype, No. 108671b.

DRUMASPIS ALBERTA, new species

PLATE 5, FIGURES 1-3

The description of this species is based on several cranidia, the most complete example being figured as the holotype.

The quadrangular glabella has a slightly indented anterior margin. Anterior angles rounded. In cross section the glabella is only slightly arched above the dorsal furrow. Longitudinally there is considerable elevation, most of which occurs in the anterior fourth. Brim narrow, apparently with a narrow upturned rim. Fixigenes about half the width of the glabella; anterior portion reduced to brim width. Eyes not strongly bowed, set at a wide angle to the dorsal furrow, forming a fixigene of fairly even width for the rear two-thirds of the head.

The fixigenes are almost flat and slope down from the dorsal furrow in line with the lateral slope of the glabella. Surface finely granulose.

Lyell formation; (loc. 64x) Ranger Brook Canyon, Sawback Range, Alberta.

Holotype.—U.S.N.M. No. 108673.

DRUMASPIS BRISCOENSIS, new species

PLATE 5, FIGURES 4-8

This species is represented by several cranidia, of which two exfoliated examples are figured.

The glabella is rectangular, with a practically straight front margin and slightly rounded anterior angles. Four sets of furrows are clearly defined in exfoliated specimens. In cross section the glabella rises with a flat curvature above the dorsal furrow, while longitudinally it is curved throughout, the curvature increasing from the rear forward. Brim of moderate width consists of a thickened rim, widened slightly in the middle. Fixigenes at their widest point slightly more than a fourth the glabellar width. Eyes rather sharply bowed. Anterior fixigenes depressed sharply. Portion of the test preserved appears to be smooth.

Sabine formation; (loc. 17p) Radium Hot Springs, Brisco Range, British Columbia.

Holotype.—U.S.N.M. No. 108674a; paratype No. 108674b.

DRUMASPIS GOODSIRENSIS, new species

PLATE 5, FIGURE 9

Only the holotype cranidium has been found at this locality.

The glabella tapers slightly forward to a straight anterior margin. The usual three pairs of glabellar furrows are developed. Owing to crushing in the shale matrix, the convexity cannot be determined. The fixigenes at their widest point are a little more than a third the glabellar width. The eyes are not greatly bowed and, because of the relatively great width of the anterior fixigenes, depart from the course of the dorsal furrow only at a small angle. Brim of average width, consisting of a slightly thickened rim of about the same width as the anterior furrow.

"Goodsir" formation; Moose Creek, Ottertail Range, British Columbia.

Holotype.—U.S.N.M. No. 108675.

DRUMASPIS SABINENSIS, new species

PLATE 5, FIGURES 10, 11

This distinctive species is represented only by a few cranidia.

The rectangular glabella is rather long and rounded at the anterior angles. Both laterally and longitudinally it has average convexity for the genus. The moderately wide brim is made up about equally of anterior furrow and rim. The rim has a horizontal position and widens out in the middle. The fixigenes, at their widest point, are less than one-third the glabellar width. Their anterior portions are turned down sharply, leaving a small ridge which extends into the preglabellar area. The eyes are of moderate size and moderately bowed.

Sabine formation; (loc. 17s) Sabine Mountain, 2 miles northeast of Canal Flats, Brisco Range, British Columbia.

Holotype.—U.S.N.M. No. 108676.

DRUMASPIS MAXWELLI, new species

PLATE 5, FIGURES 12, 13

About a dozen cranidia of this species are available.

The glabella is of normal shape and proportion, rounded at the anterior corners. The usual glabellar furrows are present but not deeply impressed. In cross section the glabella stands completely above the fixigenes and dorsal furrow, rising steeply on the sides, but is flattened on top. Longitudinally the cranidium is considerably arched, the convexity increasing from the rear forward. The brim is of normal width and upturned to a slightly thickened brim, which in the holotype cranidium is partly broken off. Fixigenes are narrow, being little more than one-fourth the glabellar width. Their anterior portion is about as wide as the brim and is turned down at the anterior angles. The eyes are of moderate size and slope outward at a small angle.

St. Charles limestone; (loc. 66z) St. Charles Canyon, Bear River Range, Idaho.

Holotype.—U.S.N.M. No. 108677.

DRUMASPIS DECKERI, new species

PLATE 5, FIGURES 14-16

Even though the available material is confined to the illustrated holotype, the species is so distinctive that it merits description. The quadrangular glabella is rounded at the anterior angles and slightly indented in front. Glabellar furrows developed as usual, the rear

pair containing pits on each side of the medial line. Laterally the glabella is only moderately convex, but longitudinally it is considerably more curved. The brim is of normal width, consisting mainly of a wide rim, in horizontal position, with a lingual extension in the middle. The fixigenes at their widest point are a little less than one-third the glabellar width, and their anterior portions, being sharply depressed, are narrower than the brim. The large eyes are sharply bowed.

Honey Creek limestone; (loc. 91b) 4 miles southeast of Hennepin, West Timbered Hills, Arbuckle Mountains, Oklahoma.

Holotype.—U.S.N.M. No. 108678.

DRUMASPIS OSELLA, new species

PLATE 5, FIGURES 17-20

Among the numerous specimens of the genus in the Texas collections, two cranidia present very distinct characteristics and are thus separated from *D. texana*. The glabella tapers forward more than the average amount for the genus and is rounded at the anterior angles to a straight front margin. Four pairs of glabellar furrows are defined. In cross section the entire cranidium is convex, the glabella standing above the dorsal furrow with a rather flat curvature. Longitudinally the head is rather convex, the greatest amount being in the anterior third. Brim rather wide, consisting of a thickened rim and a slightly narrower preglabellar area. The fixigenes at their widest point are less than one-third the width of the glabella. Their anterior portion is slightly wider than the preglabellar area. The eyes are evidently sharply bowed and not very large. Both the anterior angles and the posterolateral limbs are depressed rather sharply. The surface, except in the furrows, is ornamented with anastomosing lines, which, in places, practically form granules.

Wilberns formation; (loc. 70) Baldy Mountain, 8 miles northwest of Burnet, Texas.

Holotype.—U.S.N.M. No. 108679a; paratypes Nos. 108679b, c.

DRUMASPIS TEXANA, new species

PLATE 5, FIGURES 27-30

This species is represented by numerous specimens from several localities. The rather wide glabella contracts slightly forward and is well rounded at the anterior angles. The rear pair of glabellar furrows is deeply impressed, the next pair faint, and the forward pair very faint. In cross section the glabella is elevated as usual, longitudinally it is curved throughout. The brim consists of a narrow preglabellar

area and a slightly thickened rim expanding in the middle. Fixigenes at their widest point are a little less than one-third the glabellar width. Eyes of moderate size, rather sharply bowed. Anterior fixigenes about as wide as the brim, increasing forward into the down-turned anterior angles. Surface granulated.

Wilberns formation; (loc. 70) Baldy Mountain, 8 miles northwest of Burnet, Texas; and (loc. 67 o) Potatotop, 7 miles northwest of Burnet, Texas.

Holotype.—U.S.N.M. No. 108684a; paratype Nos. 108684b, c.

DRUMASPIS WICHITAENSIS, new species

PLATE 5, FIGURES 21, 22

More than 10 cranidia of this species are in the collection. The quadrate glabella is rounded by even curves at the anterior angles. Glabellar furrows are developed normally except that the front pair is almost obsolescent. In cross section the glabella stands completely above the fixigenes, rising rather steeply at the sides and flattened on top. Longitudinally the cranidium is high, with the front lobe of the glabella standing vertical. Brim of moderate width, consisting of a narrow preglabellar area and a slightly widened rim in horizontal position. Fixigenes narrow, at their widest point being a little more than one-fourth the width of the glabella. Anterior fixigenes sharply down-curved, attaining a width at the anterior angles of slightly more than the brim. Eyes rather small and highly bowed, with practically a circular course. Posterolateral limbs curved downward into a vertical position. Surface faintly marked by anastomosing lines.

Honey Creek limestone; (loc. 91u) 1 mile east of Canyon Creek, 15 miles northwest of Fort Sill, Wichita Mountains, Oklahoma.

Holotype.—U.S.N.M. No. 108680.

DRUMASPIS CLARA, new species

PLATE 5, FIGURES 23-26

Several cranidia and a libragene represent this species.

The glabella tapers forward to a nearly circular frontal outline. Glabellar furrows developed normally. In cross section this is a highly convex species. The glabella, standing completely above the libragenes, rises with a rather even curvature throughout. Longitudinally the cranidium also has high relief, likewise attained by a rather even curvature. Brim is of normal width. The slightly thickened rim widens in the middle, and occurs in a horizontal position. Fixigenes slightly less than one-third the glabellar width, their anterior portion

rather wide and depressed at the anterior angles. The eyes are of moderate size and not greatly bowed. The associated libragene has a heavy, striated rim, so constructed that it shows the suture to be intermarginal for more than one-third the width of the head. Ocular platform rather small, and covered with anastomosing lines similar to the elevated portions of the cranidium.

Honey Creek limestone; (loc. 91s) West Timbered Hills, Arbuckle Mountains, Oklahoma.

Holotype.—U.S.N.M. No. 108681a; paratype No. 108681b.

DRUMASPIS NITIDA, new species

PLATE 5, FIGURES 34, 35

This species is represented by several cranidia. The wide, nearly quadrate glabella is well rounded in front. All the furrows are moderately developed. The brim is normal in width and consists of a narrow preglabellar area, and a slightly thickened rim which broadens toward the middle. The fixigenes are narrow, at their widest point being little more than one-fourth the glabellar width. In their anterior portions they are about the same width as the brim, but widen toward the depressed anterior angles. The eyes are somewhat larger than average size and slightly bowed, the bowing attained by a sharp angular turn near the midpoint. A distinctive feature is the extraordinary width of the eye band. Surface covered by irregular raised lines which are equivalent to irregular curved granules.

Honey Creek limestone; (loc. 91s) West Timbered Hills, Arbuckle Mountains, Oklahoma.

Holotype.—U.S.N.M. No. 108682.

DRUMASPIS UTAHENSIS, new species

PLATE 5, FIGURES 31-33

In the National Museum collections are several cranidia which when first studied were thought to belong to *Chariocephalus*. However, when comparison was made with typical forms of that genus and of *Drumaspis,* they appeared to be nearer the latter.

The quadrangular glabella has a straight anterior margin and rounded anterior angles. The glabellar furrows are well developed, and even the anterior pair may be traced across the glabella. In cross section the glabella stands completely, but not high, above the dorsal furrow and is nearly flat on top. Longitudinally the relief is considerable, but the curvature is nowhere great except in the very front of the cranidium. The fixigenes are wide, being half the glabellar

width at their widest point. The very long eyes are curved so sharply that the two halves are almost at right angles to each other. Anterior fixigenes practically wanting and on the whole are nearly flat, sloping down from the dorsal furrow. The posterolateral limbs are very sharply depressed.

St. Charles limestone; (loc. 54x) Two Mile Canyon, 2 miles south of Malad, Wasatch Mountains, Idaho.

Holotype.—U.S.N.M. No. 108683.

UNCLASSIFIED GENERA

CHEILOCEPHALUS Berkey, 1898

CHEILOCEPHALUS WICHITAENSIS, new species

PLATE 5, FIGURE 39

Several cranidia of this interesting genus have been found in the Oklahoma collections. It is a very simple trilobite, the cranidium consisting of a large glabella with no furrows except a shallow occipital furrow. The fixigenes are simple. The glabella tapers slightly to a nearly straight anterior margin. In cross section it stands well above the dorsal furrow, rising at a fairly even rate to approximately the center. Longitudinally, the head has considerable relief, attained by even curvature. The brim is narrow and consists of a simple, slightly concave, and nearly horizontal extension, the outer edge of which is very slightly thickened but does not form a rim. The fixigenes have nearly the same width throughout, and are about equal to one-fourth the glabellar width. Test smooth.

Compared to *C. stcroixensis* the Oklahoma species is slightly smaller and differs in the distribution of convexity in both directions.

Honey Creek limestone; (loc. 9p) 15 miles northwest of Fort Sill, Wichita Mountains, Oklahoma.

Holotype.—U.S.N.M. No. 108685.

CHEILOCEPHALUS TEXANUS, new species

PLATE 5, FIGURES 36-38

The one small cranidium in the Texas collections has a smooth rectangular glabella, rounded in front. In cross section it forms a continuous curve with the fixigenes, which are barely separated by the dorsal furrow. Longitudinally, the cranidium is convex, with a rather even curvature, increasing in the anterior portion. The brim, on the whole, is slightly concave. No anterior furrow is developed, but a thickened rim turns up slightly, and is thereby separated from

the preglabellar area. The fixigenes, at the rear of the eyes, are about half the glabellar width and form wide triangular posterolateral limbs. Anterior to the rather small eye they are somewhat wider than the brim. As the cranidium has no occipital furrow, it presents a very smooth appearance.

Hickory sandstone; (loc. 68z) Packsaddle Mountain, 11 miles southeast of Llano, Texas.

Holotype.—U.S.N.M. No. 108686.

CHEILOCEPHALUS BUTTSI, new species

Plate 11, Figure 6

Unfortunately many years ago the holotype and other cranidia representing the species were damaged by poor preparation. This cranidium is fully typical of the genus, even as to size. The large glabella extends the full length of the head and has three pairs of shallow furrows. It tapers only slightly. Though incomplete the fixigenes are seen to be small anterior to the large posterolateral limbs. Longitudinally the cranidium is little curved except in the anterior fourth where the slope becomes vertical. In cross section the entire head has considerable convexity attained by a rather evenly convex glabella and continued by the lateral slopes of the fixigenes.

Surface beautifully shagreened.

Ore Hill limestone; (loc. 107v) ½ mile northwest of Drab, Pennsylvania.

Holotype.—U.S.N.M. No. 108746.

CHOLOPILUS Raymond, 1924

CHOLOPILUS NEVADENSIS, new species

Plate 6, Figures 1-2

The main features of this species relate it to *Cholopilus*. Furthermore its stratigraphic position is approximately the same as other representatives of the genus. Numerous cranidia are in hand, but no other parts.

C. nevadensis is characterized by its simplicity. The very large, smooth glabella extends nearly to the anterior margin. The dorsal furrow, fairly well impressed in the rear, decreases in depth forward until beyond the eye it can be observed only as a very faint line beneath the surface. A weak occipital furrow is developed but no glabellar furrows show on the outer surface. Exfoliated specimens have the merest trace of three pairs of glabellar furrows, the first pair recurved, the second pair turning a bit forward, and the third again

turned backward, so that the second and third pairs form a faint cross on the glabella. Laterally the glabella is rather evenly but flatly arched; longitudinally it is considerably curved. The brim continues the rounded curvature of the glabella and consists of a preglabellar area and a narrow, wirelike rim, but faintly indicated. Fixigenes at their widest point are about one-fifth of the glabellar width, and they maintain practically the same width throughout. The eyes are of normal size, situated about the midpoint of the cranidium. A faint tubercle which has more the appearance of a median eye than of a spine occurs on the occipital ring.

Hamburg limestone; (loc. 23d) near Hamburg Mine, Eureka District, Nevada.

Holotype.—U.S.N.M. No. 108687.

CHOLOPILUS (?) ALBERTENSIS, new species

PLATE 10, FIGURE 3

This cranidium of doubtful generic position is described in order to present the faunal element. Because there are no good illustrations of the type of *Cholopilus* extant, one cannot be sure that the published drawings rightly portray the glabellar proportions. The general appearance of this trilobite places it nearest to *Cholopilus*, in which genus it may be placed for the present.

The glabella is wide, occupying more than half the cranidial area. It is defined by a dorsal furrow so faint that it disappears in certain light. This cranidium is convex in both directions, the curvature being greater longitudinally than laterally. The anterior margin is slightly indented in the middle and a very faint rim is indicated.

Lyell formation; (loc. 64b) Glacier Lake Canyon Valley, 48 miles northwest of Lake Louise, Alberta.

Holotype.—U.S.N.M. No. 108733.

CALYPTOMMA, new genus

A small trilobite characterized by simplicity of structure. The large glabella is quadrate except for constriction at the anterior angles. Glabellar furrows are very faint even on exfoliated specimens. Brim a simple bar. Fixigenes very small, confined to the palpebral lobe, and in the genotype are less than half the width of the eye band. Eyes so large that they envelop the glabella, extend from the forward margin of the glabella beyond the occipital ring. Eye band wide.

This genus resembles *Cholopilus* Raymond in the simplicity and arrangement of the various cranidial parts. It differs from that genus

in two respects: first, the fixigenes are narrower, and second, the eyes are very much larger.

Surface marked by elongate granules on the elevated portions.

Name.—καλυπτω = envelop; ὀμμα = eye.

Genotype.—*C. typicale,* new species.

CALYPTOMMA TYPICALE, new species

Plate 12, Figures 8, 9

The generic description and illustrations present the specific characters.

Red Lion formation; (loc. 150e) Boulder Creek, 1 mile north of Princeton, Montana.

Holotype.—U.S.N.M. No. 108753a; paratype, No. 108753b.

ILLAENURUS Hall, 1863

ILLAENURUS PRISCUS, new species

Plate 6, Figures 3-7

This species, though not fully typical of *Illaenurus,* does not seem to warrant the establishment of a separate genus. The four cranidia figured differ slightly in proportions, and therefore it is possible that two species are included. Departure from essential features of *Illaenurus* is found in the great width and faint delimitation of the glabella. Exfoliated specimens show a completely outlined glabella, and a considerable width of fixigene. It has generally been assumed that *Illaenurus* has no fixigenes, or in other words, that the dorsal furrow passes through the two ends of the eye lobe.

In general outline the cranidium is nearly quadrate. *I. priscus* has a narrow, wirelike rim, and eyes of moderate size situated about the midpoint of the cranidium. Anterior to the eye the facial suture diverges slightly, and the anterior angles are turned down somewhat by a continuation of the cranidial slope. In cross section the glabella has a flat curvature, but longitudinally a much greater one.

Lyell formation; (locs. 66j, k) Ranger Canyon, Sawback Range, Alberta.

Holotype.—U.S.N.M. No. 108688a; paratypes Nos. 108688b, 108689a, b.

ILLAENURUS ALBERTENSIS, new species

Plate 6, Figures 8-12; Plate 14, Figure 18

This species is represented by numerous cranidia, and by a pygidium and libragene. It is not greatly unlike several undescribed species

from the Upper Mississippi Valley. On exfoliated cranidia the dorsal furrows show faintly for a short distance anterior to the eye, touching both ends of the eye lobe. Exfoliated specimens have a median eye situated about one-third the distance forward from the rear margin. In front of the eyes, which are situated behind the middle of the cranidium, the facial suture diverges considerably to form wide anterior angles. The thickened, heavily striated rim is almost vertical to the horizontal plane of the cranidium. In cross section the cranidium has a slight even curvature, but longitudinally it has considerably more relief, also attained by even curvature.

The libragene forms nearly a quarter circle, with its convexity similar to that of the cranidium. The heavily striated border continues around the margin, decreasing toward the genal angle, which evidently bore no spine.

The pygidium is short, very wide, and lacks differentiation of axis or pleura. At the anterior margin two slight depressions indicate the presence of a very wide axis. The pygidium evidently came to rather sharp points at its lateral angles.

Portions of six simple thoracic segments remain articulated on one rock fragment.

Lyell formation; (loc. 20d) Tilted Mountain Brook, 9 miles east of Lake Louise, Alberta.

Holotype.—U.S.N.M. No. 108690a; paratype, No. 108690b.

ILLAENURUS (?) SINCLAIRENSIS, new species

PLATE 6, FIGURES 13-15

This species, doubtfully referred to *Illaenurus*, comes from somewhat older beds than those that contain the more characteristic species. The cranidium is wider than long and exclusive of the posterolateral limbs is rectangular in outline. No trace of dorsal furrows has been observed. In cross section this species is rather flat, but longitudinally it is considerably convex, with the anterior margin of the cranidium turned under. A peculiar feature is the development of a rim like that of *Platycolpus*. A small occipital tubercle suggests the presence of a medial eye, and short shallow multiple furrows near it evidently represent the occipital furrow. The eyes are of moderate size, situated slightly forward of the median point of the cranidium.

Sabine formation; (loc. 16t) Sinclair Canyon, Brisco Range, British Columbia.

Holotype.—U.S.N.M. No. 108691a; paratypes, Nos. 108691b, c.

ILLAENURUS ELONGATUS (Walcott)

PLATE 6, FIGURES 18, 19

Tsinania elongata WALCOTT, Smithsonian Misc. Coll., vol. 64, No. 3, p. 228, pl. 36, figs. 10, 10a, 1916.

The cranidium on which this species is based is not average for *Illaenurus*. It is long and narrow, with little curvature in cross section but with somewhat more in longitudinal section. No dorsal furrow or rim seems to be differentiated. The anterior angles are rounded more than average for the genus. The eyes are about normal size, situated slightly forward of the glabellar midpoint.

McKay group; (loc. 23z) 2 miles west of Donald, Dogtooth Mountains, British Columbia.

Holotype.—U.S.N.M. No. 61736.

PLATYCOLPUS Raymond, 1913

PLATYCOLPUS QUINNENSIS, new species

PLATE 6, FIGURES 16, 17

The small collection from this locality has yielded a good cranidium of *Platycolpus*, which is described because of its significance in the fauna. It is normal in all essential characters of the genus. A wide glabella, faintly indicated by a shallow dorsal furrow, extends a little in front of the eyes. The rim is wide and heavily striated. Anterior to the eyes the facial suture diverges, forming large anterior angles. The eyes are of moderate size, situated well back on the head. A shallow occipital furrow delimits a wide flat occipital ring.

Mendha limestone; (loc. 7j) Quinn Canyon Range, Nevada.

Holotype.—U.S.N.M. No. 108692.

PLATYCOLPUS OKLAHOMENSIS, new species

PLATE 6, FIGURES 20-25

This species is recognized at several localities. As usual only fragments of the cranidium are preserved, a condition characterizing most species thus far recognized in the genus. The portion of the glabella available shows that it is wide, and rather evenly but not highly arched in both directions. It has the usual wide brim, although it lacks the usual striations.

The pygidium is normal in every respect. Exfoliated specimens show a well-separated axis. On the outer surface it is marked simply

by a change in slope. The pygidium is flatly convex in transverse section, but as may be observed from the illustration is much steeper in the opposite direction. The species is of average size and the surface seems to have been smooth.

Signal Mountain formation; (loc. 186s) 4 miles northwest of Ravia; (loc. 201j) Royer Ranch, Honey Creek, Arbuckle Mountains, Oklahoma.

Holotype.—U.S.N.M. No. 108693; paratypes, Nos. 108694a, b.

PLATYCOLPUS WICHITAENSIS, new species

PLATE 6, FIGURES 26-29

This species is represented by several cranidia and a pygidium, and even by a fragment of a libragene. *P. wichitaensis* averages slightly smaller than *P. oklahomensis*. The fragmentary cranidium figured has a faint dorsal furrow behind the eyes, and in both lateral and longitudinal sections is evenly and considerably arched. The eyes are of normal size and are situated about the midpoint of the cranidium. The brim is sharply demarcated, thickened, and heavily striated.

The pygidium on the same piece of rock with a cranidium of *Eurekia,* is also highly arched in both directions and shows faint dorsal and axial furrows.

Signal Mountain formation; (loc. 12g) 2 miles southwest of Signal Mountain, Wichita Mountains, Oklahoma.

Holotype.—U.S.N.M. No. 108695a; paratype, No. 108695b.

PLATYCOLPUS HIGHLANDENSIS, new species

PLATE 6, FIGURES 30, 31

This species constitutes another important element of the fauna from the upper beds in the Highland Range, and consequently is described, even though the material is fragmentary. As usual no cranidia are preserved. The pygidium on which this species is based is itself incomplete, but has the normal generic features, and it is of rather large size. As shown in the illustrations the axis is faintly defined, tapering less rapidly than in other species. It is not highly arched in either direction, but has normal distribution of convexity.

Mendha limestone; (loc. 88) 7 miles north of Bennett Springs, Highland Range, Nevada.

Holotype.—U.S.N.M. No. 27017.

PLATYCOLPUS SINCLAIRENSIS, new species

PLATE 6, FIGURES 32-36

Though there are in hand about 10 pygidia and about an equal number of libragenes, only one fragmentary cranidium, not altogether typical, has been found in the collection.

The libragene is almost flat in its rear portion but increases greatly in convexity forward, indicating that the cranidium must have been considerably arched longitudinally. The ocular platform is approximately a quarter circle and is surrounded by a wide, thickened, heavily striated border, with the striations turning toward the margin as the genal angle is approached.

The pygidium is rather convex, with the axis standing well above the pleural lobes, but the dorsal furrow is merely a change in slope. Several pleural furrows are visible on exfoliated specimens. The axis is rather long, extending beyond the midpoint of the pygidium.

Sabine formation; (loc. 16t) Sinclair Canyon, Brisco Range, British Columbia.

Holotype.—U.S.N.M. No. 108697a; paratypes Nos. 108697b, c.

ENONTIOURA, new genus

Although up to the present time only the holotype pygidium has been discovered, it is given a new generic name because it represents such a strange form. On the same piece of rock is a rounded cranidium similar to that of *Camaraspis* but it is not well enough preserved to warrant description.

The specimen assumed to be a pygidium is characterized by a very large axis, which occupies most of its area. At the front of the wide axis is a half segment which looks more like a rim than the usual segmental division. Shallow dorsal furrows separate narrow pleural lobes, the dorsal furrow continuing very faintly around the rear of the axis. Beginnning at the anterior angles a thickened, slightly upturned rim borders the outer edge of the pygidium. Aside from the peculiarity of shape and convexity, a very unusual feature is found in the striations which transverse the entire specimen from side to side, crossing both the axis and the pleural lobes. It is this feature which has several times raised the question as to whether this specimen is actually a trilobite pygidium or some oddly formed hypostoma, or even an undescribed crustacean. In view of these conditions, a description of this specimen is presented primarily to call it to the attention of geologists with the hope that its real position may be discovered.

Name.—εναντιος = contrary; ουρα = tail.

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

ENONTIOURA TYPICALIS, new species

PLATE 6, FIGURES 37, 38

The generic description, together with the illustrations, presents the characteristics of this peculiar form.

Mendha limestone; (loc. 88) 7 miles north of Bennett Springs, Highland Range, Nevada.

Holotype.—U.S.N.M. No. 108696.

MACELLOURA Resser, 1935

MACELLOURA TRANSVERSA, new species

PLATE 7, FIGURE 1

When first observed this pygidium was thought to represent *M. dia*. Comparison shows that, while typical of the genus in every respect, the pygidium is wider than that of *M. dia*.

Wilberns formation; (loc. 14f) Bartlett Hollow, Burnet County, Texas.

Holotype.—U.S.N.M. No. 108698.

ARAPAHOIA Miller, 1936

Arapahoia MILLER, Journ. Pal., vol. 10, No. 1, p. 24, 1936.
Hesperaspis STOYANOW, Bull. Geol. Soc. Amer., vol. 47, No. 4, p. 469, 1936.

At the time *Arapahoia* was originally described, only the cranidium was known to the author. Specimens from the eastern front of the Beartooth Mountains identified with the genotype *A. typa* now add the libragene and pygidium.

In the original description Miller pointed out the relationship of *Arapahoia* to *Plethometopus,* which occurs in younger Upper Cambrian strata. From the present study it becomes clear that *Norwoodella* described later is also related and that *Arapahoia, Norwoodella,* and *Plethometopus* form a single line of development. Thus far *Arapahoia* seems to be confined to horizons in the lower part of the *Cedaria* zone, and is the oldest genus of this group.

In spite of the abundance of examples, it is difficult to free good specimens of *Arapahoia,* because the matrix is refractory.

Exfoliated cranidia have well-defined dorsal and occipital furrows, and some species have three pairs of short glabellar furrows. A node on the base of the occipital spine may possibly be a median eye.

The libragene is of moderate size. In some specimens a border is faintly indicated, but it scarcely breaks the even curvature as the ocular platform slopes to the margin. The entire libragene extends into a longer or shorter genal spine.

The pygidium is short and wide, with a large axis, which seems to be segmented in all species. Some species have well-developed pleural furrows, and a few show a border.

ARAPAHOIA TYPA Miller

PLATE 7, FIGURES 37, 38

Arapahoia typa MILLER, Journ. Pal., vol. 10, No. 1, p. 25, pl. 8, fig. 6, 1936.

The figured specimens from the Beartooth Mountains are identified with the type species. However, without the holotype at hand for comparison, this identification is not without question.

Maurice formation; Butte north of Little Rocky Creek, Beartooth Mountains, Wyoming.

Holotype.—Columbia Univ. No. 12612; plesiotypes, U.S.N.M. No. 108708.

ARAPAHOIA STANTONI, new species

PLATE 7, FIGURES 2-4

This species is similar to *A. spatulata* Miller in that the glabella is not separated by relief from the fixigenes. The very shallow dorsal furrow can be seen very clearly in cross light. The keel shows in about the same degree as the glabella. Exclusive of the neck spine, the holotype canidium, measured immediately in front of the eyes, is 13.7 mm. long and 8.8 mm. wide. The anterior margin of the brim is slightly angulated. Few specimens retain the slender neck spine. The associated pygidium has two pleural furrows clearly defined.

Pilgrim formation; (loc. 26b) Mill Creek, Little Rocky Mountains, Montana.

Holotype.—U.S.N.M. No. 108699a; paratype, No. 108699b.

ARAPAHOIA REESIDEI, new species

PLATE 7, FIGURES 5-9

This species is represented by many specimens, but only a few can be cleaned reasonably well. *A. reesidei*, named for the collector, Dr. John B. Reeside, Jr., is nearly flat in cross section but has more convexity longitudinally. The brim is turned down rather sharply at the margin. The dorsal furrow is expressed by shallow furrows on the sides as far forward as the eyes; beyond that point there is only a faint indication of it. The eyes are in an elevated position. The anterior facial suture diverges slightly.

The libragenes have short slender genal spines.

Maurice formation; (loc. 26c) T. 30 N., R. 96 W., 6 miles south of Hailey, Wyoming.

Holotype.—U.S.N.M. No. 108700a; paratypes, Nos. 108700b, c.

ARAPAHOIA POLITA, new species

PLATE 7, FIGURES 10, 11

The cranidium, exclusive of the large occipital spine and posterolateral limbs, forms approximately a rectangle. A weakly defined dorsal furrow showing on the upper surface, probably is strongly indicated in exfoliated specimens. In cross section the cranidium is flatly arched but longitudinally the front third turns down rapidly. The eyes are of moderate size, situated at about the midpoint of the cranidium. Facial suture diverges slightly in front of the eye and rapidly behind the eye to form large posterolateral limbs. A broad, shallow furrow separates the greatly thickened neck ring which extends into a long, tapering, up-curved spine, the sides of which are strongly striated. No other parts have been assigned to the species.

Sullivan formation; (loc. 64h) East Lyell Glacier, 48 miles northwest of Lake Louise, Alberta.

Holotype.—U.S.N.M. No. 108701.

ARAPAHOIA ELONGATA, new species

PLATE 7, FIGURES 15-19, 32

This is a common species of the group found in this abundant fauna. It is characterized by a relatively narrow, long, tapering glabella which in exfoliated specimens is outlined by a shallow dorsal furrow. Fixigenes narrow. Eyes small. Facial suture diverges in front of eyes, then becomes intermarginal for a considerable distance, rounding the anterior angles. In cross section the head is flat, and longitudinally it has about the same flat curvature, except at the front edge, where it is rolled under slightly. The neck spine evidently was long. The libragene assigned to this species is rounded in contour on all edges, and in exfoliated specimens shows faint lines radiating from the eye. The pygidium assigned to the species is smooth and evidently has a punctate surface, but lacks a well-differentiated border.

Sullivan formation; (loc. 64h) East Lyell Glacier, 48 miles northwest of Lake Louise, Alberta.

Holotype.—U.S.N.M. No. 108703a; paratypes, Nos. 108703b, c.

ARAPAHOIA ALBERTENSIS, new species

PLATE 7, FIGURES 27-31

This is a very abundant species and is normal for the genus. Its outstanding characteristic is the enormous posterolateral limbs, which have pushed the rear facial suture forward nearly to the front margin of the glabella. In exfoliated specimens the glabella is clearly marked by four pairs of glabellar furrows. The shallow occipital furrow marks off a triangular neck ring extending into a long occipital spine. A tubercle near its base seems to be a median eye. Anterior facial suture diverges very little and evidently is intermarginal nearly to the center. The libragene assigned to the species is short and stout, to fit with the contour of the facial suture. The pygidium assigned to the species is also short and has a well-defined border.

Sullivan formation; (loc. 64h) East Lyell Glacier, 48 miles northwest of Lake Louise, Alberta.

Holotype.—U.S.N.M. No. 108705a; paratypes, Nos. 108705b, e.

ARAPAHOIA PROLIXA, new species

PLATE 7, FIGURES 20-26

This large species is represented by a number of specimens. In length it resembles *A. elongata*. On exfoliated specimens the glabella is clearly defined and shows faint traces of glabellar furrows. The outer test has a keel. At the anterior end of the eye the fixigenes are narrow, measuring a little more than the width of the dorsal furrow. Anterior to the eyes the suture diverges, but less than in *A. elongata*. In cross section the species has low convexity, attained by an even curvature. Longitudinally it has greater convexity but this is also attained with even curvature. Concentric lines appear just behind the midpoint of the cranidium and possibly surround an eye. On the other hand, the brim is characterized by vertical anastomosing lines, which are stronger on exfoliated specimens. Unfortunately no examples are complete but a rather wide libragene seems to represent the species. The pygidium assigned to the species is convex, with a fairly well-defined border. It has definite pleural furrows and grooves.

Sullivan formation; (loc. 64h) East Lyell Glacier, 48 miles northwest of Lake Louise, Alberta.

Holotype.—U.S.N.M. No. 108704a; paratypes, Nos. 108704b-d.

ARAPAHOIA WALCOTTAE, new species

PLATE 7, FIGURES 12-14

This is a short form similar to *A. albertensis*. In cranidia that retain the test the outline of the glabella is indicated by a shallow

dorsal furrow. Exfoliated specimens have the glabella much more sharply defined, and glabellar furrows are represented by pits. The eyes are slightly farther back than in *A. albertensis*. The suture diverges in front of the eye and forms large posterolateral limbs behind the eye. The middle portion of the brim projects somewhat. In cross section the cranidium has considerable elevation, attained by sharp curvature of the top of the glabella from which the posterolateral limbs bend downward with approximately the same slope. Longitudinally the species is not greatly curved.

Sullivan formation; (loc. 64e) East Lyell Glacier, 48 miles northwest of Lake Louise, Alberta.

Holotype.—U.S.N.M. No. 108702a; paratype, No. 108702b.

PLETHOMETOPUS Ulrich, 1930

PLETHOMETOPUS ALBERTENSIS, new species

PLATE 12, FIGURE 13

A single cranidium, typical of the genus in all respects is sufficiently well preserved to warrant naming. The simple large glabella, indicated by a faint dorsal furrow, is about three-fourths the length of the head, and tapers slightly to a rounded anterior margin. A strong occipital furrow separates a neck ring that extends into a short blunt spine. Fixigenes narrow, measuring at the eyes about a fifth the glabellar width. The posterolateral limbs are small and possibly short. Eyes small, situated about the midpoint of the glabella. In cross section the cranidium is rather evenly curved, while longitudinally the curvature is much greater, particularly in the anterior half. As a result the simple brim is convex in both directions. A faint broad anterior furrow is visible in the anterior angles.

Lyell formation; (loc. 20j) Tilted Mountain Brook, 9½ miles east of Lake Louise, Alberta.

Holotype.—U.S.N.M. No. 108755.

KINGSTONIA Walcott, 1924

KINGSTONIA ELECTRA, new species

PLATE 7, FIGURES 33-36

This species is represented by a number of cranidia, but thus far no pygidium which can be assigned to the species has been located. On the outer surface the cranidium shows few features. It is highly arched in both directions, becoming almost hemispherical. Indeed its outline departs slightly from a semicircle only by a flattening of the curvature at about the midpoint of the cranidial length. A narrow brim is present. Exfoliated specimens show a clearly defined glabella,

which extends to the anterior margin of the cranidium. A narrow occipital ring is indicated.

Weeks formation; (locs. 30h, i) 5 miles south of Marjum Pass, House Range, Utah.

Holotype.—U.S.N.M. No. 108706a; paratypes, No. 108707.

KINGSTONIA MUCRO, new species

PLATE 8, FIGURES 1-8

This rather large species is represented by some 20 specimens. It is characterized by enormous posterolateral limbs, which give the cranidium great width and cause it to depart from the more nearly semicircular outline of most species. The glabella is faintly indicated, more particularly in the rear where shallow furrows extend forward for some distance. There is a narrow rim of the usual type. The eyes are of normal size and situated somewhat in front of the midpoint. In cross section the head is strongly arched. The posterolateral limbs continue the downward slope, with increasing curvature near their distal ends. Longitudinally the cranidium is highly arched. The associated pygidium, when viewed from the dorsal surface, has a rounded triangular shape. In profile it is very convex. At the anterior angles the sides stand vertical, but posteriorly the curvature increases until at the rear of the axis the pygidium is folded under. The axis is faintly outlined and in exfoliated specimens shows six rings. Pleural grooves are visible.

Sherbrooke limestone; (loc. 58f) ridge west of Mount Bosworth, British Columbia.

Holotype.—U.S.N.M. No. 108709a; paratypes, Nos. 108709a-d.

KINGSTONIA BOSWORTHENSIS, new species

PLATE 8, FIGURES 9-13

This species has normal size and shape. The cranidium is quite globular with only short posterolateral limbs, and narrow brim around the front. In cross section the cranidium stands very high with its greatest curvature toward the rear. Longitudinally it is curved rather evenly throughout, with a slight flattening in the front fourth. The associated pygidium is short and very convex.

Sherbrooke limestone; (loc. 57p) ridge west of Mount Bosworth, British Columbia.

Holotype.—U.S.N.M. No. 108710a; paratypes, Nos. 108710b, c.

KINGSTONIA ROBSONENSIS, new species

PLATE 8, FIGURES 14, 15

A single cranidium, fortunately rather well preserved, was found in the collection, showing that the Sullivan formation should be recognized in the Robson District. This cranidium is of average size and shape. The glabella is defined by a complete dorsal furrow, which shows as a darker line through the test but is not expressed as a furrow. A narrow striated brim is present and the posterolateral limbs are wide and bluntly rounded at the ends.

Sullivan formation; (loc. 61r) Moose River, 10 miles northeast of Robson Peak, British Columbia.

Holotype.—U.S.N.M. No. 108711.

KINGSTONIA SULLIVANENSIS, new species

PLATE 8, FIGURES 16-19

This globular species with rather large posterolateral limbs has a faintly defined glabella. A distinctly thickened and striated rim characterizes the holotype. The posterolateral limbs are rounded off abruptly.

Sullivan formation; (loc. 64m) Sullivan Peak, 48 miles northwest of Lake Louise, Alberta.

Holotype.—U.S.N.M. No. 108712a; paratypes, No. 108712b.

KINGSTONIA PROMISSA, new species

PLATE 8, FIGURES 20-23

Numerous cranidia and a few pygidia represent this species, which is slightly smaller than average. It is a short form with relatively wide fixigenes and large posterolateral limbs. The glabella is outlined only in the rear. In cross section the cranidium is very convex; the convexity being attained by the steeply inclined posterolateral limbs and a very sharp bending at the top of the glabella. Longitudinally the convexity is that of a quarter sphere. The pygidium is very plump, swelling greatly toward the rim.

Sullivan formation; (locs. 64c, j) Glacier Lake Canyon Valley, 48 miles northwest of Lake Louise, Alberta.

Holotype.—U.S.N.M. No. 108713a; paratype, No. 108713b.

KINGSTONIA VULGATA, new species

PLATE 8, FIGURES 26-30

This species is similar to *K. promissa,* differing in being less convex in every way, and having wider posterolateral limbs. It has normal convexity in both directions, in both the head and tail.

Sullivan formation; (loc. 64b) Glacier Lake Canyon Valley, 48 miles northwest of Lake Louise, Alberta.

Holotype.—U.S.N.M. No. 108715a; paratypes, Nos. 108715b, c.

KINGSTONIA LOPERI, new species

PLATE 8, FIGURES 24, 25

This species is represented by pygidia from several localities, but a sufficiently well-preserved cranidium to permit unquestioned determination has not been found. These fossils occur in very hard arkosic sandstone and quartzite; consequently not much can be done in the way of preparation. The illustrated specimen shows the quartz grains scattered through the siliceous matrix. Owing to its great length, this pygidium agrees rather well with that of *Bynumia,* but until positive evidence is available, it is placed in *Kingstonia,* the genus blonging to the horizon of the Sawatch fauna.

This pygidium has an elongate triangular shape, with a long, narrow axis clearly defined. Some of the exfoliated specimens, when weathered in a certain way, show the axial rings and the pleural furrows. On the exterior, however, only the anterior furrow and a faintly defined brim are visible. Further segmentation is shown but very faintly by reflection through the test.

Sawatch formation; (loc. 6a) Taylor Peak, 4 miles south of Ashcroft; (loc. 6) Italian Mountain, 15 miles northeast of Crested Butte, Colorado.

Holotype.—U.S.N.M. No. 108714.

KINGSTONIA (?) PLENA, new species

PLATE 8, FIGURES 31, 32

A single pygidium represents this large and tumid species. Since the pygidium is exfoliated the lateral portions of the dorsal furrow are fairly deep, but it is not traceable around the rear of the axis. The axis rises slightly above the pleural lobes, which slope gently from the dorsal furrow for about half their width, then turn down very rapidly. At the rear the entire pygidium has such great convexity

that the margin is turned under. At the rear the test is irregularly striated.

Sullivan formation; (loc. 64h) East Lyell Glacier, 48 miles northwest of Lake Louise, Alberta.

Holotype.—U.S.N.M. No. 108716.

KINGSTONIA ARA (Walcott)

PLATE 8, FIGURES 42-46

Ucebia ara WALCOTT, Smithsonian Misc. Coll., vol. 75, No. 2, p. 60, pl. 14, fig. 4, 1924; ibid., No. 3, p. 118, pl. 17, figs. 7, 8, 1925.
Kingstonia ara RESSER, ibid., vol. 95, No. 4, p. 24, 1936.

In addition to the holotype and paratype cranidia that are refigured, another specimen from the type locality is added to show the changed aspect resulting from exfoliation. It will be remembered that the genus *Ucebia* was erected on this species, because the glabella was well defined. However, as the illustrations show both exfoliated specimens and one cranidium retaining part of the test, it is clear that *Ucebia* is not a valid genus. When the shell is removed, any species of *Kingstonia* becomes *Ucebia*.

The locality erroneously stated in the original description, is given correctly below.

Warrior limestone; (loc. 24f) 1 mile southeast of Warriors Mark, Pennsylvania.

Holotype.—U.S.N.M. No. 70257; paratype, No. 70258; plesiotype, 108720.

KINGSTONIA KINDLEI, new species

PLATE 9, FIGURES 1-4

This species is named for Dr. Cecil Kindle, who collected the cranidium and several pygidia from the belt of Warrior limestone exposed in the southwestern portion of the Bellefonte quadrangle.

K. kindlei differs somewhat from *K. ara* (Walcott), which occurs in the same limestone belt to the southwest in the Tyrone quadrangle. It averages larger and is more convex than *K. ara*. Also the anterior outline is more circular. The holotype cranidium retains the test, and consequently the dorsal furrow can be seen only when the specimen is held so that strong cross light falls parallel to the slope of the glabella and fixigene. A narrow striated rim is set in a nearly vertical position. In cross section this cranidium is very high with a nearly even curvature. When viewed from the side, the crandium appears to be a quarter sphere. The associated pygidium has a nearly cylin-

drical axis, which extends almost to the rear margin. Posteriorly it coalesces with the pleural lobes, owing to shallowing of the dorsal furrow.

Warrior limestone; (loc. 38e) 1 mile northwest of Benore, and 5 miles west of State College, Pennsylvania.

Holotype.—U.S.N.M. No. 108721a; paratypes, Nos. 108721b, c.

BYNUMIA Walcott, 1924

Bynumia Walcott, Smithsonian Misc. Coll., vol. 75, No. 2, p. 54, 1924; ibid., No. 3, p. 78, 1925.

The additional species here described add proof that *Bynumia* is a valid genus. Examples of the libragene and pygidium are also added to the genus. The illustrations show that the glabella of *Bynumia,* like that of *Kingstonia,* is clearly marked in exfoliated cranidia, but in unexfoliated examples it is seldom indicated by more than a suggestion of the dorsal furrow.

Genotype.—*B. eumus* Walcott (restricted).

BYNUMIA EUMUS Walcott

Plate 9, Figures 5-7

Bynumia eumus Walcott, Smithsonian Misc. Coll., vol. 75, No. 2, p. 54, pl. 10, fig. 2, 1924; ibid., (part) No. 3, p. 78; pl. 17, fig. 4, 1925.

A pygidium is figured in addition to the holotype cranidium. Because the number, poorly written on the type cranidium, was misread, its locality was erroneously given in the Sawback Range.

Sullivan formation; (loc. 64b) head of Glacier Lake Canyon Valley, 48 miles northwest of Lake Louise, Alberta.

Holotype.—U.S.N.M. No. 70255; plesiotype, No. 108722.

BYNUMIA ELEGANS, new species

Plate 9, Figures 8-12

This species, represented by a large number of specimens, is close to *B. eumus,* and hence typical of the genus in all respects. In *B. elegans* the glabella is rather slender and more truncate than usual. Its distinguishing characteristics, as in other species, reside chiefly in the proportions of the brim. The brim width is equal to half the glabellar length and comes to a sharper point than in *B. eumus.* Another difference from that species is found in the occipital furrow, which extends on to the posterolateral limbs. These limbs are further

distinguished by their convexity. The associated pygidium is similar to that of *B. eumus,* differing chiefly in somewhat greater relief of the axis and the portions near the margin, particularly toward the rear.

Sullivan formation; (loc. 64r) Ranger Brook Canyon, Sawback Range, Alberta.

Holotype.—U.S.N.M. No. 108723a; paratypes, Nos. 108723b-d.

BYNUMIA ARGUTA, new species

PLATE 9, FIGURES 13-15

This species is represented by several examples. Its fairly wide glabella is square in front and rounded at the anterior angles. As a whole the outline is nearly that of an equilateral triangle. A shallow dorsal furrow, visible on the exterior, separates the brim from the glabella. The brim is considerably swollen in front. From the front the cranidial cross section is little curved, except at the outer edges. Since the posterolateral limbs are greatly depressed in the rear, the cranidium is highly arched. Longitudinally the curvature is moderate, except at the very front, where the swollen rim drops steeply. The associated pygidium is flat and so fused that the axis is scarcely traceable.

Sullivan formation; (loc. 66s) Badger Pass, Sawback Range, Alberta.

Holotype.—U.S.N.M. No. 108724a; paratype, No. 108724b.

BYNUMIA WALCOTTI, new species

PLATE 9, FIGURES 16-20

Bynumia eumus WALCOTT (part), Smithsonian Misc. Coll., vol. 75, No. 3, pl. 17, figs. 5, 6, 1925.

This species was included by Walcott in *B. eumus,* which it resembles. It is abundantly represented at several localities by many specimens. Compared with *B. eumus, B. walcotti* appears to be a stockier form, particularly when not exfoliated. This appearance is due to the more convex and slightly narrower brim. The pygidium assigned to the species is flat, with the poorly defined axis raised slightly above the flat pleural lobes.

Sullivan formation; (loc. 66m) 5 miles northwest of Banff, and (loc. 66s) Badger Pass, Sawback Range, Alberta.

Holotype.—U.S.N.M. No. 108731a; paratypes, Nos. 70256, 108731b.

BYNUMIA VENUSTA, new species

PLATE 9, FIGURES 21-28

This abundantly represented species is characterized chiefly by its narrow cranidial shape, which forms an isosceles triangle. Longitudinally the curvature is not great, and the relatively wide brim continues the gradual slope of the anterior portion of the glabella. The libragene figured, the first for the genus, constitutes almost a quarter circle, the outer margin increasing its rate of curvature toward the genal angle. Several pygidia are figured, one with a complete test and two partially exfoliated examples. The latter show how the axial rings and pleural furrows and grooves are developed on the under side of the test.

Sullivan formation; (loc. 64s) Ranger Brook Canyon, Sawback Range, Alberta.

Holotype.—U.S.N.M. No. 108725a; paratypes, Nos. 108725b-f.

BYNUMIA ROBSONENSIS, new species

PLATE 9, FIGURES 30-34

One species of *Bynumia* occurs in the Robson District, far north of the localities of the other species. This species is characterized by its triangular outline, with the base being longer than the sides. The photographs fail to bring out the sharpness of the brim, owing to the high convexity developed near the tip.

Lynx formation (Sullivan equivalent); (locs. 19m, L) Iyatunga Mountain, Mount Robson, British Columbia.

Holotype.—U.S.N.M. No. 108726a; paratypes, Nos. 108726b, c.

BYNUMIA SULCATA, new species

PLATE 9, FIGURES 35, 36

A single small distinctive cranidium has the usual triangular outline and average shape of other species in the Sawback Range. Because of the depth of the dorsal furrow, *B. sulcata* is closest to *B. arguta*, but carries this development much further. Not only is the dorsal furrow deeply impressed both on the sides and in front, but in addition, the brim, set in a nearly horizontal position, does not continue the glabellar slope. This is a remarkable development in a specimen that is not completely exfoliated. The side view shows the distribution of convexity.

Sullivan formation; (loc. 64s) Ranger Brook Canyon, Sawback Range, Alberta.

Holotype.—U.S.N.M. No. 108727.

BYNUMIA RANGERENSIS, new species

PLATE 9, FIGURES 37-41

This well-represented species is allied to *B. cumus* in size and proportions of the glabella. In cross section the brim, and to a lesser degree the glabella and posterolateral limbs, are highly convex. Longitudinally the convexity is not great, except in the swollen brim. The brim width is less than half the glabellar length. The rather large associated pygidium is nearly flat in cross section, but in the opposite direction has increasing curvature in the posterior moiety.

Sullivan formation; (loc. 66L) Ranger Brook Canyon, Sawback Range, Alberta.

Holotype.—U.S.N.M. No. 108728a; paratypes, Nos. 108728b, c.

BYNUMIA SAWBACKENSIS, new species

PLATE 9, FIGURES 42-44

This large, well-represented species is characterized particularly by its wide brim, which exceeds half the glabellar length. Not only is the brim wide, but when viewed from the front comes to a blunt, nearly cylindrical point. The pygidium has a blunt rear margin, reached by the faintly outlined axis.

Sullivan formation; (loc. 64w) Ranger Brook Canyon, Sawback Range, Alberta.

Holotype.—U.S.N.M. No. 108729a; paratype, No. 108729b.

BYNUMIA (?) MODESTA, new species

PLATE 8, FIGURES 33, 34

This species lies between *Bynumia* and *Kingstonia* and should possibly be referred to the latter genus.

The glabella is large and relatively wide, so that it occupies by far the greater portion of the cranidium. The front outline is strongly curved but does not come to such a sharp point as in other species. Longitudinally the cranidium is convex with an even curvature. It is also convex laterally, but this convexity is attained by a sharp bend along the median line causing the glabella and posterolateral limbs, as well as the palpebral lobes, to slope down sharply on each side. The steeply inclined halves of the cranidium are only a little curved in themselves. The eyes are small and are situated well forward. A narrow rim is visible in front.

Sullivan formation; (loc. 64h) Glacier Lake Canyon Valley, 48 miles northwest of Lake Louise, Alberta.

Holotype.—U.S.N.M. No. 108717.

BYNUMIA (?) PRODUCTA, new species

PLATE 8, FIGURES 35, 36

Although this species is represented by many specimens, only one cranidium is figured. In its relatively flat anterior outline and somewhat upturned, thickened rim, and in the lack of divergence of the anterior facial suture, this species resembles *Blountia*. However, since the fixigenes are almost triangular in shape, it is placed in *Bynumia*.

Owing to the truncate anterior outline, the glabella is more quadrate than usual. The very shallow dorsal furrow converges slightly forward and rounds off the anterior angles. A shallow occipital furrow outlines a narrow ring. A deep depression crosses the preglabellar area in front of the glabella, and the rim is thickened, so that it is rather prominent in side view.

Numerous pygidia are in hand, but because the specific association is rather uncertain they have not been definitely assigned to the species. These pygidia are characterized by the usual triangular shape, axial and other features, differing from *B. mollis* chiefly in the abrupt slopes along the outer margin, which are so steep that the edges are rolled over.

Sullivan formation; (loc. 64i) Glacier Lake Canyon Valley, 48 miles northwest of Lake Louise, Alberta.

Holotype.—U.S.N.M. No. 108718.

BYNUMIA MOLLIS, new species

PLATE 8, FIGURES 37-41

A few specimens characterized by a pronounced triangular shape represent this species. The glabella is faintly outlined on the sides by the dorsal furrow and in front by a change in slope. The thickened rim is slightly upturned. Viewed from the rear, the glabella stands above the posterolateral limbs, owing to deep notching of the posterior margin at the ends of the dorsal furrow. Viewed from the front, the lateral curvature is rather even, with the greatest amount along the median line. Longitudinally the nearly even curvature of the glabella is interrupted by the more horizontal position of the brim. The pygidial axis is long, slender, and tapers gradually, reaching nearly to the rear margin. A faint border is visible, and on exfoliated specimens the usual segmentation is clearly defined both in the axis and the pleural lobes.

Sullivan formation; (loc. 64h) East Lyell Glacier, 48 miles northwest of Lake Louise, Alberta.

Holotype.—U.S.N.M. No. 108719a; paratypes, Nos. 108719b, c.

BYNUMIELLA, new genus

It appears that the *Bynumia* stock continued into Franconia time, taking on a somewhat changed form. The alterations in structure may be summed up by stating that they are modifications of *Bynumia* in the direction of average trilobite structure. For instance, the brim structure is retained, but with modification in the direction of reduction to the more normal band form. Likewise the glabella develops considerable taper, the dorsal furrow becomes deeper and an occipital furrow separates a neck ring, which is expanded backward in the middle. Only cranidia are known.

Diagnosis.—Small trilobites with a tapering glabella without furrows. Dorsal and occipital furrows are well defined. The simple brim varies in width, but tends to extend forward in the middle, causing the anterior outline of the cranidium to project.

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

BYNUMIELLA TYPICALIS, new species

PLATE 10, FIGURES 1, 2

Several small cranidia have been located in the collection, characterized by a glabella which tapers to a rounded point, and which is demarcated by the well-defined dorsal furrow. An equally deep occipital furrow separates a swollen neck ring. The fixigenes average about the same width as the brim, and the latter has a width equal to one-third the glabellar length. The eyes are small, situated well forward.

Lyell formation; (loc. 66j) Northeast branch Ranger Brook Canyon, 10 miles northwest of Banff, Sawback Range, Alberta.

Holotype.—U.S.N.M. No. 108732a; paratype No. 108732b.

BYNUMIELLA BRISCOENSIS, new species

PLATE 9, FIGURE 29

Several cranidia from the Sabine formation represent *Bynumiella.* In the holotype cranidium the glabella tapers to a rounded front less sharp than in *B. typicalis.* The brim width is somewhat less than one-third the glabellar length. Owing to depression of the anterior angles, the brim is convex. The cranidium is moderately arched in both directions.

Sabine formation; (loc. 16t) Sinclair Canyon, Brisco Range, British Columbia.

Holotype.—U.S.N.M. No. 108730.

BYNUMIELLA (?) OKLAHOMENSIS, new species

PLATE 10, FIGURES 27, 28

Pending the availability of better material several cranidia that are not fully typical are referred to the genus. This species differs from typical forms in that the glabella tapers less rapidly and in the size and position of the eyes, which are far larger and situated much farther back than they should be for a *Bynumiella*. Brim, occipital ring, and fixigenes are all typical.

The illustrations show the characteristics of the holotype cranidium. Faint glabellar furrows are present. A thickening of the neck ring produces a short blunt spine. Longitudinal curvature is shown in figure 27, and that in the opposite direction is about the same.

Signal Mountain formation; (loc. 201j) 1 mile south of Royer Ranch, Arbuckle Mountains, Oklahoma.

Holotype.—U.S.N.M. No. 108743.

BYNUMINA, new genus

A second genus *Bynumina* is erected for the *Bynumia* stock that continued into Franconia time. As in *Bynumiella* this genus represents development of *Bynumia* in the direction of more average trilobite structure. Although glabellar taper was an essential change in this instance, the head as a whole is less constricted anteriorly. Glabellar furrows also appear, but the most pronounced change lies in the brim structure, which brings that part more nearly to form a transverse band.

Diagnosis.—Small trilobites characterized by large, somewhat tapered glabella. Dorsal and occipital furrows well defined. Glabellar furrows faint. Neck ring narrow and of even width throughout. Eyes small, situated well forward. Brim simple, of nearly even width throughout. Faint eye lines present. Pygidium simple; axis long, tapered, poorly defined, and with faint axial rings. Pleural lobes completely fused.

Genotype.—*B. caelata*, new species.

BYNUMINA CAELATA, new species

PLATE 10, FIGURES 18-22

Numerous cranidia and one pygidium represent this species. The illustrations show both the generic and specific characteristics.

The glabella tapers gradually to a truncated front margin. The anterior corners are rounded, and along the sides the dorsal furrow

bows outward slightly. Several pairs of recurved glabellar furrows are visible. The occipital furrow, both on the glabella and fixigenes, is deeply impressed. In cross section the cranidium is convex, reaching the greatest curvature as the median line is approached. Longitudinally the convexity is less, and the rate of curvature even throughout. The brim width is a little more than one-fourth the glabellar length, and is a simple convex band surrounding the front of the head. The associated pygidium is also convex, with a broad, faintly outlined axis and fused pleural lobes.

Davis formation; (loc. 92d) Federal Lead Mine No. 4, Flat River, Missouri.

Holotype.—U.S.N.M. No. 108740a; paratypes, Nos. 108740b-d.

BYNUMINA MISSOURIENSIS, new species

PLATE 10, FIGURES 23-26

This is the more common Missouri species, and it differs from *B. caelata* mainly in its narrower rim.

B. missouriensis has a tapering glabella, but the curvature of the lateral dorsal furrows is not even. It expands rapidly as far forward as the first glabellar furrow, then suddenly begins to contract, maintaining a nearly straight course until it approaches the anterior angles, where the rate of taper becomes less again. Besides this peculiarity, the species is characterized by a rim width of a little more than one-fifth the glabellar length.

Davis formation; (locs. 11k, 91y) Flat River, Missouri.

Holotype.—U.S.N.M. No. 108741; paratypes, Nos. 108742a, b.

STENOPILUS Raymond, 1924

STENOPILUS BACCA, new species

PLATE 10, FIGURES 8-13

Such a featureless hemispherical trilobite as *Stenopilus* is difficult to describe. Several species are here presented, chiefly to show the differences between small and large examples, and the variation in degree of sphericity. There seems to be little doubt but that these trilobites developed from a *Kingstonia* ancestor.

Large cranidia of *S. bacca* are nearly hemispherical in shape, but, as may be seen in figures 10 and 11, small heads show a distinct *Kingstonia* shape. Of course, the indentations of the dorsal furrow in the rear remain, but unless the very convex specimen is specially posed, they are obscured by the bulging cranidium.

Signal Mountain formation; (locs. 12i, j) 2 miles southwest of Signal Mountain, Wichita Mountains, Oklahoma.

Holotype.—U.S.N.M. No. 108737; paratypes Nos. 108738a-c.

STENOPILUS ADUNCUS, new species

PLATE 10, FIGURES 14-17

A second species is chosen for description to show the elongate form taken by species of *Stenopilus*. This development recalls the *Bynumia* elongation of the *Kingstonia* stock, but in *Stenopilus* this attends obesity and elimination of all furrows. As a result a smooth trilobite is developed, so convex that the glabella overhangs the posterior margin. This high convexity is reduced forward, but the curvature is not eliminated in any portion of the test.

S. aduncus is longer than wide and has its greatest convexity at the rear. Otherwise it is practically featureless.

Signal Mountain formation; (loc. 12L) Pickens Ranch, Arbuckle Mountains, Oklahoma.

Holotype.—U.S.N.M. No. 108739a; paratype, No. 108739b.

BLOUNTIA Walcott, 1916

BLOUNTIA PLANA, new species

PLATE 14, FIGURES 12-14

Only pygidia have been assigned to the species. While the long axis is defined, and the usual interrupted axial furrows are visible, it does not stand above the pleural lobes. The chief characteristic of the species is found in the flatness of the pygidium. When viewed from the rear, the pleural platforms, with the axis, form only a slightly convex shield. The border is slightly concave, thereby increasing the curvature near the lateral margins.

Sullivan formation; (loc. 64c) Glacier Lake Canyon Valley, 48 miles northwest of Lake Louise, Alberta.

Holotype.—U.S.N.M. No. 108779a; paratype, No. 108799b.

BLOUNTIA KINDLEI, new species

PLATE 14, FIGURES 27-31

Two small pygidia and a portion of the cranidium are figured. A somewhat broken pygidia is included to show appearance of the test; one much larger pygidium has not been figured. This species, which is named in honor of the collector, Dr. Cecil Kindle, is typical of the genus in every respect.

The large glabella tapers at a normal rate to the rounded front. It lacks furrows and even the occipital furrow is very faint. The fixigenes average less than half the glabellar width, expanding to the moderate anterior angles, and behind the eye into stout posterolateral limbs. Eyes are small, situated about the midpoint of the cranidium. The rather heavy, somewhat upturned rim is about the same width as the preglabellar area. When exfoliated, the pygidium shows a long axis on which at least six rings are faintly indicated. As a whole, the pygidium is triangular in outline. In cross section the curvature is gentle, except near the margins where the slope increases so much that the outer edges are slightly turned under.

Warrior limestone; (loc. 38e) 1 mile northwest of Benore, 5 miles west of State College, Pennsylvania.

Holotype.—U.S.N.M. No. 108788a; paratypes, Nos. 108788b, c.

BLOUNTIA (?) DISPARILIS, new species

PLATE 14, FIGURES 10, 11

This narrow cranidium is not typical of *Blountia*. The glabella tapers to a rounded anterior outline and lacks glabellar furrows. A shallow occipital furrow separates a narrow neck ring. The fixigene is narrow, averaging about one-third the average glabellar width. The wide brim is subdivided into a preglabellar area and a wider rim. The rim is thickened and increases in the middle to about twice the width of the preglabellar area. Eyes small. Longitudinally the cranidium attains considerable convexity by rather strong curvature in the rear portion. In cross section the curvature, including the posterolateral limbs, is more even.

Sullivan formation; (loc. 64h) Glacier Lake Canyon Valley, 48 miles northwest of Lake Louise, Alberta.

Holotype.—U. S. N.M. No. 108775.

BLOUNTIELLA Resser, 1938

BLOUNTIELLA ALBERTA, new species

PLATE 14, FIGURES 19-26

Although this species is represented by numerous cranidia, the pygidium has not been located. Taken as a whole, the cranidium is rather short, and the glabella occupies most of its cranidial area. Glabellar furrows are lacking even in exfoliated specimens. The fixigenes average less than half the glabellar width. The eyes are small, situated about the midpoint of the cranidium. A narrow preglabellar

area separates the thickened, striated rim from the dorsal furrow. Laterally the head is moderately and evenly convex, but longitudinally the curvature is much greater. A shallow occipital furrow separates a narrow ring.

Sullivan formation: (locs. 64c, b) Glacier Lake Canyon Valley, 48 miles northwest of Lake Louise, Alberta.

Holotype.—U.S.N.M. No. 108776a; paratypes, Nos. 108776b, 108777a, b.

ELLIPSOCEPHALOIDES Kobayashi, 1935

Ellipsocephaloides Kobayashi, Journ. Fac. Sci. Imp. Univ. Tokyo, sect. 2, vol. 4, pt. 2, p. 196, 1935.

This generic name was assigned without proper study of the specimens, for it perpetuates the false idea of relationship between these trilobites and *Ellipsocephalus*. The species of *Ellipsocephaloides*, moreover, are unique in several respects, and could not belong to the *Illaenuridae*, which should have been apparent even before the pygidium was known. Under present circumstances the best procedure is to place the genus in a new family, leaving the determination of the family's position in trilobite classification to future study.

Considerable variation in width of the anterior fixigene and the more advanced course of the facial suture due to a more forward position of the eye may be observed among the species here described. Though these variations fall almost entirely on one side of the genotype, *E. curtus* (Whitfield), the narrow forms and those in which the eye is farther back are not segregated as a separate genus since sufficient gradation seems to exist to tie all together. *Ellipsocephaloides* is apparently characteristic of Franconia horizons, for it is associated with *Idahoia, Pseudagnostus, Briscoia*, and other genera of Franconia age.

Species of *Ellipsocephaloides* vary considerably in shape. The glabella is large and clearly defined, both by the dorsal furrow and its elevation above the fixigenes. Some species have three pairs of short glabellar furrows. Occipital furrow always developed, marking off a neck ring, usually of even width throughout. Brim a simple band, except in the wider species where a narrow rim is demarcated by a shallow anterior furrow. The brim continues as the anterior fixigene around the anterior angles and therefore curves much more sharply in the narrow than in the wide forms. At their widest point the fixigenes, exclusive of the eye band, vary from less than half to more than the glabellar width at the same point. Fixigenes between the dorsal furrow and the eye are usually nearly flat, though they may

be concave. Since the very heavy eye bands are elevated, most of the fixigene may lie below the level both of the dorsal furrow and of the eye. The moderate-size eyes vary considerably in position. Libragene unknown.

Pygidium characterized by a stout axis in which two or more segments are indicated. The axis is from a half to two-thirds the length of the pygidium and stands above the dorsal furrow. Pleural lobes flat, extending fanwise into marginal spines. Pleural furrows strong and pleural grooves usually visible. Marginal spines usually rather blunt, forming a serrate edge. As the genus is now constituted they number from one to five on a side, depending on the degree of fusion.

ELLIPSOCEPHALOIDES ARGUTUS, new species

PLATE 10, FIGURES 5, 6

Several cranidia from the Ram Creek area retain sufficient of their characters to warrant description. The cranidium is broad. The almost parallel-sided glabella extends nearly the full length of the cranidium. In cross section it stands entirely above the shallow dorsal furrow and the fixigenes which slope gently down from it. The occipital furrow is clearly defined both on the glabella and fixigenes, and three pairs of glabellar furrows are traceable. The fixigenes between the eyes and the dorsal furrow are about as wide as the glabella at the same point. Unfortunately the eyes are not completely preserved, but appear to have been of normal size, shape and position.

Sabine formation; (loc. 12s) Ram Creek, 15 miles south of Canal Flats, British Columbia.

Holotype.—U.S.N.M. No. 108735a; paratype, No. 108735b.

ELLIPSOCEPHALOIDES BRISCOENSIS, new species

PLATE 10, FIGURE 7

One of a dozen or more cranidia is figured. *E. briscoensis* is narrower than *E. argutus* from the same region. Because of this feature it bridges the gap between the genotype and the narrow forms. The glabella is rectangular with rounded anterior angles and has two or three pairs of glabellar furrows represented by elongate pits. In width the brim measures less than a fourth the glabellar length. It has a peculiar narrow elevation in the middle, and also has a faintly defined narrow rim. As a whole the brim is slightly convex and is set in a horizontal position. On the sides the brim passes into the anterior fixigenes which maintain its level. In fact the outer margins of the fixigenes are curved up and back to the genal angles so that

the ocular platforms are depressed, leaving the eye lobes in a prominent position. In this species the eyes are long, and the eye bands wide and heavy. Faint eye lines extend straight across the fixigenes slightly anterior to the second pair of glabellar furrows.

Sabine formation; (loc. 17s) Sabine Mountain, Brisco Range, British Columbia.

Holotype.—U.S.N.M. No. 108736.

ELLIPSOCEPHALOIDES SILVESTRIS, new species

PLATE 11, FIGURES 1-3; PLATE 12, FIGURE 7

This form, intermediate between the broad and narrow species, is well represented in the collections. The nearly quadrate glabella is a little longer than wide and is well rounded in front. The occipital ring is of even width. The fixigenes are less than half the glabellar width and maintain their width throughout. The simple brim, only a little narrower than the fixigenes, has an elongate boss in the middle. A narrow rim is faintly indicated for a short distance in the middle of the head. Wide eye lines connect the wide eye lobes with the dorsal furrow.

The associated pygidium has a short wide axis on which three or four rings are demarcated. The pleural lobes and the rear border, which is as wide as the axis is long, have both pleural grooves and furrows. Both extend to the margin, producing sharp ridges. Five spines are developed on each side.

Honey Creek limestone; (loc. 91b) West Timbered Hills, Arbuckle Mountains, Oklahoma.

Holotype.—U.S.N.M. No. 108744a; paratypes, Nos. 108744b-d.

ELLIPSOCEPHALOIDES SAWBACKENSIS, new species

PLATE 11, FIGURES 4, 5

Only the two cranidia illustrated represent this distinctive species. The glabella is longer than wide and has three pairs of glabellar furrows indicated by pits. The fixigenes are about half the glabellar width and vary little from front to back. Heavy eye lines connect the large elevated eye bands with the dorsal furrow at a point in front of the anterior pair of glabellar furrows. The brim, about half the width of the fixigenes, is simple in structure but is raised as a boss in the center.

Lyell formation; (loc. 64x) Ranger Brook Canyon, Sawback Range, Alberta.

Holotype.—U.S.N.M. No. 108745a; paratype, No. 108745b.

ELLIPSOCEPHALOIDES CARUS, new species

PLATE 11, FIGURES 7, 8

This is a small form associated with *E. argutus*.

The subcylindrical glabella is rounded in front and has three pairs of glabellar furrows. The fixigenes are convex in contrast to most other species; consequently the rather thin eye lines appear to be more curved than usual. The eyes are on slightly upturned heavy bands.

Sabine formation; (loc. 12s) Ram Creek, 15 miles south of Canal Flats, British Columbia.

Holotype.—U.S.N.M. No. 108747a; paratype, No. 108747b.

ELLIPSOCEPHALOIDES MONTIS, new species

PLATE 11, FIGURES 9-11

The third species from the locality is an intermediate form, approaching the narrow rather than the broad species. Width may be an aspect as much as a reality, since the narrowness in dorsal view is sometimes due to the sloping position of the anterior angles, whereas other species appear wider because the anterior flanges of the same size are more nearly in a horizontal position. The wide glabella of *E. montis* is well rounded in front, and has a slight indentation at the center. Glabellar furrows are reduced to faint pits. The most distinctive feature is the fusing of the broad eye line with the brim, which slopes back to the eyes, the latter being in a posterior position. This gives the cranidium the appearance of being made up of the large glabella about which is draped a wide band that slopes toward the rear. Anterior fixigenes are eliminated by this juncture of the eye ridge and brim. Between the eyes and glabella the fixigenes have just a little more than one-third the glabellar width. In this species the neck ring is rather wide.

Sabine formation; (loc. 12s) Ram Creek, 15 miles south of Canal Flats, British Columbia.

Holotype.—U.S.N.M. No. 108748a; paratype, No. 108748b.

ELLIPSOCEPHALOIDES BEARENSIS, new species

PLATE 11, FIGURE 12

An imperfect cranidium represents the genus in the St. Charles formation of Idaho, showing that this element is also present in that fauna. This species is much more like the genotype in general aspect, but differs distinctly owing to the more posterior position of the eyes. Glabellar furrows seem to be lacking. The eye lines are very much

reduced, consisting only of a slightly elevated portion of the fixigenes. The eye band is turned up but does not have a distinct palpebral furrow.

St. Charles limestone; (loc. 66z) 5 miles west of St. Charles, Bear River Range, Idaho.

Holotype.—U.S.N.M. No. 108749.

ELLIPSOCEPHALOIDES BUTLERI, new species

PLATE 11, FIGURES 14, 15

This species, represented by numerous cranidia, is preserved in sandstone, and is associated with *Briscoia*. It has a typical development for the genus but is not proportionally as wide as the genotype. Glabellar furrows are present but may be lacking on the test. The eyes are strongly bowed and situated about the middle of the cranidium.

Sawatch formation; (loc. 37x) near Gilman, Mosquito Range, Colorado.

Holotype.—U.S.N.M. No. 108751a; paratype, No. 108751b.

ELLIPSOCEPHALOIDES NITELA, new species

PLATE 11, FIGURE 13; PLATE 12, FIGURES 1-3

This narrow form, represented by many examples, most resembles *E. silvestris*. Compared with that species *E. nitela* is somewhat broader and in the pygidium the pleura are wider. The nearly quadrate glabella has rounded anterior angles. The fixigenes are less than half the glabellar width, and are a little wider than the brim. The eye lines are weak and the broad eye bands are clearly defined by the palpebral furrows. The simple brim has a slight elevation in the middle. The associated pygidium has a broad axis on which the furrows are deep. In cross section the axis stands above the pleural lobes, which retain both the pleural grooves and furrows. The latter bisect the pleura obliquely, decreasing in strength posteriorly. Four marginal spines, decreasing in size from front to back, terminate the four pleural segments.

Honey Creek limestone; (loc. 12m) 7 miles north of Springer, Arbuckle Mountains, Oklahoma.

Holotype.—U.S.N.M. No. 108750a; paratypes, Nos. 108750b-d.

ELLIPSOCEPHALOIDES MONSENSIS, new species

PLATE 12, FIGURES 4-6

This narrow species similar to *E. montis* is represented by a number of cranidia and the pygidium. The quadrangular glabella is about

a third longer than wide, and has several pairs of glabellar furrows. The brim is narrower than the neck ring, a characteristic common to several of the Canadian species. The brim joins the eye ridges, which also form a raised band. The rather large eyes are situated well forward. The fixigenes, less than half the glabellar width, contract forward to meet the relatively narrow brim.

A beautiful pygidium with a wide flaring border bears two spines on each side. Its short, wide axis extends into a long postaxial ridge. Only two axial rings and pleura are defined. The entire pygidium is covered by prominent anastomosing lines.

Lyell formation; (loc. 64f) Mons Glacier, 50 miles northwest of Lake Louise, Alberta.

Holotype.—U.S.N.M. No. 108752a; paratype, No. 108752b.

ELLIPSOCEPHALOIDES DECLIVIS, new species

PLATE 12, FIGURES 10-13

This species is represented by several cranidia. It is similar to *E. monensis* except for the more posterior position of the eyes. The long, parallel-sided glabella is rounded in front, and in cross section stands completely above the palpebral lobe. The rear pair of glabellar furrows is continuous across the glabella and one shallow pair is visible anterior to it. The fixigenes, measuring less than half the glabellar width, slope down steeply from the dorsal furrow, though at a lesser angle than the sides of the glabella. The eyes are of normal size and are connected by a thickened eye ridge with the narrow convex brim.

Lyell formation; (loc. 20j) Tilted Mountain Brook, 9½ miles east of Lake Louise, Alberta.

Holotype.—U.S.N.M. No. 108754a; paratype, No. 108754b.

MARYVILLIA Walcott, 1916

MARYVILLIA WYOMINGENSIS (Resser)

PLATE 12, FIGURES 14-20; PLATE 14, FIGURE 1

Bathyuriscus sp., WALCOTT, U. S. Geol. Surv. Monogr. 32, p. 466, pl. 64, fig. 6, 1899.

Coosia wyomingensis RESSER, Smithsonian Misc. Coll., vol. 95, No. 22, p. 7, 1937.

Heads and tails of a species of *Maryvillia* occur throughout the Yellowstone Park region ranging from Clark Fork, Wyoming, to the Castle Mountains, Montana. A good cranidium on the hand specimen with the holotype of *Tricrepicephalus tripunctatus* (Whitfield) comes from Moss Agate Springs in the Castle Mountains, Montana.

The glabella tapers slightly to a rounded front. At the eye the fixigenes are exactly half the glabellar width. The facial suture forms rather broad posterolateral limbs. Eyes small and strongly bowed. Brim concave, with a rim differentiated by a change in slope. Eye lines traceable on exfoliated specimens.

Pygidium convex, sloping down rather sharply at the anterior angles. Outer test smooth, and dorsal furrow shallow. On exfoliated specimens both the pleural furrows and grooves are visible.

Pilgrim formation; Dead Indian Creek; and (loc. 151g) mouth of Clark Fork River, Absaroka Range, Wyoming; (loc. 4r) Suce Creek, Mount Delano, Snowy Range; and near Moss Agate Springs, Castle Mountains (with type of *Tricrepicephalus tripunctatus*), Montana.

Holotype.—U.S.N.M. No. 94343; plesiotypes, Nos. 108756, 108757, 108772.

MARYVILLIA VIOLAENSIS, new species

PLATE 12, FIGURES 21-26

About a dozen cranidia and half as many pygidia have been located in the collections. Only two small cranidia are illustrated, as all the larger specimens are incomplete.

Two partially preserved cranidia show that the cranidium of the species attained a length of about 15 mm. and a width of about 25 mm. The glabella is poorly defined because the dorsal furrow is very shallow. Eyes, eye lines, and fixigenes are average in development. The brim on the other hand is excessively concave, and consequently the rim seems to be more distinct than usual. As a whole the cranidium is gently convex in a transverse direction and much more sharply convex longitudinally.

In the pygidium the axis is clearly outlined by a shallow dorsal furrow. Axial rings and the anterior pleural furrows are faintly indicated. The pleural lobes, nearly flat in their inner half, become convex in their outer portion. Longitudinally the pygidium slopes gently rearward.

Maurice formation; (loc. 151k) Lebarge Creek, near Viola, Uinta County, Wyoming.

Holotype.—U.S.N.M. No. 108758a; paratype, No. 108758b.

MARYVILLIA UTAHENSIS, new species

PLATE 12, FIGURES 27-32

Oolitic and soft granular limestone beds of the Weeks formation have yielded species of *Maryvillia*. *M. utahensis* is represented by

fairly good material which includes all the various parts. In the striation and structure of the brim, the larger size of the eye, and the wider border of the pygidium, this species approaches *Coosia*. However, it seems better to place the species on the *Maryvillia* side of the boundary and recognize these discrepancies.

The glabella tapers to a rounded front, and in exfoliated specimens is clearly outlined by a deep dorsal furrow. The fixigenes, convex in cross section, are a little less than half the glabellar width. Rather heavy eye lines are accentuated in appearance by the abrupt slope adjacent to them. The width of the brim is equal to half the length of the glabella exclusive of the occipital ring. The rim is demarcated by a change in slope. Heavy striations occur on the front edge of the rim. Eyes rather large, being nearly as long as the brim is wide.

The libragene shows that the suture is intramarginal for a short distance. Its rather wide and strongly striated rim increases in width slightly from the front to the rounded genal angle. The ocular platform is very narrow opposite the anterior portion of the eye. At its widest point, at the rear of the eye, it is not much broader than the rim. The associated hypostoma is nearly circular in outline with the central convex portion occupying less than half of its area. The outer upturned flange is striated in a manner similar to that of the rims on the cranidium and libragene.

The associated pygidium is strongly convex in lateral direction and slopes very steeply longitudinally. The axis, occupying only a little more than half the length of the tail, is not strongly differentiated from the pleural lobes, although it stands completely above them. Axial rings and the anterior pleura are faintly indicated.

Weeks formation; (loc. 32w) Fandango Spring Canyon, Dugway Range, Utah.

Holotype.—U.S.N.M. No. 108759a; paratypes, Nos. 108759b-e.

MARYVILLIA MARJUMENSIS, new species

PLATE 12, FIGURES 33-35

This species is well represented, and on several pieces of rock cranidia and pygidia lie close together. One fairly large cranidium is figured, but even larger ones are present in the collection. *M. marjumensis* is fully typical of *Maryvillia* in that the pygidial axis extends nearly the full length of the pygidium. As usual the glabella tapers to a rounded front and in exfoliated specimens is clearly defined by a rather deep dorsal furrow, which on the outer test is shallow. Fixigenes average just about half the glabellar width. Eyes are of normal

size. The brim width equals about half the length of the glabella, including the occipital ring. It is gently concave with a rather wide rim indicated by a slight change in curvature. The cranidium is slightly convex in both directions.

The associated hypostoma is almost circular in outline, and is striated on the wide flange which surrounds the convex but depressed central elevation.

The plump pygidium with an axis extending nearly the full length terminates in a postaxial ridge.

Weeks formation; (loc. 30i) 5 miles south of Marjum Pass, House Range, Utah.

Holotype.—U.S.N.M. No. 108760a; paratypes, Nos. 108760b-e.

MARYVILLIA LOPERI, new species

PLATE 12, FIGURES 36-38

This species is found at two localities in arkosic, calcareous, and quartzitic sandstone. It averages rather large in size compared to other western species. The glabella tapers forward to the rounded front in the usual manner, and is a little longer than in the other species here described. At the eyes the fixigenes are slightly more than half the glabellar width. The eyes are normal in size and position. The brim width is about one-third the glabellar length. A shallow anterior furrow separates a slightly thickened rim. In cross section the cranidium is moderately and evenly convex, but longitudinally it is rather flat.

The associated pygidium is likewise rather convex in cross section, but longitudinally proportionately has greater convexity than the cranidium. The prominent axis occupies nearly three-fourths the length of the pygidium. In exfoliated specimens three pleural grooves are visible on each side.

Sawatch formation; (loc. 6a) Taylor Peak, 4 miles south of Ashcroft; (loc. 6) Italian Mountain, 15 miles northeast of Crested Butte, Colorado.

Holotype.—U.S.N.M. No. 108761a; paratype, No. 108761b.

MARYVILLIA ALBERTA, new species

PLATE 13, FIGURES 1-4

This species is founded on a single exfoliated cranidium, and a pygidium from a nearby locality is referred to it. The cranidium, typical in all respects, has a large glabella that tapers to a rounded frontal outline. Exfoliated specimens have a strongly developed keel.

At the eyes the fixigenes are half the width of the glabella. The width of the simple, gently concave brim is a little less than the glabellar length. The eyes are slightly larger than usual. In both directions the convexity of the cranidium amounts to little.

The pygidium from a nearby locality, assigned to the species, has a prominent axis which tapers somewhat more than usual. The rear border occupies about one-third the pygidial length, which with the rather large eye, indicates the approach to *Coosia*.

Sullivan formation; (locs. 64i, 64c) Glacier Lake Canyon Valley, 48 miles northwest of Lake Louise, Alberta.

Holotype.—U.S.N.M. No. 108762; paratype, No. 108770.

MARYVILLIA MONTIS, new species

PLATE 13, FIGURES 11-13

Several cranidia and pygidia are in hand. The glabella which tapers to a rounded front, is almost without trace of furrows but does have a faint keel. In this species the brim is rather wide, equaling one-third the cranidial length. A slightly thickened rim, separated by a wide anterior furrow, can be seen when the specimen is lighted from the front, but when the direction of lighting is changed the brim appears to be concave without a rim. At the eye the fixigenes are about half the glabellar width. Longitudinally the cranidium is nearly flat. However, the glabella is gently convex and the preglabellar area depressed, while the brim rises until its anterior half extends above the level of the glabella. In cross section there is little convexity.

The prominent pygidial axis occupies three-fourths the length of the pygidium and has a postaxial ridge that reaches practically to the rear margin. Axial and pleural furrows shallow. Moderate convexity is developed in both directions.

Deadwood formation; (loc. 17L) ½ mile west of Deadwood, Black Hills, South Dakota.

Holotype.—U.S.N.M. No. 108763a; paratype, No. 108763b.

MARYVILLIA HYBRIDA, new species

PLATE 13, FIGURES 14-17

Although this species is not fully typical of the genus, the cranidial and pygidial characters appear to be closer to *Maryvillia* than to any other described genus. Therefore *M. hybrida* is placed in this genus for the present. The exfoliated cranidium has a glabella that tapers to a rounded front. The occipital ring is narrow. No trace of glabellar furrows remains. The brim width equals nearly one-third the

glabellar length. It is concave without differentiation of a rim either by furrow or change in contour.

At the eyes the fixigenes are about half the glabellar width, increasing posteriorly to expand in rather large posterolateral limbs. In cross section the cranidium is rather convex with an even curvature, while longitudinally the convexity is greater. The pygidium has a conspicuous axis rising above the pleural lobes. Axial and pleural furrows obliterated. In cross section the profile is rather flat, but longitudinally the axis is convex and the rear portion of the pygidium slopes down steeply.

Cap Mountain formation; (loc. 14d) Bartlett Hollow, Burnet County, Texas.

Holotype.—U.S.N.M. No. 108765a; paratype, No. 108765b.

MARYVILLIA MOOSENSIS, new species

PLATE 14, FIGURES 15-17

This species is represented by several examples of cranidia and pygidia from a single boulder found in the Moose River, and therefore the association of head and tail is certain. This is the first identification of the genus in the lower beds of the Lynx formation in the Robson District. The matrix is a dark crystalline limestone containing vaugnite pebbles.

The illustrated cranidium is partially exfoliated, and therefore has a deep dorsal furrow and faint glabellar furrows. The slightly thickened rim is a little wider than the preglabellar area. Fixigenes are narrow, averaging about half the glabellar width at its anterior end. An exfoliated pygidium is illustrated, showing the nodes in the axial furrows, and also shallow pleural furrows. The axis tapers very little and slopes down in the rear rather steeply.

Lynx formation (Sullivan equivalent); (loc. 61r) drift in Moose River, 10 miles northeast of Robson Pass, British Columbia.

Holotype.—U.S.N.M. No. 108771a; paratype No. 108771b.

METEORASPIS Resser, 1935

METEORASPIS BANFFENSIS, new species

PLATE 13, FIGURES 5-10

Meteoraspis is not yet well understood. Reference of these cranidia and possibly the pygidium to the genus is warranted according to our present knowledge.

The large tumid glabella occupies about three-fourths of the cranidial area. Furrows are only faintly indicated even on the exfoliated cranidium. Occipital furrow and ring are well developed. Brim width

about one-fourth the glabellar length. Thickened rim wider than the nearly flat preglabellar area. Fixigenes narrower than the rim, convex adjacent to the eye. The small, strongly bowed eyes are set parallel to the dorsal furrow. Suture diverges normally anterior to the eye. Relief of the cranidium is considerable as shown in the illustrations. Anterior angles and posterolateral limbs are moderately depressed. Surface closely granulose.

The associated pygidium is similar to certain forms assigned to *Maryvillia* or *Coosella*. Its axis extends about three-fourths the pygidial length. Pleural furrows weakly developed. A rather wide, flat, border is underlain by a striated doublure.

Sullivan formation; (loc. 66m) $4\frac{3}{4}$ miles northwest of Banff, Sawback Range, Alberta.

Holotype.—U.S.N.M. No. 108764a; paratypes, Nos. 108764b, c.

COOSIA Walcott, 1911

COOSIA CANADENSIS, new species

PLATE 13, FIGURES 18-20

Several pygidia and one cranidium have been segregated. It is a rather small species for the genus but typical in most other respects. The glabella, tapering to a rounded front, is without furrows. The concave brim width is about one-third the glabellar length. A flat rim demarcated by a shallow anterior furrow about equals the preglabellar area in width. Fixigenes narrow, their width being less than one-fourth the glabellar width at both ends of the eye lobe. The fixigenes rise from the dorsal furrow, but the palpebral lobes have a nearly horizontal position. Laterally the glabella is slightly convex, and longitudinally the cranidium attains moderate convexity by depression of the brim and the steepness of the slope in the anterior part of the glabella. The pygidium has a prominent axis occupying a little more than half its length. In dorsal view a postaxial ridge makes the axis appear much longer than it is. Axial rings are faintly shown, but the pleural furrows and grooves are so completely fused that only the anterior pair remains.

Sullivan formation; (loc. 64i) Glacier Lake Canyon Valley, 48 miles northwest of Lake Louise, Alberta.

Holotype.—U.S.N.M. No. 108766a; paratype, No. 108766b.

COOSIA ALBERTENSIS, new species

PLATE 13, FIGURES 25-28

Although apparently an abundant species, only a few specimens have been segregated in the collection. This is not a large species,

but is typical of the genus. The glabella tapers to a rounded front. A keel is clearly defined and faint shadows indicate glabellar furrows. Brim, one-third the length of the glabella, has a more clearly defined rim than usual. The fixigenes are narrow and the palpebral lobes rather large.

In the pygidium the axis, with fairly deep furrows, occupies about half the pygidial length. The pleural lobes slope down rather gently to the wide border which assumes a horizontal position.

Sullivan formation; (loc. 65i) Glacier Lake Canyon Valley, 48 miles northwest of Lake Louise, Alberta.

Holotype.—U.S.N.M. No. 108768a; paratype, No. 108768b.

COOSIA DAKOTENSIS, new species

PLATE 13, FIGURES 29-31

Although this large species is abundantly represented, only a few unbroken examples of each part have been freed from the matrix. It occurs in thin limestone lenses composed chiefly of trilobite fragments. Some of the fragments show the heavy doublure characteristic of the genus.

The cranidium is fully typical of *Coosia* in its tapering unfurrowed glabella, wide concave brim, and narrow fixigenes. The brim width is considerably more than half the glabellar length. It is without an anterior furrow, but the heavy doublure causes a thickening in the anterior portion. Fixigenes and eyes are normal in development.

Libragene large, with an elongate ocular platform and a heavy rim that extends into a long, heavy, nearly straight genal spine. Brim on both the cranidium and libragene striated.

Pygidium normal, with the axis occupying about half the pygidial length. Axial rings well defined, and on exfoliated specimens the pleural furrows are visible.

Deadwood formation; (loc. 17j) Galena, Black Hills, South Dakota.

Holotype.—U.S.N.M. No. 108769a; paratypes, Nos. 108769b, c.

COOSIA TRIDENTENSIS, new species

PLATE 15, FIGURES 12-17

This species is abundantly represented in the small collection from this locality. Unfortunately the rock is shattered with injection of calcite veins, which with the crowding of the fossils accounts for the difficulty in getting complete specimens.

The glabella tapers rather rapidly to a rounded front. Lighted from certain directions it appears to be sharply truncate because of the contour of the anterior lobe. Another peculiar feature is the

outward curvature of the dorsal furrow slightly anterior of the midpoint of the eye, which creates a small side lobe on the glabella. The concave brim is a little more than one-third the glabellar length. A sudden increase of curvature develops a broad, shallow anterior furrow near the middle of the brim. Between the eyes, with their broad bands, the fixigenes are confined to the palpebral lobes, which are not as wide as the eye band. Anterior to the eye the facial suture diverges rapidly, developing large anterior angles. Since the eyes extend almost to the occipital furrow, there is almost no fixigene behind the eye, and the posterolateral limbs are therefore very narrow.

The pygidium has the typical oval shape, with a tapering axis that occupies about two-thirds its length. A light postaxial ridge is traceable to the margin. Longitudinally the axis is slightly convex, dropping to the nearly flat border with a smooth concave curve. Furrows, weak on the axis, become clearly defined on the pleural lobes when the test is exfoliated.

Pilgrim formation; (loc. 20y) 3 miles north of Trident, north of Logan, Montana.

Holotype.—U.S.N.M. No. 108786a; paratypes, Nos. 108786b-g.

COOSELLA Lochman, 1936

COOSELLA TEXANA, new species

PLATE 13, FIGURES 21-24; PLATE 14, FIGURES 2-5

The first species of *Coosella,* typical in all respects, to be recognized in Texas occurs at two localities. Only the holotype cranidium and the nearly complete pygidium were collected at one locality, but several of each of the parts occur at the other place.

The large glabella tapers rapidly to the rounded front. Faint broad depressions shadow the glabellar furrows. The brim width equals a little less than one-third the glabellar length. In cross light the brim is simple and concave, but when the lighting is from the front a broad, slightly thickened rim is demarcated by a shallow anterior furrow. The diagonal set of the eyes and the nondivergence of the anterior facial suture cause the brim to be much shorter than the rear of the cranidium, producing the pinched effect in the anterior part of the cranidium characteristic of the genus. At the anterior end of the eye lobe the fixigene equals half the glabellar width at the same point, while at the rear of the eye lobe the same relationship is less than one-third. This shows that the fixigene retains its width but little changed, whereas the glabella expands rapidly. The eyes are of normal size, situated opposite the anterior portion of the glabella, and are set parallel to the dorsal furrow.

The axis is about half as long as the pygidium and although it rises above the pleural lobes, its convexity is not great. On the exfoliated portion axial furrows and the pleural grooves are clearly indicated by shallow furrows.

Cap Mountain formation; (loc. 14d) Bartlett Hollow, and (loc. 67a) Potatotop, 7 miles northwest of Burnet, Texas.

Holotype.—U.S.N.M. No. 108767a; paratypes, Nos. 108767b, 108773a, b.

COOSELLA BREVIS, new species

Plate 14, Figures 6-9

Only the illustrated incomplete cranidium and pygidium have been found in this small collection. This species is fully characteristic of *Coosella* in features of both the head and tail. The glabella, which tapers to a rounded front, lacks glabellar furrows. On the other hand the occipital furrow and ring are clearly defined. At the anterior end of the eye the fixigene is about half the glabellar width. The fixigene maintains the same width with little change. Owing to the moderate divergence of the anterior facial suture, there is a slight expansion in front of the eye. The brim width equals nearly half the glabellar length. It has a heavily striated swollen rim, defined by the anterior furrow. The preglabellar area, which is wider than the rim, is depressed below both the rim and glabella.

The eye lobes, about half as long as the glabella, are not greatly bowed and are set nearly parallel to the converging dorsal furrow.

The almost semicircular pygidium is slightly wider than long. The axis stands above the pleural platforms, and extends back for more than two-thirds the pygidial length. It slopes sharply downward near the posterior end to a slight postaxial ridge. Axial and pleural furrows are shallow, but clearly defined in the exfoliated type. Since the test is thick it is probable they are not to be seen on the outer surface. The doublure has a width equal to about one-fourth the pygidial length.

Warrior limestone; (loc. 38c) 1 mile northwest of Benore, and 5 miles west of State College, Pennsylvania.

Holotype.—U.S.N.M. No. 108774a; paratype, No. 108774b.

PTEROCEPHALINA Resser, 1938

PTEROCEPHALINA TEXANA, new species

Plate 14, Figures 32, 33

Only the holotype pygidium has been found in this collection. The wide axis with at least four rings tapers to a rather sharp point, back

of which a postaxial ridge extends to the indented median margin. The pleural platforms are shaped as small triangles, considerably curved to meet the wide concave border. This border develops sizeable flanges at the posterior angles, giving the rear a rather straight margin and the entire pygidium a quadrate shape.

Wilberns formation; (loc. 69) Honey Creek, 8 miles southeast of Llano, Texas.

Holotype.—U.S.N.M. No. 108780.

PTEROCEPHALINA NOTHA, new species

PLATE 14, FIGURES 34-38

The pygidium is typical of the genus. The associated cranidium assigned to the species differs from the head supposed to represent *P. bilobata,* but is like those assigned to the other species of the genus.

The glabella which has two pairs of short furrows, tapers to a poorly defined front, as shown in the side views. This characteristic is due not only to the shallowness of the anterior dorsal furrow but also to the fact that the preglabellar area and the anterior fourth of the glabella form a slope of uniform curvature to the depths of the concavity in the brim. The wide brim rises sharply and the outer portion of the rim is somewhat thickened. A slight change in slope marks the inner edge of the rim which in itself is very concave. Since it is so poorly marked, light must strike this angle properly in order to make it visible. It will be noted that the rim is scarcely perceptible in the dorsal view and in one of the side views. The fixigenes rise rather steeply to the palpebral lobes, on which a strongly curved eye occupies a prominent position because it has a wide swollen eye band. Preglabellar area and part of rim marked by vertical anastomosing lines. In the pygidium the axis is long and rather slender, a postaxial ridge connecting it with the indented median margin. A wide border is produced by the concave portion underlain by the doublure.

Mendha limestone; (loc. 7j) 1 mile north of Italian Ranch foothills, north end of Quinn Canyon Range, Nevada.

Holotype.—U.S.N.M. No. 108781a; paratypes, Nos. 108781b-d.

PTEROCEPHALINA BILOBATA (Hall and Whitfield)

PLATE 14, FIGURES 39-43

Dikelloccphalus (*Pterocephalus*) *bilobatus* HALL and WHITFIELD, U. S. Geol. Expl. 40th Par. vol. 4, p. 226, pl. 2, fig. 36, 1877.

Dicellocephalus bilobatus WALCOTT, U. S. Geol. Surv. Monogr. 8, p. 40, 1884.

Platycolpus bilobatus WALCOTT, Smithsonian Misc. Coll., vol. 57, No. 13, p. 349, 1914.
Pterocephalina bilobata RESSER, ibid., vol. 97, No. 10, p. 42, 1938.

Additional specimens of this species are figured in order that it may be better understood. A small tail is figured to show the features at that stage. The large cranidium, from which a rim of unknown but evidently considerable width has been broken away, is tentatively assigned to the species.

Secret Canyon shale; (loc. 65) east side of Sierra Canyon, opposite Pinnacle Peak; and (loc. 61) south of Hamburg Mine, Eureka District, Nevada.

Holotype.—U.S.N.M. No. 24568; plesiotypes, Nos. 108782a-c.

PTEROCEPHALINA POGONIPENSIS, new species

PLATE 15, FIGURES 1-2

Several small pieces of very fossiliferous limestone contain a pygidium and a cranidium regarded as belonging to the same species. Originally it was identified as *P. flabellifer.*

The cranidium is small for the genus. The glabella occupies more than half the cranidial length and since it is exfoliated, three pairs of recurved furrows are faintly visible in cross light. The concave brim is divided into a slightly convex preglabellar area and a wider, flat, somewhat upturned rim. The convex fixigenes are less than half the glabellar width.

As may be observed in the illustrations the axis occupies nearly the full length of the pygidium. It is almost straight on top, sloping back at an even rate to the short postaxial ridge. Axial and pleural furrows are well developed, the latter extending to the margins. Though the lateral margins are somewhat extended, the border is less flared than in more typical species.

Secret Canyon shale; west side of Pogonip Mountain, White Pine District, Nevada.

Holotype.—U.S.N.M. No. 108783a; paratype, No. 108783b.

PTEROCEPHALINA GRATA, new species

PLATE 15, FIGURES 3-6

This small distinctive species is represented by several cranidia and pygidia. The narrow cranidium has a large slightly tapered glabella and a concave brim about one-third as wide as the glabellar length. The demarcation of a wide rim is so faint that only in a certain light does the brim appear to be anything but a simple concave plate.

The axis occupies only about half the pygidial length. It is slightly concave in a longitudinal direction and slopes abruptly to the wide border. Furrows are visible on the axis and in the anterior portions of the pleural platforms. A slight postaxial ridge extends to the rear margin.

Secret Canyon shale; (loc. 23b) ridge east of Hamburg Ridge, Eureka District, Nevada.

Holotype.—U.S.N.M. No. 108784a; paratype, No. 108784b.

PTEROCEPHALINA UTAHENSIS, new species

Plate 15, Figures 7-11

A very fine species of *Pterocephalina* has been found in western Utah. This genus should be represented in other formations of the same age throughout the cordilleran region.

The glabella tapers to a truncated front, where the dorsal furrow is almost obliterated. Three pairs of glabellar furrows are faintly defined, the posterior pair having a very irregular course. The wide, gently concave brim occupies nearly half the glabellar length. Fixigenes are narrow, being only one-third the glabellar width between the eyes and the dorsal furrow. Eye bands are heavy. Anterior to the eyes the facial suture diverges moderately to meet the wide brim. The axis occupies less than half the length of the pygidium and stands above the small pleural platforms. Three rings are clearly defined. Three pleural furrows, decreasing in depth from posteriorly, are visible. The wide border is nearly flat, and has a wide medial indentation.

Orr formation; (loc. 33d) east side of Fish Spring Range, Utah.

Holotype.—U.S.N.M. No. 108785a; paratype, No. 108785b.

BURNETIDAE, new family

Kobayashi established the Dokimocephalinae as a subfamily in the Solenopleuridae Angelin, to include the genera *Burnetia, Dokimocephalus, Iddingsia, Elkia,* and *Acrocephalites.* The last-named genus superficially resembles the others, but since it is a Middle Cambrian Atlantic Province genus and therefore far removed from the others in time and space, its relationship may be questioned. In my opinion *Acrocephalites* is related to *Solenopleura* and should remain in that family. The Burnetidae are not from the *Solenopleura* line but have descended from trilobites found in the cordilleran region. To the named genera must be added *Berkeia,* and several others still undescribed.

Thus constituted, the new family is found to play a rather prominent role in the Upper Cambrian, beginning in *Crepicephalus* time and extending to about the middle of the Upper Cambrian. Wide variation appears to exist between the ordinary swollen rim of *Berkeia* and the enormous snout of *Dokimocephalus*. However, since the glabella, fixigenes, eyes, and furrows are much alike in these genera, the variations in rim shape are not to be looked upon as a separating but rather as a uniting feature of the family. Variability of the rim is found between species of the same genus. Consequently, with such a characteristic, wide variation must be expected in the family, and as such becomes a family characteristic.

BURNETIA Walcott, 1924

BURNETIA INTERMEDIA, new species

PLATE 17, FIGURES 10, 11

B. intermedia is one of the linguloid forms. Its glabella tapers moderately to a rounded front. Two pairs of glabellar furrows are clearly defined. The enlarged neck ring extends into a long, erect spine. At the anterior end of the eyes the fixigenes are less than one-third the glabellar width. The palpebral lobes are sharply angulated. The palpebral furrow is wide and eye band heavy. The brim attains a width equal to the length of the glabella exclusive of the neck ring, and the preglabellar area is less than one-fifth this width. Viewed from the rear the glabella is roundly convex and the fixigenes rise to the eyes. Viewed from the front, however, the relative convexity of the several parts is much less, though the anterior fixigenes drop steeply to the depressed anterior angles. Greater convexity of the cranidium is found in the longitudinal profile, attained by a rather even curvature of both glabella and brim, which together form a smooth sigmoid curve. Surface granulose.

Honey Creek limestone; (loc. 12p) 4 miles southeast of Hennepin, Arbuckle Mountains, Oklahoma.

Holotype.—U.S.N.M. No. 108805.

BURNETIA ALTA, new species

PLATE 17, FIGURES 12-14

The long glabella has two pairs of furrows. In dorsal view it appears to be narrow and tapered more rapidly than in most species. If, however, the excessive convexity in both directions is taken into consideration the area of the glabella is really large. The brim is not wide, being less than half the glabellar length exclusive of the neck

ring. The preglabellar area is less than one-fourth the rim width. Longitudinally the convexity of the cranidium is so great that the front fourth has taken the position of a 90° angle with the posterior portion of the glabella. From that position the brim takes a less steep angle and is in itself nearly flat. In cross section the glabella is also very convex, attaining a height equal to about one-third its length. Because the anterior angles are also greatly depressed this species becomes one of the most convex Cambrian trilobites.

The associated libragene is large. The wide and long ocular platform is only slightly convex and lacks a furrow. Toward the long genal spine the libragene becomes convex forming a ridge that extends into the genal spine. Elevated portions of surface of head and cheek coarsely granulated.

Davis formation; (loc. 11k) Federal Lead Mine No. 4, Flat River, Missouri.

Holotype.—U.S.N.M. No. 108801a; paratype, No. 108801b.

BURNETIA EXTENSA, new species

PLATE 17, FIGURES 15-22

This species is abundantly represented by numerous cranidia, several libragenes, and possibly also by a pygidium. It is the extreme of the linguloid forms thus far found. It will be observed that a slight variation has been allowed among the specimens figured.

The glabella, rounded in front, has two pairs of furrows. The occipital furrow is almost interrupted at the center, and the neck ring carries a large spine. The brim, which comes to a rather sharp point, exceeds the length of the glabella exclusive of the neck ring. A narrow preglabellar area is present. Eyes are strongly bowed and have heavy eye bands. The libragenes illustrated show that the suture is intramarginal for a considerable distance and that the wide doublure apparently extends all the way across, with an increase in width toward the middle. The associated pygidium has a long, stout axis and pleural lobes that are slightly convex, sloping to a concave border.

Honey Creek limestone; (loc. 89v) West Timbered Hills, Arbuckle Mountains, Oklahoma.

Holotype.—U.S.N.M. No. 108807a; paratypes, Nos. 108807b-g.

BURNETIA EXILIS, new species

PLATE 17, FIGURES 23-27

This species also is well represented by cranidia. Because of its nearly circular anterior outline it is closer to the normal form. In

fact, taken as a whole, the cranidium gives the impression of circularity. At the same time *B. exilis* is a convex form, the glabella standing high above the fixigenes and the brim continuing the downward slope of the anterior portion of the glabella. Eyes, fixigenes, glabellar furrows, and eye bands are similar to corresponding parts in species of average structure for *Burnetia*. The brim width is about three-fourths the glabellar length and has only a narrow preglabellar area. Viewed from the front, the brim has an even curvature between the depressed anterior angles. In cross light several shallow secondary furrows parallel to the front margin are visible, but they may represent doublure impressions. Surface of elevated portions granulated.

Honey Creek limestone; (loc. 89v) West Timbered Hills, Arbuckle Mountains, Oklahoma.

Holotype.—U.S.N.M. No. 108808a; paratypes, Nos. 108808b, c.

BURNETIA ECTYPA, new species

PLATE 17, FIGURES 30, 31

Only a small fragment in addition to the beautiful holotype cranidium has been found. The glabella, well rounded in front, has the rear pair of glabellar furrows of normal development and very shallow identations indicating the second pair. No nuchal spine and practically no preglabellar area remain. The brim is about two-thirds the length of the glabella including the neck ring. Longitudinally the glabella is rather highly and evenly convex. The concave brim is set at such an angle that it makes the cranidium as a whole high. In cross section the glabella rises steeply above the dorsal furrow to a somewhat angulated median portion. The rim is evenly convex between the moderately depressed anterior angles.

Honey Creek limestone; (loc. 89v) West Timbered Hills, Arbuckle Mountains, Oklahoma.

Holotype.—U.S.N.M. No. 108809.

BURNETIA LINGULA, new species

PLATE 17, FIGURES 32, 33

A single cranidium of another linguloid form, much like *B. extensa*, has greater convexity and a brim of the same width as the glabellar length. A narrow preglabellar area remains. Viewed from the side the glabella is gently convex at the rear, increasing its rate of curvature until the anterior third is turned sharply downward. The proclivity of the glabella is continued by the brim at a decreasing rate for nearly half its width, beyond which point the rate of slope de-

creases until the anterior part is nearly horizontal. In cross section the glabella is moderately convex, the anterior angles not greatly depressed and the anterior portion of the rim nearly flat. Surface not preserved.

Honey Creek limestone; (loc. 89v) West Timbered Hills, Arbuckle Mountains, Oklahoma.

Holotype.—U.S.N.M. No. 108810.

BURNETIA CURTA, new species

PLATE 17, FIGURES 28, 29

A cranidium has a peculiar large glabella with a nearly circular front outline. Three pairs of furrows are visible. Fixigenes and eyes are normal. The brim width is not much more than half the glabellar length and has a narrow preglabellar area. The neck ring extends into a long elevated spine that nearly equals the length of the cranidium. Convexity is not great in cross section, but longitudinally it is considerably more.

Honey Creek limestone; (loc. 9q) Blue Creek Canyon, Wichita Mountains, Oklahoma.

Holotype.—U.S.N.M. No. 108811.

BURNETIA CAVA, new species

PLATE 20, FIGURES 1-3

A cranidium and associated libragene impression represent this species. Glabella normal in size and shape although it possibly is a little wider than average. Two pairs of furrows are well developed and a third is faintly indicated. The neck ring may have borne a spine, but if so, it was no more than a node. The brim width is considerably greater than half the glabellar length. Most of it consists of a concave rim with only a narrow preglabellar area demarcated by a shallow furrow. Fixigenes average only a little more than a fourth of the glabellar width, and the divergence of the suture anterior to the eye produces large anterior angles into which the wide rim extends. The sharply bowed eyes are set at a somewhat more divergent angle than the dorsal furrow and are situated slightly in advance of the occipital furrow, leaving a considerable posterolateral limb. The broad fixigene assigned to the species has a rather large genal spine. The suture evidently is intramarginal to the center, but since it is broken away in front, that structure is not readily observable.

Surface covered with evenly spaced granules except in furrows. They are arranged in radiating lines on the libragene.

Ore Hill formation; (loc. 107v) ½ mile northwest of Drab, Pennsylvania.

Holotype.—U.S.N.M. No. 108827a; paratype, No. 108827b.

BURNETIA EDWARDSI, new species

PLATE 20, FIGURES 20, 21

A large cranidium associated with species of *Taeniocephalus* and *Orygmaspis* occurs on a hand specimen of soft sandstone. Although the brim is narrow, the entire structure is typical of the genus. The glabella, tapering at a normal rate, has several sets of broad, shallow furrows faintly indicated. The occipital furrow also is broad and shallow. The concave brim is subdivided almost equally between a rim and a preglabellar area. Its width is just a little more than a fourth of the cranidial length. The fixigenes are a little less than half the glabellar width. The sharply bowed eyes are of normal size but situated a little farther forward than the ordinary position for the genus. In front of the eyes the sutures diverge considerably to form large anterior angles. Longitudinally the head forms a sigmoid curve with the rear part of the glabella nearly horizontal and the anterior part arched down sharply to the concave brim. Viewed laterally the glabella stands completely above the fixigenes and has a fairly even curvature.

Franconia sandstone; 2 miles west of Clifton, Monroe County, Wisconsin.

Holotype.—U.S.N.M. No. 108832.

BURNETIA PENNSYLVANICA, new species

PLATE 21, FIGURES 29-31

Several cranidia and a libragene from the type locality have been assigned to this species. From the other locality there are other less complete cranidia and fragments of other parts. This species is typical of the genus, belonging to the group in which the brim is not expanded. Restoration of the front of the glabella from the counterpart allows the cranidium to be reproduced in its entirety. The glabella tapers forward at the usual rate for cranidia of this type. The rear pair of furrows is deeply impressed, while pits next to the dorsal furrow indicate the position of the other two pairs. The width of the moderately concave brim is just half the glabellar length exclusive of the occipital ring. The rim is much wider than the preglabellar area and is not evenly concave because it has a furrowlike depression paralleling the anterior furrow. The eyes of normal size are so sharply bowed that the palpebral lobe is angulated. At the anterior

end of the eye the fixigene is less than a third the glabellar width. Anterior angles and narrow posterolateral limbs are strongly depressed. Surface of exterior granulose, evidently with two sets of granules. Exfoliated surfaces are even more closely covered with coarser granules varying considerably in size.

Ore Hill formation; (loc. 107e) 1 mile south of Ore Hill; and (loc. 107v) ½ mile west of Drab, Pennsylvania.

Holotype.—U.S.N.M. No. 108842a; paratype, No. 108842b.

IDDINGSIA Walcott, 1924

IDDINGSIA NEVADENSIS, new species

PLATE 16, FIGURES 15-17

A cranidium and libragene which were previously identified as *I. robusta,* differ from that species in several respects. *I. nevadensis* is characterized by the usual large glabella on which the rear pair of furrows are deep and the next pair short and shallow. A wide occipital furrow separates a prominent neck ring. At the anterior end of the eye the fixigenes are about one-third the glabellar width. In width the brim is just half the length of the glabella including the neck ring. It is divided about equally into a somewhat convex preglabellar area and a slightly thickened rim. Longitudinally the cranidium is convex, the glabella having a nearly even curvature except toward the front, where there is a slight decrease. On the other hand the brim as a whole is moderately concave. In cross section the glabella is convex, and the libragenes rise from the dorsal furrow rather steeply. The anterior angles are sharply depressed. Likewise the posterolateral limbs appear to have been considerably depressed. The associated libragene has a large ocular platform and a rim to match the brim width. A heavy genal spine of unknown length is built from the heavy rim and the thickened rear portion of the cheek.

This species differs from *I. robusta* in its longer glabella and relatively narrower rim. In *I. robusta* the brim as a whole continues the downward slope of the anterior half of the glabella, thus giving the cranidium much greater convexity.

Secret Canyon shale; (loc. 61) South of Hamburg Mine, Eureka District, Nevada.

Holotype.—U.S.N.M. No. 108796a; paratype, No. 108796b.

IDDINGSIA UTAHENSIS, new species

PLATE 16, FIGURES 18-20

Several cranidia from the Dugway Range are the basis for a species, which in general appearance resembles *I. nevadensis. I. utahensis* is

characterized by a normal glabella on which two pairs of furrows are clearly impressed. At a point immediately in front of the eye the fixigene is about one-third the glabellar width. Divergence of the facial suture in front of the eye develops moderately large anterior angles. The brim width is about two-thirds the glabellar length including the occipital ring. The slightly convex preglabellar area is about two-thirds the width of the rim. Little curvature exists in the rear half of the glabella, but the forward part turns down sharply. The preglabellar area continues that slope, but the rim is turned toward a horizontal position. Surface granulose, as usual.

Orr formation; (loc. 32t) Fandango Spring Canyon, Dugway Range, Utah.

Holotype.—U.S.N.M. No. 108797a; paratype, No. 108797b.

IDDINGSIA MISSOURIENSIS, new species

Plate 16, Figures 21-26

This is a rather prolific species, associated with *Berkeia, Pterocephalia,* and other genera. Besides the numerous cranidia several libragenes also represent the species. The glabella, tapering to a somewhat truncated front, has three pairs of well-developed furrows. The width of the flaring brim equals about two-thirds of the glabellar length. In the middle the flat rim is wider than the preglabellar area. The slightly convex preglabellar area continues the downward slope of the anterior portion of the glabella, but the nearly flat rim has a less steep slope. At the anterior end of the eye the fixigene is one-third as wide as the glabella. It rises sharply from the dorsal furrow but is in itself not very convex. The strongly bowed eyes are situated far back, practically in contact with the occipital furrow. An eye line extends forward from the eye to the anterior glabellar lobe. Longitudinally the cranidium is strongly convex, the relief being attained by a slight curvature of the posterior half of the glabella and a strong down-curving of the anterior half, continued by the slope of the brim. Laterally the glabella rises little above the level of the palpebral lobes, but the posterolateral limbs are sharply depressed. At the eye lines the fixigenes slope abruptly downward to the anterior angles. A small node occurs on the well-defined occipital ring.

The rather large libragene has a long stout genal spine. At the eye the fixigene rises steeply to the ocular platform which has a globular convexity. The rim is flat and the suture intramarginal at least for half and possibly all the distance to the center. None of the specimens preserves the doublure which probably maintains its width across the

cranidium. A peculiar feature of the libragene is the convexity that begins about halfway back in the rim and extends into the round, elevated genal spine.

Davis formation; (loc. 11k) Federal Lead Mine No. 4, Flat River, Missouri.

Holotype.—U.S.N.M. No. 108798a; paratypes, Nos. 108798b-d.

IDDINGSIA BICINCTA, new species

PLATE 16, FIGURES 27-29

Several plump cranidia from Blue Creek Canyon constitute another species. Compared with others in the region the distinctive feature seems to be the subdivision of the brim into two approximately equal portions. The rather short glabella is rounded in front and rises above the dorsal furrow with an even curvature. Furrows are so faint that they are scarcely traceable. The occipital furrow on the other hand is wide and deep, and the ring carries a long slender spine. The brim width nearly equals the length of the glabella exclusive of the neck ring. At the anterior end of the eye, the fixigenes are only one-third the glabellar width. Divergence of the facial suture forms rather large anterior angles. Longitudinally the cranidium is convex, the rear half of the glabella being nearly level and the anterior third sharply curved, and the slightly convex preglabellar area continues its downward trend, while the rim turns to a nearly horizontal position. In cross section the glabella appears elevated with a nearly circular curvature. In like manner the fixigenes near the eyes are also convex. There is but a slight depression of the anterior angles so that the slope of the preglabellar area is not much more at the sides than in the middle. Surface of test nearly smooth. However, the exfoliated preglabellar area is marked by rather strong vertical anastomosing lines.

Honey Creek limestone; (loc. 9q) Blue Creek Canyon, Wichita Mountains, Oklahoma.

Holotype.—U.S.N.M. No. 108799.

IDDINGSIA CRASSIMARGINATA, new species

PLATE 16, FIGURES 30-32

This cranidium, associated with *I. missouriensis,* is very distinct, owing to its wide, flaring brim and relatively small glabella. The glabella tapers to a slightly rounded front and has two pairs of furrows. The brim is nearly as wide as the length of the glabella exclusive of the occipital ring. It has a wide, slightly concave rim

nearly one and one-half times as wide as the preglabellar area. Eyes are strongly bowed and situated just in front of the occipital furrow. At the anterior end of the eye the fixigenes are less than half the glabellar width. In cross section this species has little relief. The glabella rises to a rounded median angle and the fixigenes rise without curvature to the palpebral lobes. Longitudinally the glabella is gently curved, increasing its declivity near the front, while the slightly concave brim slopes less. The anterior angles are moderately depressed, but the elevated palpebral lobes accentuate the steepness of the slopes of the anterior fixigenes immediately forward of the eye lines.

Davis formation; (loc. 11k) Federal Lead Mine No. 4, Flat River, Missouri.

Holotype.—U.S.N.M. No. 108800.

IDDINGSIA ALPERSENSIS, new species

PLATE 16, FIGURES 33-38

The glabella is rounded in front and practically without furrows. The brim width is about half the length of the glabella including the thickened neck ring, which carries a long spine. Because of the circular anterior outline of the cranidium and the comparatively much less curved anterior furrow, the rim widens appreciably toward the center, where its width is about equal to the preglabellar area. At the anterior end of the eye the fixigene is about one-third the glabellar width. In this species the eyes are not so strongly bowed, nor do they extend back to the occipital furrow. As a whole the cranidium has considerable convexity. In the rear the glabella stands high above the dorsal furrow, but this relationship decreases anteriorly. Thus a forward slope of the whole is created, which is continued by the convex preglabellar area. The wide flat rim rises somewhat above a horizontal position. A slight rise brings the fixigenes up to the palpebral lobes. Anterior angles depressed. Preglabellar area marked by strong anastomosing lines.

Honey Creek limestone; (loc. 12p) 4 miles east of Alpers, Arbuckle Mountains, Oklahoma.

Holotype.—U.S.N.M. No. 108801a; paratypes, Nos. 108811b, c.

IDDINGSIA (?) QUINNENSIS, new species

PLATE 16, FIGURES 39-41

At first glance this cranidium seems to be far removed from *Iddingsia*. However, when its features are examined individually, each feature fits *Iddingsia* more closely than any other genus. In other

words, while the ensemble does not look so much like *Iddingsia,* the separate features fall readily within its generic limits.

The glabella is large, nearly rectangular, slightly rounded in front, and has three pairs of furrows. The neck ring carries a small spine. Since the anterior facial suture diverges at a small angle and the anterior margin is rather straight, the cranidium as a whole has a quadrangular shape. The brim, divided almost equally between rim and preglabellar area, equals about half the glabellar length exclusive of the neck ring. At the anterior end of the eye the fixigene is less than half the glabellar width. The eyes situated far back against the occipital furrow are rather strongly bowed and have particularly heavy palpebral furrows and eyebands.

Mendha limestone; (loc. 7j) 1 mile northwest of Italian Ranch foothills, Quinn Canyon Range, Nevada.

Holotype.—U.S.N.M. No. 108802a; paratype, No. 108802b.

IDDINGSIA ANATINA, new species

PLATE 17, FIGURES 1, 2

This neat species is characterized by its smooth, rounded glabella. The occipital furrow is narrower than usual, but the neck ring expands in the center and has a long spine. The brim width equals the length of the glabella exclusive of the occipital ring. Owing to the forward projection of the anterior margin, the rim at its center exceeds the width of the preglabellar area. Fixigenes are of average size and shape, being peculiarly marked by the swellings in the inner rear portion of the palpebral lobe. The evenly and sharply bowed eyes have heavy bands. In cross section the evenly convex glabella rises above the dorsal furrow. The fixigenes opposite the eyes are also convex. Longitudinally the glabella is gently convex. The cranidium as a whole slopes forward, its declivity being continued by the preglabellar area as far as the anterior furrow, beyond which the rim is turned up somewhat. Brim covered with vertical anastomosing lines.

Honey Creek limestone; (loc. 9q) Blue Creek Canyon, Wichita Mountains, Oklahoma.

Holotype.—U.S.N.M. No. 108803.

IDDINGSIA SIMPLICITAS, new species

PLATE 17, FIGURES 3-9

This prolific species, represented by many cranidia and several libragenes was first regarded as representing a new genus. However,

upon close examination it appears to be merely a simplification of the regular *Iddingsia* features.

The fairly large glabella has two pairs of faint furrows. The expanded neck ring, separated from the glabella by a strong furrow, carries a large spine in an elevated position. Although in the posterior position of the genus *Iddingsia*, the eyes are sufficiently removed from the occipital furrow to leave a small gap. Measuring along the contours of the brim, its width equals the length of the glabella exclusive of the neck ring. A median boss is developed in the convex preglabellar area, thus accentuating the variant aspect of the species. A change in contour alone marks the position of the anterior furrow, In different light directions this concavity shifts its position, causing the rim to appear relatively wider or narrower than the preglabellar area. The fairly large libragene has a moderately convex ocular platform. The suture is intramarginal for a considerable distance. A swelling beginning in the rear portion of the rim and the outer corner of the ocular platform, continues into the long genal spine which is in a horizontal position, thus having a conisderable upward and outward course from the ocular platform.

Honey Creek limestone; (loc. 89y) West Timbered Hills, Arbuckle Mountains, Oklahoma.

Holotype.—U.S.N.M. No. 108804a; paratypes, Nos. 108804b-d.

BERKEIA Resser, 1937

BERKEIA COMES, new species

PLATE 15, FIGURES 18-21

Although several cranidia are available, the pygidium has not been determined.

All of the cranidia are exfoliated, and therefore the furrows appear much deeper than on the exterior of the test. The large glabella is well rounded in front. Because of the enlargement of the dorsal furrow the glabella appears to be restricted posterior to the rear pair of glabellar furrows. Three pairs of recurved furrows are clearly impressed. The swollen occipital ring is elevated and carries a short spine. The brim width is about one-fourth the glabellar length. In dorsal view it appears to be divided almost equally between the preglabellar area and the rim, but in side view the rim seems to be relatively narrower. This subdivision is attained by a change in slope between the somewhat convex preglabellar area and the slightly thickened rim, turned up a little above the horizontal position. Opposite the eyes the fixigenes equal one-third the glabellar width. Owing

to the sharp depression of the anterior angles, the divergence of the anterior facial suture is not apparent. Back of the eyes the posterolateral limbs, also sharply depressed, are about three times the width of the occipital ring. Laterally the glabella stands completely above the fixigenes with very steep sides. Longitudinally the entire cranidium is very convex.

Deadwood formation; (loc. 88a) Deadwood, Black Hills, South Dakota.

Holotype.—U.S.N.M. No. 108787a; paratype, No. 108787b.

BERKEIA SARATOGENSIS, new species

PLATE 15, FIGURES 22-25

Although this species is not fully typical of the genus in that the rim is narrower than the preglabellar area, the difference in appearance may be due to the fact that on these specimens the test is preserved. However, since this form does not fit in any other existing genus and because its departure from the characteristics of *Berkeia* is confined to the narrowness of rim, the species is placed in that genus.

As usual the large glabella tapers to a rounded front and has three pairs of recurved furrows. The brim width is somewhat less than a third the glabellar length. The preglabellar area is more than twice the width of the slightly upturned rim. Opposite and behind the eye the fixigenes average about half the glabellar width. Divergence of the suture creates fairly large anterior angles. In cross section the total convexity across the eyes is moderate, although both the glabella and fixigenes are individually convex. By depression of the anterior angles and of the posterolateral limbs, both the front and back portions of the cranidium attain considerable convexity. Longitudinally the cranidium is strongly convex, attained by a rather even curvature throughout.

Potsdam sandstone; Greenfield, northwest of Saratoga, New York.

Holotype and paratypes.—New York S. M.; casts U.S.N.M. Nos. 108792a-c.

BERKEIA NEVADENSIS, new species

PLATE 15, FIGURES 26, 27

B. nevadensis, represented at several localities, differs from *B. affinis* chiefly in its lesser convexity in longitudinal direction. This difference is not merely a matter of preservation, for *B. nevadensis* is represented by nearly a score of specimens.

Features which make this an average species of the genus include similar glabellar proportions and furrows, narrow convex fixigenes, and brim subdivided into convex preglabellar area and rim of equal width. In dorsal view this species looks like *B. affinis,* but in side view, although nearly equally convex in the glabella, it has a brim less convex in its individual parts and as a whole much less downturned.

Secret Canyon shale; (loc. 61) south of the Hamburg Mine, and (loc. 62) north of Adams Hill, Eureka District, Nevada.

Holotype.—U.S.N.M. No. 108788a; paratype, No. 108788b.

BERKEIA RETUSA, new species

PLATE 15, FIGURES 28-30

This species acquires a peculiar aspect for two reasons. First, the preglabellar area is wider than the rim, and second, the chief distinction lies in the slight swelling of the middle portion of the preglabellar area. Glabellar furrows are well developed. Eyes and fixigenes are of normal size and shape. As stated, the preglabellar area is wide and convex. Longitudinally the cranidium is rather evenly convex, turning down more rapidly in the anterior half. In cross section the glabella and fixigenes are each convex, but taken together are rather flat in profile. The anterior angles and posterolateral limbs are moderately depressed.

Honey Creek limestone; (loc. 12p) 4 miles southeast of Hennepin, Arbuckle Mountains, Oklahoma.

Holotype.—U.S.N.M. No. 108789a; paratype, No. 108789b.

BERKEIA WICHITAENSIS, new species

PLATE 15, FIGURES 31-33

The rather long cranidium has the usual large glabella, in which two pairs of furrows are well defined. The fixigenes average less than a third the glabellar width. The preglabellar area is wider than the rim. In this species the rim expands somewhat to the middle, which together with the more angular anterior margin exaggerates the actual length of the cranidium.

The small pygidium, tentatively assigned to the species, has a wide axis occupying more than half its length, and flat pleural lobes. As a whole the pygidium is oval in outline.

Honey Creek limestone; (loc. 91L) Big Baldy, Wichita Mountains, Oklahoma.

Holotype.—U.S.N.M. No. 108790a; paratype, No. 108790b.

BERKEIA ANGUSTATA, new species

PLATE 15, FIGURES 34-39

B. angustata is a prolific species which appears to be narrower than others from the same region. Its aspect is due to the relatively long glabella and the angulation of the anterior margin. The glabella, rounded in front, has two well-developed pairs of furrows. The neck ring extends into a short blunt spine. In this species the preglabellar area is considerably wider than the brim.

Honey Creek limestone; (loc. 89y) West Timbered Hills, Arbuckle Mountains, Oklahoma.

Holotype.—U.S.N.M. No. 108791a; paratypes, Nos. 108791b, c.

BERKEIA SCULPTILIS, new species

PLATE 16, FIGURES 1-4

This small species is not fully typical of the genus because of the relative depression and constriction of the middle portion of its preglabellar area. The prominent glabella stands well above the fixigenes. It is rounded in front and has three pairs of furrows on exfoliated specimens. The fixigenes average nearly half the glabellar width and the brim width equals about one-third the glabellar length including the neck ring. Both the anterior angles and the posterolateral limbs are sharply downturned so that in dorsal view the strong curve of the brim is exaggerated. The rim is thickened in the center, where it is about as wide as the preglabellar area.

Honey Creek limestone; (loc. 12k) Honey Creek, 7 miles north of Springer, Wichita Mountains, Oklahoma.

Holotype.—U.S.N.M. No. 108793a; paratype No. 108793b.

BERKEIA JUCUNDA, new species

PLATE 16, FIGURES 5-10

This is the smaller of the two species in the Davis formation. It is typical of the genus in every respect, agreeing rather closely with those Oklahoma species which are characterized by the wide preglabellar area. The moderately convex glabella tapers at the normal rate to a rounded front and has three pairs of furrows on exfoliated specimens. The fixigenes are narrower than the brim, averaging about one-third the glabellar width. The eyes are rather large, and the palpebral lobe is angulated near its center. The brim width equals half the glabellar length exclusive of the neck ring. It has a nearly even brim about half as wide as the preglabellar area. The front margin is slightly angulated in the middle.

Davis formation; (loc. 11k) Federal Lead Mine No. 4, Flat River, Missouri.

Holotype.—U.S.N.M. No. 108794a; paratypes, Nos. 108794b, c.

BERKEIA MISSOURIENSIS, new species

PLATE 16, FIGURES 11-14

This abundant species associated with *Pterocephalia* and *Burnetia* is one of the largest found. The slightly truncate glabella has three pairs of furrows. The very narrow fixigenes at the anterior end of the eye are only about one-fourth as wide as the glabella. On the other hand the brim is wide, equaling more than a third the glabellar length. In this species the eye lobes are only slightly curved. A small node occurs on the neck ring.

Davis formation; (loc. 11k) Federal Lead Mine No. 4, Flat River, Missouri.

Holotype.—U.S.N.M. No. 108795a; paratypes, Nos. 108795b, c.

UNCLASSIFIED GENERA

ELVINIA Walcott, 1924

ELVINIA MONTIS, new species

PLATE 18, FIGURES 1-4

E. montis is characterized by a normally tapered, truncate glabella. Two pairs of furrows are present, the rear pair taking a straight course in the middle third. The brim width is about half the length of the glabella exclusive of the occipital ring. It has a narrow rim, which at its widest point equals about half the preglabellar area. At the front end of the eye the fixigenes are half the glabellar width. Back of the rather strongly bowed eyes, which slope outward at an angle somewhat greater than the course of the dorsal furrow, the fixigenes expand into wide posterolateral limbs. On the outer surface none of the furrows are deeply impressed, and the surface apparently is smooth.

It was hoped that this form would turn out to be *E. tetonensis,* the species previously known from western Wyoming. Unfortunately it proved impossible to place it in that species owing to the more truncate glabella, less evenly curved glabellar furrows, and more strongly bowed eyes.

Snowy Range formation; (loc. 37r) Warm Spring Creek, Wind River Range, Wyoming.

Holotype.—U.S.N.M. No. 108812a; paratype, No. 108812b.

ELVINIA UTAHENSIS, new species

PLATE 18, FIGURES 5, 6

Except for the fact that this is such an important element of the fauna, this peculiarly weathered cranidium would have awaited the finding of additional material before its description. Strangely enough, this is the only *Elvinia* specimen found in large collections from the locality. In spite of its poor preservation this cranidium allows the specific characteristics to be ascertained.

The glabella tapers forward at a normal rate to a truncate front. Only a very shallow rear pair of furrows is visible, and the wide occipital furrow is also shallow. The brim, occupying nearly a third of the cranidial length, is separated into a thickened rim and a slightly wider convex preglabellar area. Eyes normal in size and position, and are not strongly bowed. The posterolateral limbs are long.

St. Charles limestone; (loc. 54e) Blacksmith Fork, Bear River Range, Utah.

Holotype.—U.S.N.M. No. 108813.

ELVINIA RUEDEMANNI, new species

PLATE 18, FIGURES 7-10

Ruedemann identified this form as *E. matheri*. However, very considerable differences in brim structure and the granulated surface exist. It is not certain that the larger and smaller cranidia here illustrated belong to the same species, for none of the smaller heads is well preserved, although it is clear that they are granulated. *E. ruedemanni* belongs to a group which may eventually have to be separated from *Elvinia*, but at present the altered appearance resulting from depression of the preglabellar area does not seem to warrant such action.

E. ruedemanni is characterized by a rather rapidly tapering glabella. Two pairs of furrows are developed, the anterior pair being short and shallow while the deeper rear pair is connected as usual. The rather large eyes are so far forward that their anterior ends are on a line with the front margin of the glabella. At this point the fixigenes are more than half the glabellar width. Rearward the fixigenes expand less rapidly than the glabella, and extend into large posterolateral limbs. The brim occupies about one-fourth the cranidial length and consists of a thickened rim nearly circular in cross section. The rim is less than half the width of the depressed preglabellar area. The surface is covered with granules except on the preglabellar area where vertical anastomosing lines take their place.

Potsdam sandstone (Theresa member); Greenfield, west of Saratoga Springs, New York.

Holotype and paratypes.—New York S. M.; casts, U.S.N.M. Nos. 108814a-c.

ELVINIA GRANULATA, new species

PLATE 18, FIGURES 11, 12

This cranidium, lying next to a good example of *Berkeia affinis,* is the only one found.

The large glabella tapers slightly to a rounded front. Only the rear pair of furrows is developed. The eyes are situated well forward. At the anterior end of the eyes the fixigenes are about one-third the glabellar width. Posterolateral limbs large and long. The brim, divided about equally between the preglabellar area and the thickened, somewhat upturned rim, occupies about a fourth the cranidial length. The surface is covered closely by evenly spaced and evenly sized granules which in the preglabellar area overlie a system of vertical anastomosing lines.

Secret Canyon shale; (loc. 63) northeast of Adams Hill, Eureka District, Nevada.

Holotype.—U.S.N.M. No. 108815.

ELVINIA MISSOURIENSIS Resser

PLATE 18, FIGURES 13-17

Elvinia roemeri BRIDGE (part), U. S. Geol. Surv. Prof. Pap. 186-M, p. 251, pl. 69, figs. 12, 13, 1937.

Elvinia missouriensis RESSER, Smithsonian Misc. Coll., vol. 97, No. 10, p. 31, 1938.

A well-preserved cranidium, the pygidium, and the libragene are figured to illustrate specific characteristics not shown in the holotype. It will be observed that the doublure evidently extends completely across the head.

Davis formation; (loc. 11k) Federal Lead Mine No. 4, Flat River, Missouri.

Holotype.—U.S.N.M. No. 93011; plesiotypes, No. 108819.

ELVINIA GREGALIS, new species

PLATE 18, FIGURES 18-23

This is one of the smaller species of the genus but seems to be rather widespread in the Wichita Mountains.

The glabella tapers at a normal rate to a truncate front margin. A shallow rear glabellar furrow is developed. The fixigenes average

about half the glabellar width. In front of the eye the suture diverges little, but back of the eye it forms posterolateral limbs of normal shape.

The brim, almost exactly a third of the cranidial length, has a somewhat thickened rim considerably narrower than the preglabellar area. Longitudinally the considerable convexity is attained by a sharp bend about the midpoint. In cross section the relief is not so great, as the nearly flat fixigenes slope less steeply, and the glabella is gently arched. The anterior angles are not greatly depressed. The associated pygidium is characterized by the usual large, stout axis standing well above the pleural platforms and terminating very abruptly in the rear. Deep pleural furrows rib the slightly convex pleural platforms. The border turns up sharply all around.

Honey Creek limestone; (loc. 9q) Blue Creek Canyon, and other localities in the Wichita Mountains, Oklahoma.

Holotype.—U.S.N.M. No. 108816a; paratypes, Nos. 108816b, c.

ELVINIA LONGA, new species

PLATE 18, FIGURES 24-27

This species resembles *E. gregalis* but must be regarded as distinct owing to greater relative and absolute relief and its longer glabella.

The long glabella appears to be slender. It tapers at a normal rate to a rounded front margin. In spite of considerable relative relief the glabellar furrows are very shallow. At the anterior end of the eye the fixigenes are considerably more than half the glabellar width. Their width is not greatly increased either forward or backward and the posterolateral limbs are not so long. The brim occupies about one-fourth the cranidial length, which makes it relatively narrower than in *A. gregalis*. Both the rim and the preglabellar area are strongly convex, the rim occupying a little more than a third the brim width. Longitudinally the cranidium is decidedly convex, being slightly curved in the rear half and sharply curved in the front portion. Since the glabella and fixigenes are both convex, and the anterior angles sharply depressed, the lateral convexity is great.

Honey Creek limestone; (loc. 9p) Blue Creek Canyon, Wichita Mountains, Oklahoma.

Holotype.—U.S.N.M. No. 108817a; paratype, No. 108817b.

ELVINIA BRIDGEI Resser

PLATE 18, FIGURES 28-31; PLATE 19, FIGURES 1-5

Elvinia roemeri BRIDGE (part), U. S. Geol. Surv. Prof. Pap. 186-M, p. 251, pl. 69, figs. 19-21, 1937.

Elvinia bridgei RESSER, Smithsonian Misc. Coll., vol. 97, No. 10, p. 31, 1938.

Additional specimens of this species are figured to illustrate characteristics of pygidium and the peculiar flatness of the head.

Honey Creek limestone; (loc. 12p) 4 miles southeast of Hennepin, and other localities in the Arbuckle Mountains, Oklahoma.

Cotypes.—U.S.N.M. Nos. 93025a, b; plesiotypes, Nos. 108818a, b, 108820a, b.

ELVINIA VAGANS, new species

PLATE 19, FIGURES 6-9

Cranidium, exclusive of posterolateral limbs, nearly quadrate. Glabella, tapered to a slightly rounded frontal outline, is a little more than two-thirds the glabellar length. Brim divided about equally between a well-defined, slightly upturned rim, and preglabellar area. At their narrowest point the fixigenes are about one-third the glabellar width. Anterior to the eyes the facial suture diverges moderately to form rather square anterior angles. Posterolateral limbs long and stout. The moderately bowed eyes are a little less than one-third the cranidial length and are set nearly parallel to the lateral dorsal furrow. Occipital furrow deep both on glabella and posterolateral limbs. Rear glabellar furrow shallow, others not developed. Laterally the glabella stands above the fixigenes with gentle curvature. Fixigenes nearly flat. Longitudinally the head has considerable convexity attained by an angulation near the midpoint. Each half individually is nearly in a plane, except for the furrows and raised rim. Associate pygidium normal in all respects. The wide axis reaches nearly to the rim. Three axial furrows are well developed. The nearly flat pleural platforms have two wide shallow furrows and a thickened and raised border.

Honey Creek limestone; (loc. 9q) 15 miles northwest of Fort Sill, Wichita Mountains, Oklahoma.

Holotype.—U.S.N.M. No. 108821a; paratype, No. 108821b.

ELVINIA BREVIFRONS, new species

PLATE 19, FIGURES 10-14

This species is so constricted in brim width and length that it is no longer fully characteristic of *Elvinia*. Cranidium as a whole forms a truncated isosceles triangle. The long glabella which tapers to a truncated front, with slightly rounded anterior angles, is demarcated by a shallow dorsal furrow. Brim width equals about one-fourth the glabellar length and has a nearly straight front outline. The occipital and rear glabellar furrows are deep. Measured at the same point the fixigenes are about half the width of the glabella. In front of the

eyes the facial suture diverges slightly. Eyes of moderate size, situated rather far forward, so that their anterior ends are about opposite the front of the glabella. They are only slightly bowed, but the palpebral lobes lie entirely outside the margin of the fixigene and are set at an angle slightly greater than the course of lateral dorsal furrow. Heavy but low eye ridges are developed. Viewed from the front the cranidium is evenly convex, with glabella and fixigenes forming one curved slope. Longitudinally the convexity is greater but is also even, except for the slight flattening of the brim toward a horizontal position. The associated libragene has a large occular platform, a raised thickened rim, and a slender genal spine.

Honey Creek limestone; (loc. 12p) 4 miles east of Alpers, Arbuckle Mountains, Oklahoma.

Holotype.—U.S.N.M. No. 108822a; paratypes, Nos. 108822b, c.

TAENICEPHALUS Ulrich and Resser, 1924

TAENICEPHALUS PEALEI, new species

PLATE 19, FIGURES 15-23

Limestone layers in the Dry Creek formation cropping out from Logan eastward to the Bridger Range, and thence southeastward beyond Livingston, contain a species of *Taenicephalus*, often occurring in abundance. Most of the rock is a chowder, but here and there cranidia and other parts escaped being broken before entombment.

This species is characterized by normal features throughout. The glabella tapers at a normal rate. On the outside two pairs of shallow furrows may be traced, but on exfoliated examples three pairs are clearly visible. Where the test remains, the dorsal furrow is rather deep but narrow, and the occipital furrow is prominent both across the glabella and on the large posterolateral limbs. The fixigenes are half the glabellar width at the anterior end of the eyes. Brim width equals half the glabellar length. Preglabellar area rather wide and strongly convex. Rim expanded forward in middle, giving the anterior outline an angulated appearance. Eyes of moderate size and in normal position.

The pygidium is of normal size and oval shape. The almost completely exfoliated example figured has deeper furrows and greater relief than the exterior would show. The wide axis extends nearly the full length of the tail.

Although the outside of test seems to be smooth, the preglabellar area and other elevated portions of exfoliated specimens exhibit

scattered granules. Beneath the anterior furrow a somewhat irregular row of granules is present.

Dry Creek shale; (loc. 153) north of Gallatin River, east of Logan, Horseshoe Hills; (locs. 147a, 151, 152) Churn and Cottonwood Canyons, Bridger Range; Davis Creek, south of Livingston, Snowy Range, Montana.

Holotype.—U.S.N.M. No. 108823a; paratypes, Nos. 108823b-g.

TAENICEPHALUS HOLMESI, new species

PLATE 19, FIGURES 24-27

The glabella which tapers to a rounded front, has three pairs of fairly deeply impressed furrows. The brim width exceeds more than half the glabellar length. At the center the brim is divided about equally between rim and preglabellar area, both of which have about the same convexity. At the eye the fixigenes are almost exactly equal to half the glabellar width. The small eyes are situated about the midpoint of the cranidium. They are very strongly bowed in a longitudinal direction, which, together with the distinctness of the palpebral lobe, projects the eyes considerably above the remainder of the cranidium. In cross section the glabella is moderately, and the fixigenes greatly, curved. Although individual parts have high relief the longitudinal curvature is not great and is rather evenly distributed. The pygidium, typical in size and shape, has considerable convexity.

The specific name is given in recognition of the geologic work done by the collector, Dr. W. H. Holmes.

Dry Creek shale; (loc. 66x) Gallatin Valley, northwestern Yellowstone National Park, Wyoming.

Holotype and paratypes.—U.S.N.M. No. 9595.

TAENICEPHALUS SPECIOSUS, new species

PLATE 20, FIGURE 19

This rather large species found in the northeastern part of the Yellowstone National Park differs from *T. holmesi* in that all furrows are shallower, and the brim is wider. Also, the glabella and fixigenes are less highly arched in both directions. The surface is smooth.

Dry Creek shale; (loc. 62r) Abiathar Mountain, northeastern Yellowstone National Park, Wyoming.

Holotype.—U.S.N.M. No. 108831a; paratype, No. 108831b.

TAENICEPHALUS LIBERTYENSIS, new species

PLATE 19, FIGURES 28-32

Several cranidia, a libragene, and several small pygidia are contained in the collection from this locality. Only the larger of the specimens have been figured. The species is characterized by normal shape and development of the several parts, with the possible exception of a flattening in the preglabellar area. The glabella tapers at a normal rate. On the outer surface its anterior outline is straighter than on exfoliated specimens, a condition due to widening of the dorsal furrow in the latter instance. Two pairs of furrows show on the outside and three on the inside of the test. The deep occipital furrow is irregular. The neck ring has a small spine. Fixigenes are about half the glabellar length exclusive of the occipital ring. Rim slightly elevated and thickened, expanding forward somewhat in the middle where it is only slightly less wide than the preglabellar area. Eyes are normal size and moderately bowed. In cross section the curvature is not great in the central portion of the cranidium. In spite of the depressed anterior angles the front margin is nearly straight but has considerable relief because of the greatly depressed posterolateral limbs. Libragene normal in size and shape, with a rather wide and possibly short genal spine. The associated pygidium is normal in all respects.

St. Charles limestone; (loc. 56g) 6 miles west of Liberty, Bear River Range, Idaho.

Holotype.—U.S.N.M. No. 108824a; paratype, No. 108824b.

TAENICEPHALUS CORDILLERENSIS Miller

PLATE 19, FIGURE 33

Taenicephalus cordillerensis MILLER, Journ. Pal., vol. 10, No. 1, p. 33, pl. 8, figs. 40, 41, 1936.

Many of the fossils of this zone are found on weathered surfaces. The illustrated example shows several cranidia in various states of preservation and part of a libragene.

Snowy Range formation; (loc. 37r) Warm Springs Creek, Wind River Range, Wyoming.

Holotype.—Columbia Univ. No. 12622; plesiotype, U.S.N.M. No. 108825.

TAENICEPHALUS GRANULOSUS, new species

PLATE 20, FIGURES 4-7

This moderately large species is covered with rather large, evenly distributed granules.

The glabella tapers considerably to a narrow truncate front. Three pairs of glabellar furrows are deeply impressed, and the occipital furrow and ring are strongly developed. The brim width exceeds a third of the cranidial length, and the preglabellar area is somewhat wider than the rim at the center. At the eye the fixigene is about one-third the glabellar width. Longitudinally the head is only slightly convex, except that the fixigenes are flexed at the palpebral lobe. In cross section the glabella is moderately convex, with a slight indication of a keel, while the fixigenes are very convex. Both the rim and preglabellar area are highly convex owing to the depth of both dorsal and anterior furrows. Posterolateral limbs bent down rather sharply.

St. Charles limestone; (loc. 4y) Two Mile Canyon, south of Malad, Wasatch Mountains, Idaho.

Holotype.—U.S.N.M. No. 108828a; paratypes, No. 108828b.

TAENICEPHALUS MALADENSIS, new species

Plate 20, Figures 8-10

Associated with *T. granulosus* is a smaller form with shallower furrows. Its surface is not granulose but ornamented by raised anastomosing lines, which form a more or less reticulate network. Neither the fixigenes nor the preglabellar area is as convex, which gives *T. maladensis* a smoother appearance than *T. granulosus*.

St. Charles limestone; (locs. 54x, 4y) Two Mile Canyon, south of Malad, Wasatch Mountains, Idaho.

Holotype.—U.S.N.M. No. 108826a; paratype, No. 108826b.

TAENICEPHALUS ORNATUS, new species

Plate 20, Figures 11, 12

Several species of *Taenicephalus* have been collected in Blacksmith Fork canyon. They were not found at the same spot and therefore may occur at somewhat different levels. Several cranidia, characterized by an ornate appearance due to the conspicuous granulation and deep furrows as well as to the relatively high relief, may appropriately be named *T. ornatus*. The rather wide glabella tapers at the average rate of a rounded front and has three pairs of furrows rather deeply impressed on the outside of the test. The slightly convex fixigenes average nearly half the glabellar width. The brim is about one-third the cranidial length. A deep anterior furrow separates the somewhat thickened and considerably elevated rim which expands forward in the center from a preglabellar area of nearly equal width. The rather small and very sharply bowed eyes are prominent because the palpebral lobe projects outward and the fixigenes are arched at the eyes.

Longitudinally the relief of the cranidium is not great but because both the dorsal and anterior furrows are deep the relative relief between the several parts is accentuated. In cross section the convexity of the glabella and sharp rise of the fixigenes to the eyes as well as sharp depression of anterior angles and posterolateral limbs, give both the front and rear margins of the head considerable curvature. The surface is covered by evenly spaced granules.

St. Charles limestone; (loc. 54e) Blacksmith Fork, Bear River Range, Utah.

Holotype.—U.S.N.M. No. 108829.

TAENICEPHALUS STRIATIFRONS, new species

PLATE 21, FIGURES 1-3

The second species from the locality is characterized by a rather strongly tapering glabella and a vertically striated brim. The fixigenes are rather evenly covered by granules but only a few are found on the more elevated parts of the glabella. Brim width is considerably less than one-third the cranidial length. The longitudinal convexity is not great nor does the cross section attain high relief, even though the glabella and the fixigenes are convex.

St. Charles limestone; (loc. 54e) Blacksmith Fork, Bear River Range, Utah.

Holotype.—U.S.N.M. No. 108833a; paratype, No. 108833b.

TAENICEPHALUS UTAHENSIS, new species

PLATE 21, FIGURES 4-6

This third species from the locality is represented by several cranidia. It is most like *T. striatifrons* in shape and general appearance but differs in having considerably less surface ornamentation. The average size glabella tapers at a normal rate and has the usual sets of furrows faintly outlined. The brim width is just about one-third the cranidial length. The rim is about two-thirds the width of the preglabellar area in the center. Both are convex. The fixigenes are narrow and the eyes of normal size and shape. Longitudinally the head is not very convex, most of it being attained in the anterior portion. In cross section the fixigenes rise rather abruptly from the dorsal furrow. The anterior angles are considerably depressed but the posterolateral limbs are not.

St. Charles limestone; (loc. 54e) Blacksmith Fork, Bear River, Range, Utah.

Holotype.—U.S.N.M. No. 108834a; paratype, No. 108834b.

TAENICEPHALUS HYRUMENSIS, new species

PLATE 20, FIGURES 13-18

This species is represented by a number of cranidia, a hypostoma, and several pygidia. It is characterized by the smoothness of the test. Slight indications of granulation are found on parts of the glabella and rim. They are more clearly developed on the preglabellar area. The rather long, fairly slender glabella tapers to a rounded front. Faint furrows are present on the test, but in exfoliated specimens three well-developed sets can be seen. Brim width less than half the glabellar length, divided by the anterior furrow into about equal parts. The fixigenes average less than half the glabellar width. Posterolateral limbs fairly large. Eyes of moderate size, moderately bowed. The associated pygidium is rather large and flat, approaching that of *Wilbernia* in several respects, but it lacks the pronounced doublure of that genus. It is possible that this pygidium should be referred to *T. modestus* from the same locality.

St. Charles limestone; (loc. 55h) Blacksmith Fork, Bear River Range, Utah.

Holotype.—U.S.N.M. No. 108830a; paratypes, Nos. 108830b-e.

TAENICEPHALUS MODESTUS, new species

PLATE 21, FIGURE 7

A single cranidium is sharply demarcated from the other species at the locality. Its reference to *Taenicephalus* may be questioned because of the width of the cranidium across the brim and the flatness of the whole. However, it is closer to this genus than to *Elvinia,* which it most resembles. The glabella tapers at the normal rate and has average proportions. Several sets of furrows are faintly indicated, while the occipital furrow is rather deep. The brim width is half the glabellar length exclusive of the occipital ring. Both the preglabellar area and rim are convex and of about equal width. Fixigenes, eyes, and course of the suture are approximately normal, except that the anterior branch of the suture diverges slightly more than average.

St. Charles limestone; (loc. 55h) Blacksmith Fork, Bear River Range, Utah.

Holotype.—U.S.N.M. No. 108835.

TAENICEPHALUS TEXANUS, new species

PLATE 21, FIGURES 8-12

All of the 10 or more cranidia are normal in size and shape with a projecting front due to the forwardly expanded rim. The glabella

is about average in size and shape and has the usual three sets of furrows. The brim width is half of the glabellar length exclusive of the neck ring. Fixigenes are rather narrow, averaging a little more than a third of the glabellar width. Surface finely granulose.

Wilberns formation; (loc. 68) Packsaddle Mountain, 11 miles southeast of Llano; and (loc. 70) Baldy Mountain, 8 miles northwest of Burnet, Texas.

Holotype.—U.S.N.M. No. 108836a; paratypes, Nos. 108836b-d.

TAENICEPHALUS WICHITAENSIS, new species

PLATE 21, FIGURES 13-17

A number of cranidia occur in a coarsely granular limestone full of trilobite fragments. Much of the rock is nearly white, but it contains many particles of glauconite and most of the trilobites are stained red, which gives the rock a peculiar appearance. This species is normal in all respects. The fairly wide glabella is truncated in the front. All specimens are exfoliated, and on them three sets of furrows are visible. The neck ring expands, possibly bearing a short spine. The brim width exceeds the length of the glabella including the neck ring. It consists of a rim that expands rapidly forward in the middle from a nearly straight anterior furrow to give the front of the head a considerable projection. The rim shrinks to extinction at the anterior angles from the same width as the preglabellar area at the center while the latter maintains its width into the anterior angles. At the front end of the eye the fixigenes are less than half the glabellar width, an average which they maintain throughout. The fairly large eyes are in normal position for the genus. Triangular posterolateral limbs are of considerable size. Surface of available exfoliated specimens smooth, as are the small fragments of test remaining.

Honey Creek limestone; (loc. 9q) Blue Creek Canyon, 15 miles northwest of Fort Sill, Wichita Mountains, Oklahoma.

Holotype.—U.S.N.M. No. 108837a; paratypes, Nos. 108837b-d.

TAENICEPHALUS QUINNENSIS, new species

PLATE 21, FIGURES 18-23

This species is represented by cranidia, libragenes, and a pygidium. Owing to greater width across the anterior part of the cranidium and the flatter relief in the brim, the species approaches *Elvinia* in appearance.

The fairly wide glabella, well rounded in front, has the usual sets of well-defined furrows, the rear pair being connected across the

middle by a wide bar. The brim width is just about half the glabellar length including the neck ring. The rim, not greatly expanded beyond the anterior angles, is much narrower than the preglabellar area. Fixigenes rather wide, averaging over three-fourths the glabellar width. Behind the eyes the sutures do not diverge rapidly, thus forming wide and rather short posterolateral limbs. Anterior to the eyes the divergence of the suture is not great, which leaves only moderate anterior angles. The eyes are fairly sharply bowed. The palpebral furrow in line with the facial suture has little curvature and a wide eye band; hence the eyes are prominent. Longitudinally the head does not have great convexity. Laterally, although both the glabella and fixigenes are convex, the total relief is not great. Anterior angles only moderately depressed and the posterolateral limbs even less.

Mendha limestone; (loc. 7j) 1 mile north of Italian Ranch foothills, Quinn Canyon Range, Nevada.

Holotype.—U.S.N.M. No. 108838a; paratypes, Nos. 108838b-d.

TAENICEPHALUS CASTLENSIS, new species

PLATE 21, FIGURES 24, 25

Several cranidia are in the small collection from this locality, which is situated between the Yellowstone Park and the occurrences of *Taenicephalus* species north of the Gallatin River. It is typical in most respects. The moderately long glabella tapers to a truncated front. Three pairs of furrows are sharply impressed on the exfoliated holotype, and the occipital furrow is wide. In the center the brim width is a little less than half of the glabellar length including the occipital ring. It consists of approximately equal subdivisions. The rim tapers rapidly to extinction at the anterior angles which are somewhat rounded. Both rim and preglabellar area have about the same degree of convexity. Anastomosing lines cover the preglabellar area, and a few scattered granules appear on the rim. Eyes, fixigenes, and posterolateral limbs are of normal size and proportions.

Dry Creek formation; (loc. 62s) Castle Peak, north of Squaw Creek, Gallatin Range, Montana.

Holotype.—U.S.N.M. No. 108839.

TAENICEPHALUS WYOMINGENSIS, new species

PLATE 21, FIGURE 32

A small collection from the Big Horn Mountains contains a good species of *Taenicephalus*. It is close to *T. cordillerensis* Miller from the Wind River Range but has a wider preglabellar area. Compared

with *T. holmesi,* the palpebral lobes are less prominent because the fixigenes are less sharply bowed at that point.

Snowy Range formation; head of Buffalo Fork, west side of Big Horn Mountains, Wyoming.

Holotype and paratypes.—U.S.N.M. No. 11593.

TALBOTINA Lochman, 1938

TALBOTINA CANDIDA, new species

PLATE 21, FIGURES 27, 28

The glabella covers somewhat less than half the cranidial area and is sculptured by three sets of recurved furrows and a deep, wide occipital furrow. The fixigenes average about half the glabellar width. Posterolateral limbs are fairly long and of normal width. The brim, about equal in width to the fixigenes, is separated into rim and preglabellar area. The somewhat swollen rim widens to the center, chiefly by rather sudden expansion rearward. The eyes, of average size, are situated behind the midpoint of the glabella. Eye lines present. Convexity is about average in amount, while the relief is pronounced. The surface is abundantly granulose. Libragene, thorax, and pygidium unknown.

Wilberns formation; (loc. 14b) Cold Creek, opposite north end of Sponge Mountain, Texas.

Holotype.—U.S.N.M. No. 108841.

TALBOTINA ULRICHI, new species

PLATE 21, FIGURE 26

A second species from Texas is characterized by being shorter and by the glabella in consequence occupying a relatively greater proportion of the cranidium. The anterior furrow also has a more even course near the center, although the rim remains proportionally about the same as in *T. candida.* The surface is nearly smooth.

Wilberns formation; (loc. 14b) Cold Creek, opposite north end of Sponge Mountain, Texas.

Holotype.—U.S.N.M. No. 108840.

TALBOTINA CAELATA, new species

PLATE 10, FIGURE 4

When the fauna from the locality was described, this cranidium was overlooked. *T. caelata* is a beautifully sculptured trilobite of medium size. It differs essentially from the genotype in its narrowness.

The large, well-demarcated glabella tapers at a normal rate to a rounded front. Two pairs of shallow recurved furrows are visible. The fixigenes at the anterior end of the eye are about half the glabellar width. The eye lines are made conspicuous by a furrow which parallels them on their front side. Brim about half the glabellar length exclusive of the occipital ring. A conspicuous, somewhat thickened rim widens backward in the center, greatly reducing the width of the preglabellar area. The moderate-sized eyes are not strongly bowed and are situated posterior to the middle of the cranidium. The cranidium has considerable relief in each separate part, as well as in its entirety. Longitudinally the cranidium stands high, with a fairly even curvature, slightly accentuated in the glabella. In cross section the glabella stands completely above the fixigenes. The fixigenes are rather strongly convex in lateral direction, having greatly depressed posterolateral limbs, with convexity increasing anterior to the eye lines.

Nolichucky shale; (loc. 27d) U. S. 11, 7 miles northeast of Rogersville, Tennessee.

Holotype.—U.S.N.M. No. 108734.

EXPLANATION OF PLATES

Figures are natural size unless otherwise indicated. Since all the species described belong to the Upper Cambrian, only the formational names are given with the locality descriptions.

PLATE 1

PAGE

Chariocephalus tenerus, new species 5
1-3. Dorsal, front, and side views of the holotype cranidium (× 5).
Honey Creek limestone; (loc. 37t) 4 miles southeast of Hennepin, Arbuckle Mountains, Oklahoma.

Chariocephalus bellus, new species 6
4-6. Dorsal, front, and side views of the holotype cranidium (× 3).
Honey Creek limestone; (loc. 37v) West Timbered Hills, Arbuckle Mountains, Oklahoma.

Chariocephalus bulla, new species 7
7, 8. Dorsal and rear views of the pygidium assigned to the species (× 2).
9-11. Dorsal, side, and front views of the holotype cranidium (× 3).
Honey Creek limestone; (loc. 37v) West Timbered Hills, Arbuckle Mountains, Oklahoma.

Chariocephalus teres, new species 7
12, 13. Dorsal and front views of holotype cranidium (× 5).
Honey Creek limestone; (loc. 37v) West Timbered Hills, Arbuckle Mountains, Oklahoma.

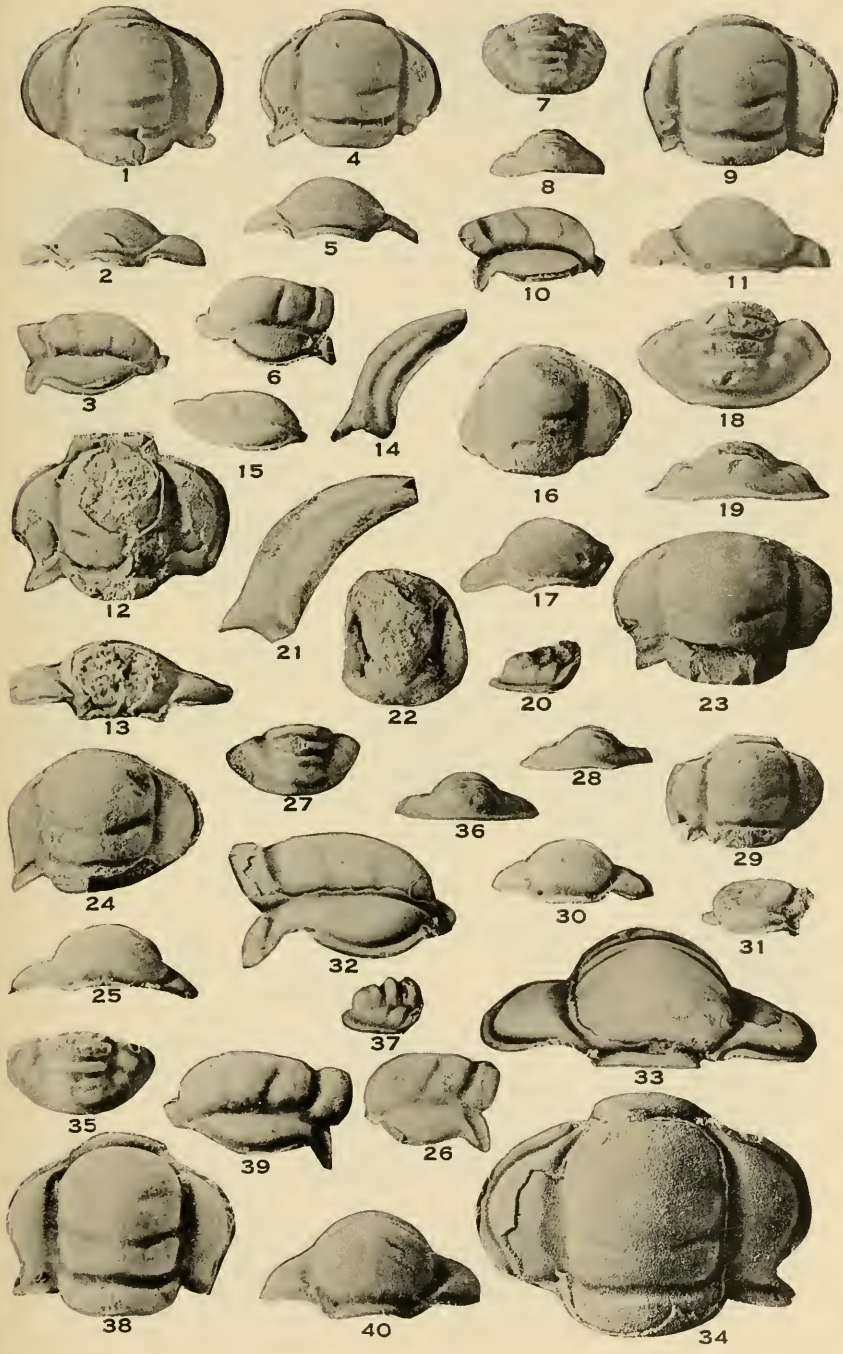
Chariocephalus affinis, new species 8
14. Associated libragene (× 2).
15-17. Side, dorsal, and front views of the cranidium (× 3).
18-20. Dorsal, side, and rear views of the pygidium (× 3).
Honey Creek limestone; (loc. 37u) West Timbered Hills, Arbuckle Mountains, Oklahoma.

Chariocephalus agrarius, new species 8
21. Libragene (× 2).
22. Hypostoma (× 1.5).
23. Large cranidium (× 2).
24-26. Dorsal, front, and side views of holotype cranidium (× 2).
27, 28. Dorsal and side views of pygidium (× 2).
Honey Creek limestone; (loc. 37v) West Timbered Hills, Arbuckle Mountains, Oklahoma.

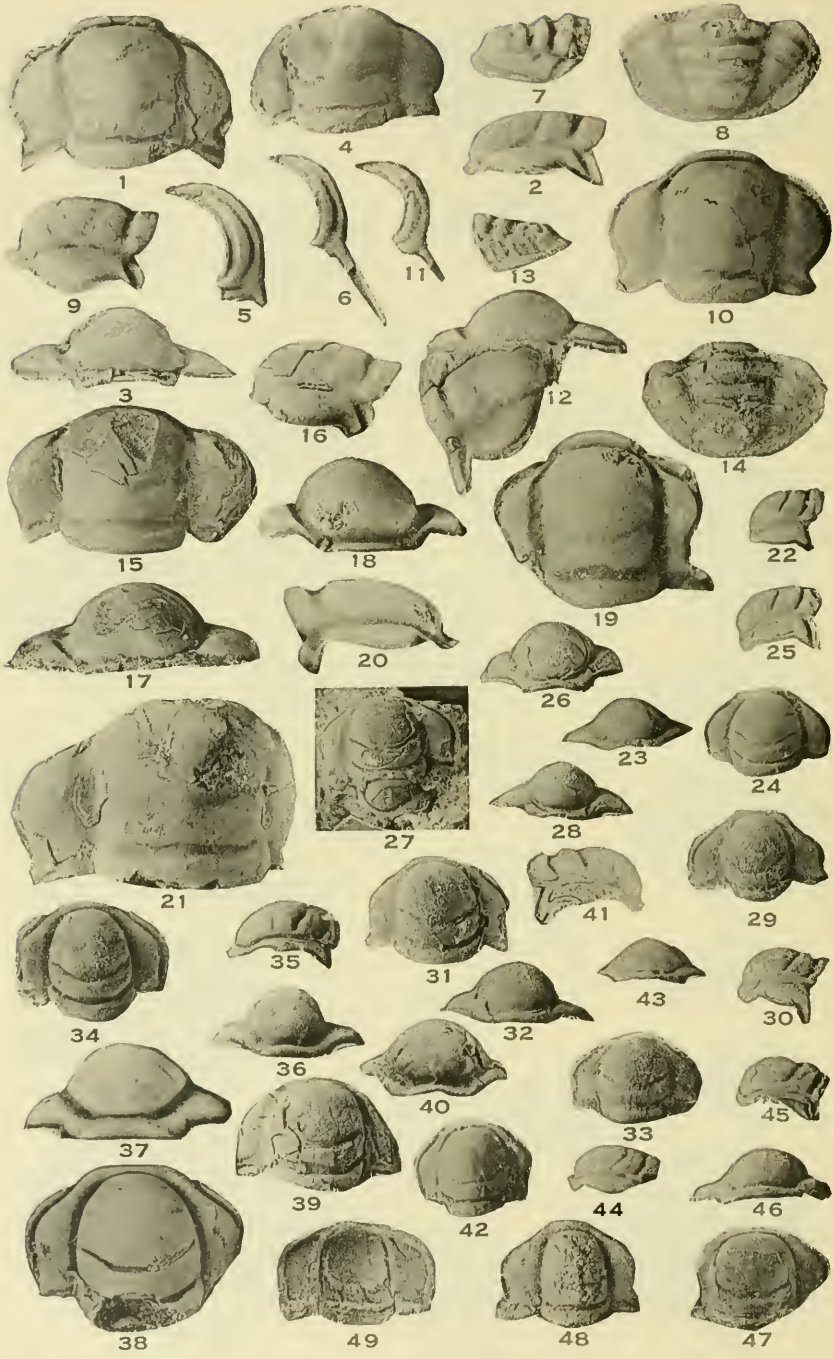
Chariocephalus gracilens, new species 9
29-31. Dorsal, front, and side views of the holotype cranidium (× 3).
Honey Creek limestone; (loc. 9y) 2 miles southeast of Canyon Creek, Wichita Mountains, Oklahoma.

Chariocephalus montis, new species 10
32-34. Side, front, and dorsal views of holotype cranidium (× 5).
Honey Creek limestone; (loc. 91q) 8 miles southeast of Mountain View, Wichita Mountains, Oklahoma.

Chariocephalus angustatus, new species 9
35-37. Dorsal, side, and rear views of the associated pygidium (× 2).
38-40. Holotype cranidium (× 6).
Honey Creek limestone; (loc. 37v) West Timbered Hills, Arbuckle Mountains, Oklahoma.



UPPER CAMBRIAN TRILOBITES



UPPER CAMBRIAN TRILOBITES

PLATE 2

PLATE 3

PAGE

Irvingella oblonga, new species 17
1-3. Dorsal, side, and front views of the holotype cranidium (× 2.5).
Wilberns formation; (loc. 70) Baldy Mountain, 8 miles northwest of Burnet, Texas.

Irvingella agrestis, new species 17
4-6. Dorsal, front, and side views of the holotype cranidium (× 2.5).
Wilberns formation; (loc. 69) Honey Creek, 8 miles southeast of Llano, Texas.

Irvingella ardmorensis, new species 18
7-9. Dorsal, side, and front views of the holotype cranidium (× 1.5).
10-12. Another partially exfoliated cranidium (× 1.5).
Honey Creek limestone; (loc. 12p) 4 miles east of Alpers, Arbuckle Mountains, Oklahoma.

Irvingella plena, new species 18
13-15. Dorsal, side, and front views of the holotype cranidium (× 1.5).
Wilberns formation; (loc. 14b) Cold Creek, opposite north end of Sponge Mountain, San Saba County, Texas.

Irvingella alta, new species 19
16-18. Dorsal, side, and front views of the holotype cranidium (× 1.5).
Honey Creek limestone; (loc. 9p) 15 miles northwest of Fort Sill, Wichita Mountains, Oklahoma.

Irvingella deckeri, new species 19
19-21. Views of a small cranidium (× 2.5).
22-24. A larger cranidium (× 1.5).
25-27. Front, side, and dorsal views of the holotype cranidium (× 3).
Honey Creek limestone; (loc. 89y) West Timbered Hills, Arbuckle Mountains, Oklahoma.

Irvingella burnetensis, new species 20
28-30. Front, dorsal, and side views of the holotype cranidium (× 1.5).
31-33. Dorsal and side views of two cranidia on one base, and front view of the upper specimen (× 2).
Wilberns formation; (loc. 70) Baldy Mountain, 8 miles northwest of Burnet, Texas.

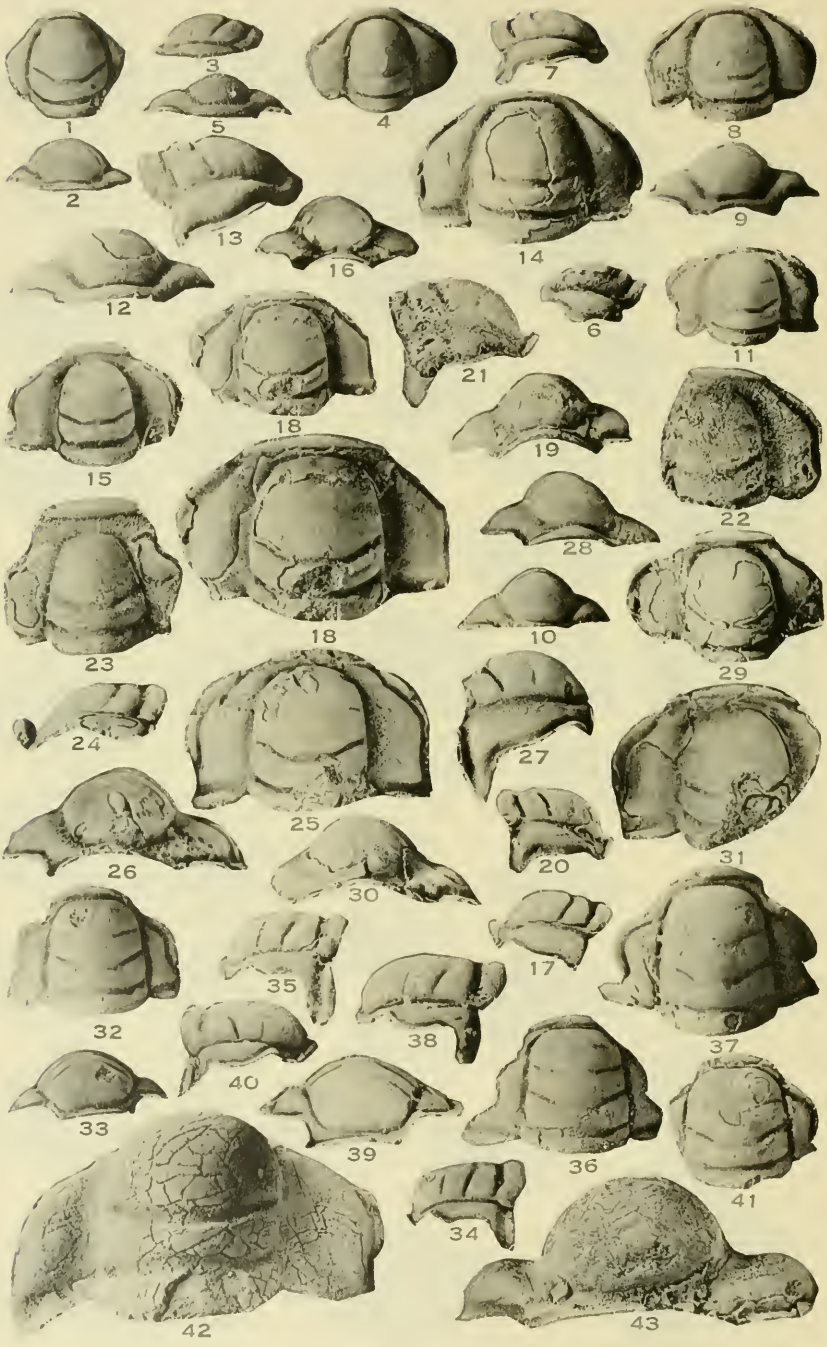
Irvingella bacca, new species 20
34-36. Dorsal, side, and front views of the holotype cranidium (× 2.5).
Wilberns formation; (loc. 14b) Cold Creek Canyon, opposite north end of Sponge Mountain, San Saba County, Texas.

Irvingella accincta, new species 21
37-39. Front, side, and dorsal views of the holotype cranidium (× 2.5).
Wilberns formation; (loc. 14b) Cold Creek Canyon, opposite north end of Sponge Mountain, San Saba County, Texas.

Irvingella abrupta, new species 21
40-42. Dorsal, side, and front views of the holotype cranidium (× 1.5).
43-45. A smaller cranidium (× 2.5).
Wilberns formation; (loc. 14b) Cold Creek Canyon, opposite north end of Sponge Mountain, San Saba County, Texas.

Irvingella media, new species 22
46-48. Side, front, and dorsal views of the holotype cranidium (× 5).
49-51. Another excellent specimen (× 5).
Wilberns formation; (loc. 70) Baldy Mountain, 8 miles northwest of Burnet, Texas.
52-54. Dorsal, front, and profile views of a larger cranidium (× 3).
Wilberns formation; (loc. 14b) Cold Creek, opposite north end of Sponge Mountain, San Saba County, Texas.

UPPER CAMBRIAN TRILOBITES



UPPER CAMBRIAN TRILOBITES

PLATE 4

PAGE

Irvingella alberta, new species 23
1-3. Dorsal, front, and side views of the holotype cranidium (× 2).
Lyell formation; (loc. 19u) Johnson Creek, 8 miles east of Lake Louise, Alberta.

Irvingella richmondensis, new species 23
4-6. Dorsal, front, and side views of the holotype cranidium (× 6).
Secret Canyon shale; (loc. 60) near Richmond Mine, Eureka District, Nevada.

Irvingella adamsensis, new species 24
7-9. Side, dorsal, and front views of the holotype cranidium (× 2.5).
10, 11. Front and dorsal views of a larger cranidium (× 1.5).
Secret Canyon shale; (loc. 60) near Richmond Mine, Eureka District, Nevada.

Irvingella flohri, new species 24
12-14. Front, side, and dorsal views of the holotype cranidium (× 3).
Secret Canyon shale; (loc. 60) near Richmond Mine, Eureka District, Nevada.

Parairvingella eurekensis, new species 26
15-17. Dorsal, front, and side views of the holotype cranidium (× 3).
Secret Canyon shale; (loc. 61) south of Hamburg Mine, Eureka District, Nevada.

Parairvingella angustilimbata Kobayashi 26
18-20. Two dorsal, front, and profile views of a complete cranidium (× 2).
21, 22. Side and dorsal views of the holotype cranidium (× 1.5).
Secret Canyon shale; (locs. 62, 63) north of Adams Hill, Eureka District, Nevada.

Parairvingella hamburgensis, new species 27
23, 24. Dorsal and side views of the holotype cranidium (× 2).
Secret Canyon shale; (loc. 61) south of Hamburg Mine, Eureka District, Nevada.

Parairvingella intermedia, new species 27
25-27. Dorsal, front, and side views of the holotype cranidium (× 3).
28, 29. A larger cranidium (× 2).
30, 31. Large incomplete cranidium (× 1.5).
Secret Canyon shale; (loc. 61) south of Hamburg Mine, Eureka District, Nevada.

Drumaspis idahoensis, new species 29
32-34. Dorsal, front, and side views of the holotype cranidium (× 2).
35, 36. Another, less complete cranidium (× 2).
St. Charles limestone; (loc. 4y) Two Mile Canyon, 2 miles south of Malad, Wasatch Mountains, Idaho.

Drumaspis walcotti, new species 28
37-39. Dorsal, side, and front views of the holotype cranidium (× 5).
40, 41. A larger cranidium (× 3).
St. Charles formation; (loc. 4y) Two Mile Canyon, 2 miles south of Malad, Wasatch Mountains, Idaho.

Irvingella tumifrons (Hall and Whitfield) 25
42, 43. Dorsal and front views of the holotype cranidium (× 1.5).
Secret Canyon shale; Pogonip Mountain, White Pine District, Nevada.

PLATE 5

PAGE

Drumaspis alberta, new species 29
1-3. Dorsal, side, and front views of the holotype cranidium (× 6).
Lyell formation; (loc. 64x) Ranger Brook Canyon, Sawback Range, Alberta.

Drumaspis briscoensis, new species 30
4, 5. Front and dorsal views of an incomplete cranidium (× 2.5).
6-8. Three views of the holotype cranidium (× 2.5).
Sabine formation; (loc. 17p) Radium Hot Springs, Brisco Range, British Columbia.

Drumaspis goodsirensis, new species 30
9. Impression of holotype cranidium (× 3).
"Goodsir" formation; Moose Creek, Ottertail Range, British Columbia.

Drumaspis sabinensis, new species 31
10, 11. Dorsal and side views of the holotype cranidium (× 6).
Sabine formation; (loc. 17s) Sabine Mountain, 2 miles northeast of Canal Flats, Brisco Range, British Columbia.

Drumaspis maxwelli, new species 31
12, 13. Side and dorsal views of the holotype cranidium (× 3).
St. Charles limestone; (loc. 66z) St. Charles Canyon, Bear River Range, Idaho.

Drumaspis deckeri, new species 31
14-16. Dorsal, front, and side views of the holotype cranidium (× 6).
Honey Creek limestone; (loc. 91b) 4 miles southeast of Hennepin, West Timbered Hills, Arbuckle Mountains, Oklahoma.

Drumaspis osella, new species 32
17-19. Dorsal, side, and front views of the holotype cranidium (× 3.5).
20. Another less complete cranidium (× 3.5).
Wilberns formation; (loc. 70) Baldy Mountain, 8 miles northwest of Burnet, Texas.

Drumaspis wichitaensis, new species 33
21, 22. Dorsal and side views of the holotype cranidium (× 2).
Honey Creek limestone; (loc. 91u) 1 mile east of Canyon Creek, 15 miles northwest of Fort Sill, Wichita Mountains, Oklahoma.

Drumaspis clara, new species 33
23. Libragene (× 3).
24-26. Front, side, and dorsal views of the holotype cranidium (× 2).
Honey Creek limestone; (loc. 91s) West Timbered Hills, Arbuckle Mountains, Oklahoma.

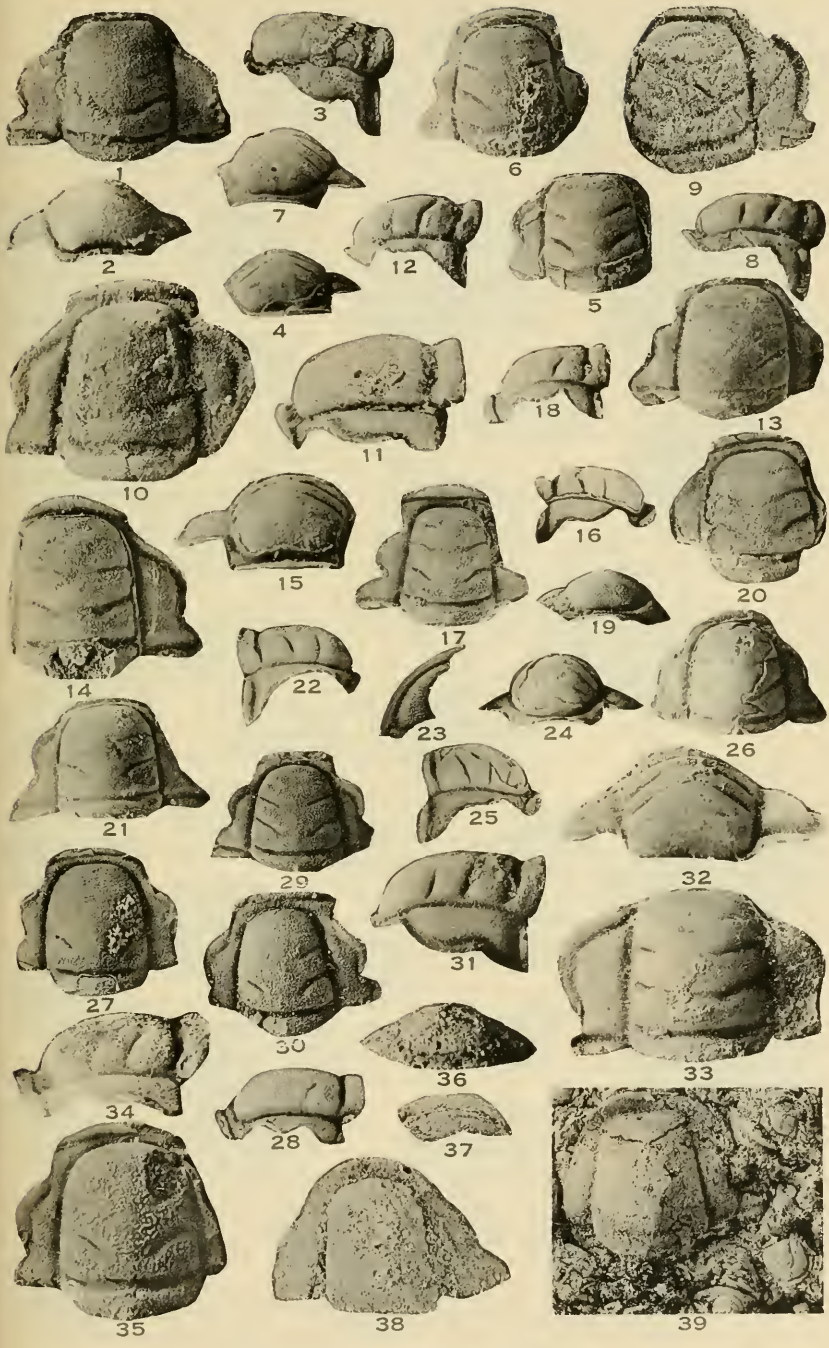
Drumaspis texana, new species 32
27, 28. Dorsal and side views of a large cranidium (× 6).
29. Holotype cranidium (× 5).
30. A small cranidium (× 5).
Wilberns formation; (loc. 70) Baldy Mountain, 8 miles northwest of Burnet, Texas.

Drumaspis utahensis, new species 34
31-33. Side, front, and dorsal views of the holotype cranidium (× 6).
St. Charles limestone; (loc. 54x) Two Mile Canyon, 2 miles south of Malad, Wasatch Mountains, Idaho.

Drumaspis nitida, new species 34
34-35. Side and dorsal views of the holotype cranidium (× 5).
Honey Creek limestone; (loc. 91s) West Timbered Hills, Arbuckle Mountains, Oklahoma.

Cheilocephalus texanus, new species 35
36-38. Front, side, and dorsal views of the holotype cranidium. (36 and 37, × 3; 38, × 6.)
Hickory sandstone; (loc. 68z) Packsaddle Mountain, 11 miles southeast of Llano, Texas.

Cheilocephalus wichitaensis, new species 35
30. Holotype cranidium (× 2).
Honey Creek limestone; (loc. 9p) 15 miles northwest of Fort Sill, Wichita Mountains, Oklahoma.



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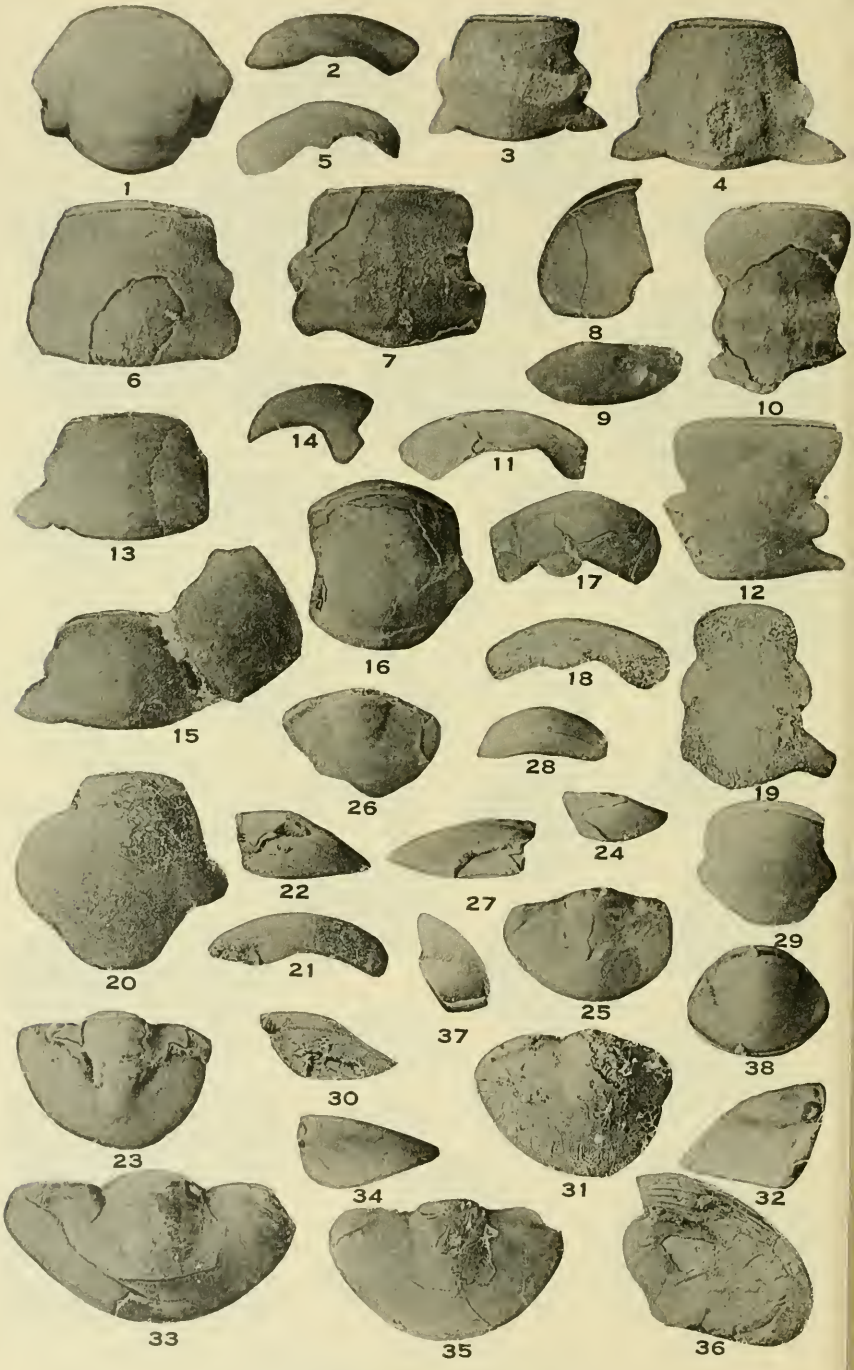


UPPER CAMBRIAN TRILOBITES

PLATE 6

PLATE 7

PAGE

Macclloura transversa, new species 43
1. Holotype pygidium (× 1.5).
Wilberns formation; (loc. 14f) Bartlett Hollow, Burnet County, Texas.

Arapahoia stantoni, new species 44
2. Holotype cranidium.
3, 4. Pygidium (× 2).
Pilgrim formation; (loc. 26b) Mill Creek, Little Rocky Mountains, Montana.

Arapahoia resseidei, new species 44
5. Pygidium (× 1.5).
6, 7. Dorsal and side views of the holotype cranidium (× 2).
8, 9. Another cranidium (× 2.5).
Maurice formation; (loc. 26c) 6 miles south of Hailey, Wyoming.

Arapahoia polita, new species 45
10, 11. Dorsal and profile views of the holotype cranidium (× 1.5).
Sullivan formation; (loc. 64h) East Lyell Glacier, 48 miles northwest of Lake Louise, Alberta.

Arapahoia walcottae, new species 46
12, 13. Dorsal and side views of the holotype cranidium (× 1.5).
14. A smaller, exfoliated cranidium (× 2).
Sullivan formation; (loc. 64e) East Lyell Glacier, 48 miles northwest of Lake Louise, Alberta.

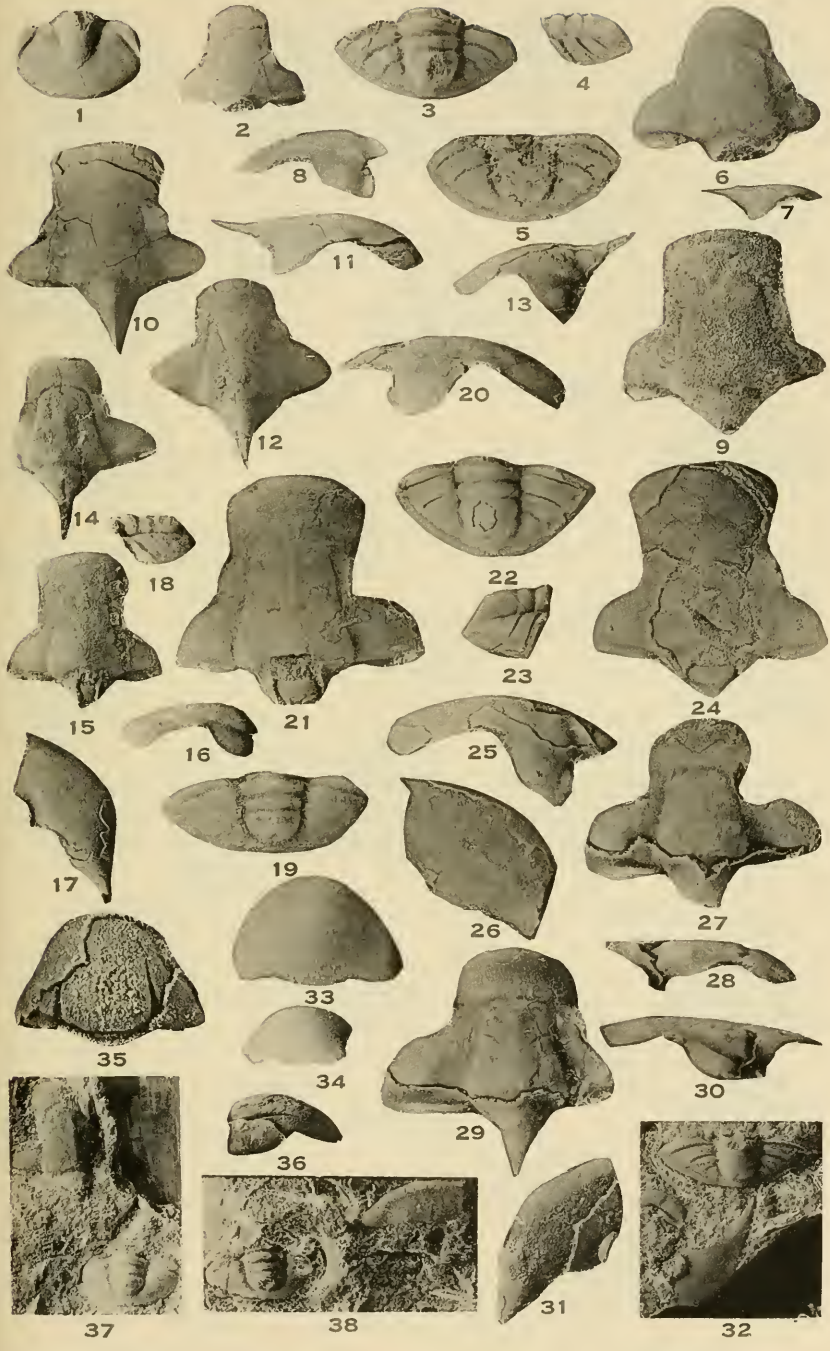
Arapahoia elongata, new species 45
15, 16. Dorsal and side views of the holotype cranidium (× 1.5).
17. Libragene (× 1.5).
18, 19. Pygidium (× 1.5). (See also fig. 32.)
Sullivan formation; (loc. 64h) East Lyell Glacier, 48 miles northwest of Lake Louise, Alberta.

Arapahoia prolixa, new species 46
20, 21. Side and dorsal views of the holotype cranidium (× 1.5).
22, 23. Pygidium (× 1.5).
24, 25. A partially exfoliated cranidium (× 2).
26. Libragene (× 1.5).
Sullivan formation; (loc. 64h) East Lyell Glacier, 48 miles northwest of Lake Louise, Alberta.

Arapahoia albertensis, new species 46
27. Cranidium (× 3).
28, 29. Side and dorsal views of the holotype cranidium (× 3).
30. Side view of unexfoliated cranidium (× 3).
31. Libragene (× 1.5).
32. Pygidium and libragene of *A. elongata* (× 1.5). (See also figs. 17-19.)
Sullivan formation; (loc. 64h) East Lyell Glacier, 48 miles northwest of Lake Louise, Alberta.

Kingstonia electra, new species 47
33, 34. Dorsal and side views of the holotype cranidium (× 5).
35, 36. A partially exfoliated cranidium (× 5).
Weeks formation; (locs. 30h, i) 5 miles south of Marjum Pass, House Range, Utah.

Arapahoia typa Miller 44
37. Cranidium and pygidium (× 1.5).
38. Libragene and pygidium (× 1.5).
Maurice formation; Butte north of Little Rocky Creek, Beartooth Range, Wyoming.



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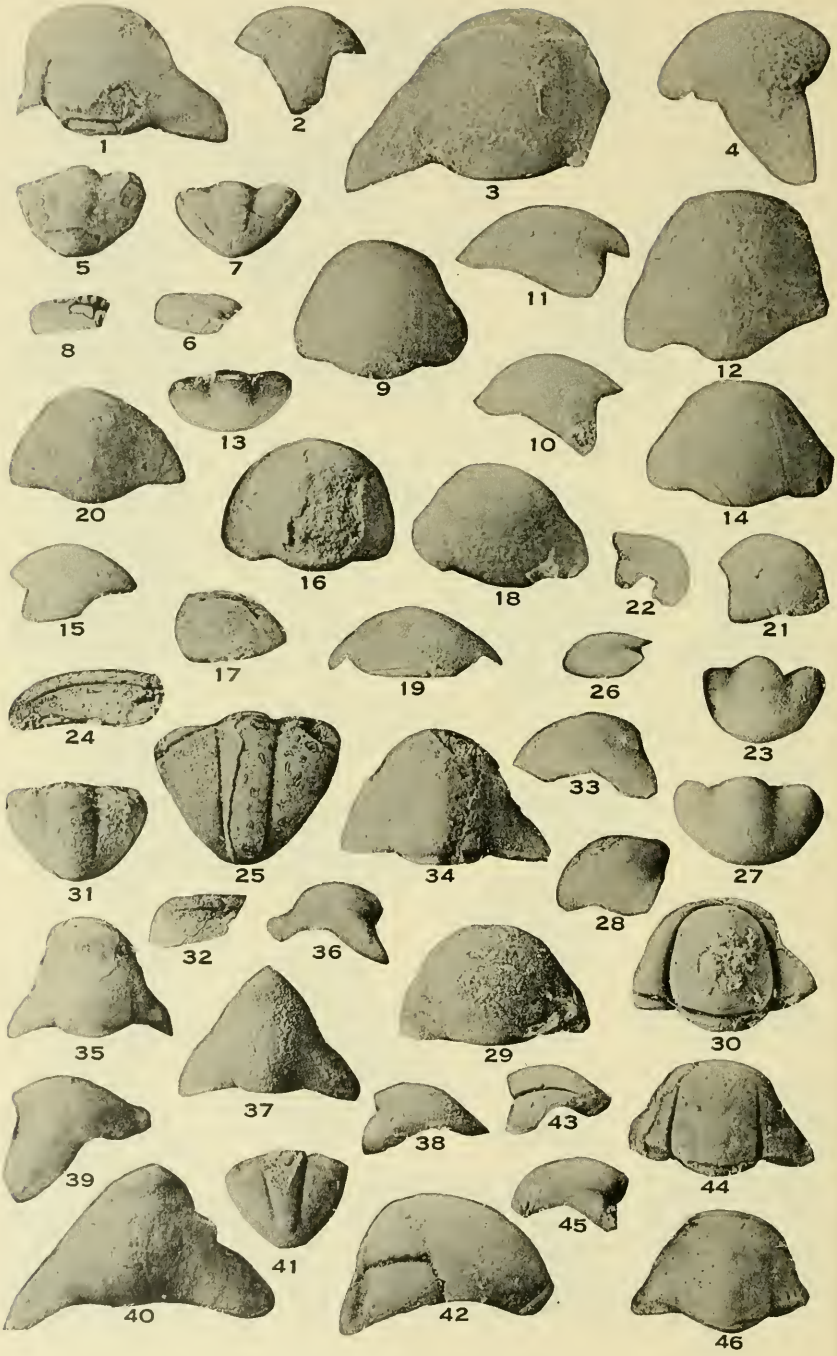


UPPER CAMBRIAN TRILOBITES

PLATE 8

PLATE 9

PAGE

Kingstonia kindlei, new species 51
1, 2. Dorsal and side views of the holotype cranidium (×3).
3, 4. Two pygidia (×5).
Warrior limestone; (loc. 38e) 1 mile northwest of Benore, and 5 miles west of State College, Pennsylvania.

Bynumia eumus Walcott 52
5, 6. Dorsal and side views of the holotype cranidium (×3).
7. Pygidium (×3).
Sullivan formation; (loc. 64b) head of Glacier Lake Canyon Valley, 48 miles northwest of Lake Louise, Alberta.

Bynumia elegans, new species 52
8, 9. Dorsal and side views of the holotype cranidium (×6).
10. Smaller cranidium (×3).
11, 12. Two pygidia (×3).
Sullivan formation; (loc. 64r) Ranger Brook Canyon, Sawback Range, Alberta.

Bynumia arguta, new species 53
13, 14. Side and dorsal views of the holotype cranidium (×5).
15. The associated pygidium (×3).
Sullivan formation; (loc. 66s) Badger Pass, Sawback Range, Alberta.

Bynumia walcotti, new species 53
16, 17. Side and dorsal views of the partially exfoliated holotype cranidium (×3).
18, 19. An exfoliated cranidium figured by Walcott as *B. eumus* (×3).
20. The associated pygidium (×2.5).
Sullivan formation; (loc. 66m) 5 miles northwest of Banff, Sawback Range, Alberta.

Bynumia venusta, new species 54
21, 22. Side and dorsal view of the holotype cranidium (×3).
23. Libragene (×5).
24-26. Three pygidia (×3).
27, 28. A somewhat variant cranidium (×2.5).
Sullivan formation; (loc. 64s) Ranger Brook Canyon, Sawback Range, Alberta.

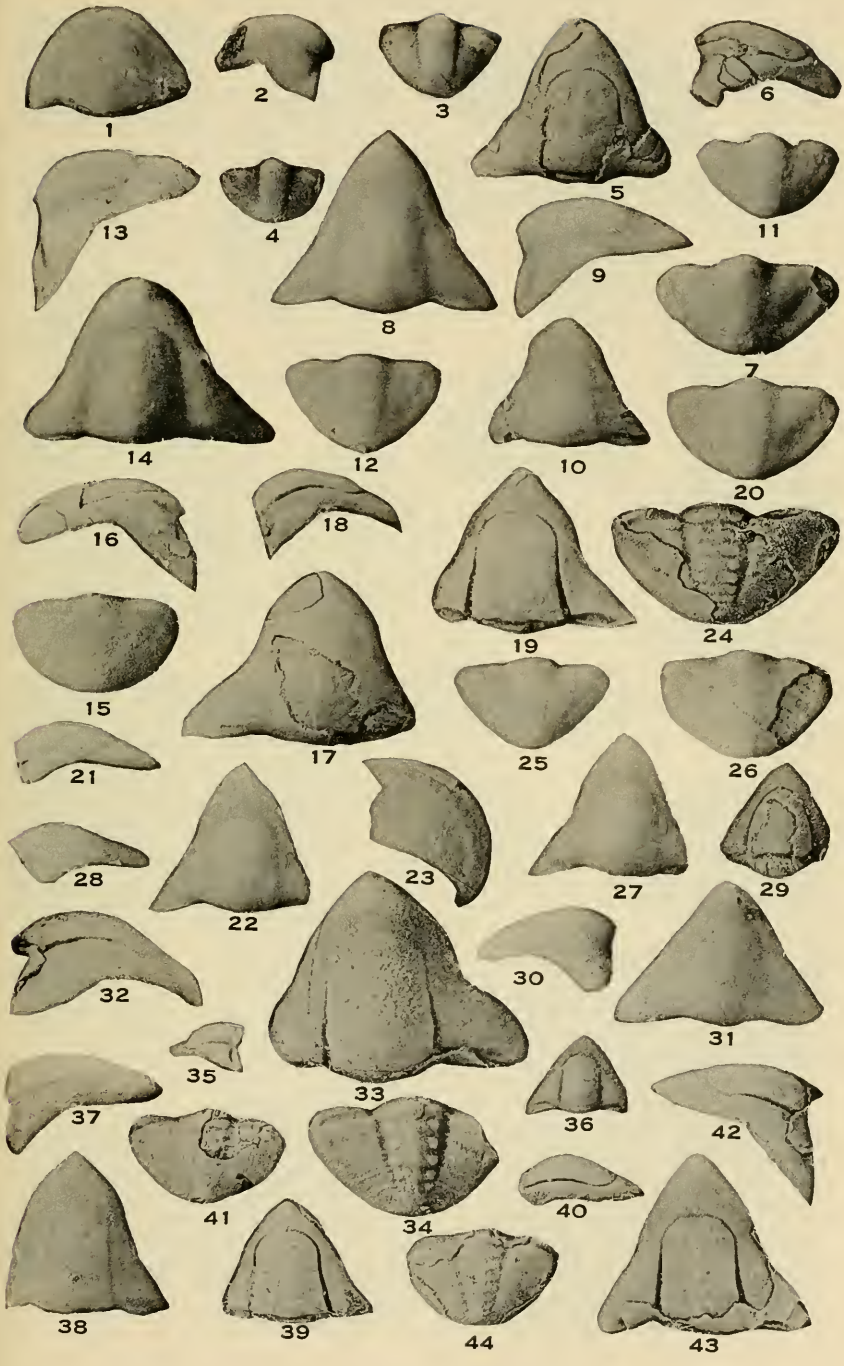
Bynumiella briscoensis, new species 57
29. Holotype cranidium (×5).
Sabine formation; (loc. 16t) Sinclair Canyon, Brisco Range, British Columbia.

Bynumia robsonensis, new species 54
30, 31. Side and dorsal views of the holotype cranidium (×4).
32, 33. An exfoliated cranidium (×6).
34. An exfoliated pygidium (×3.5).
Lynx formation; (loc. 19m) Iyatunga Mountain, Mount Robson, British Columbia.

Bynumia sulcata, new species 54
35, 36. Side and dorsal views of the holotype cranidium (×5).
Sullivan formation; (loc. 64s) Ranger Brook Canyon, Sawback Range, Alberta.

Bynumia rangerensis, new species 55
37, 38. Side and dorsal views of the holotype cranidium (×3).
39, 40. An exfoliated cranidium (×3).
41. Pygidium (×2).
Sullivan formation; (loc. 66L) Ranger Brook Canyon, Sawback Range, Alberta.

Bynumia sawbackensis, new species 55
42, 43. Side and dorsal views of the holotype cranidium (×3).
44. Pygidium (×2).
Sullivan formation; (loc. 64w) Ranger Brook Canyon, Sawback Range, Alberta.



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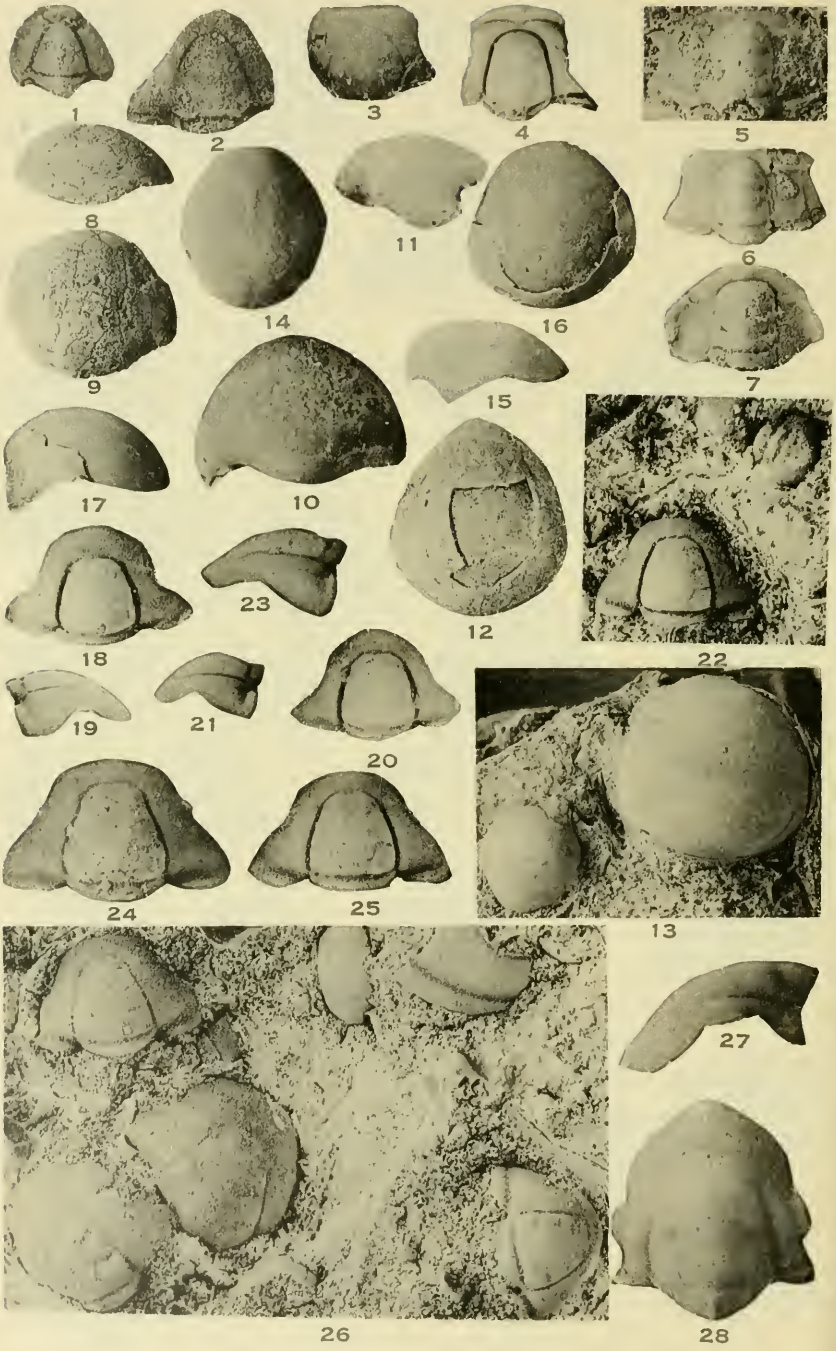

UPPER CAMBRIAN TRILOBITES

PLATE 10

PAGE

Bynumiella typicalis, new species 57
1. Holotype cranidium (× 4).
2. A larger cranidium (× 5).
Lyell formation; (loc. 66j) Northeast branch Ranger Brook Canyon, 10 miles northwest of Banff, Sawback Range, Alberta.

Cholopilus (?) *albertensis,* new species 37
3. Holotype cranidium (× 2).
Lyell formation; (loc. 64b) Glacier Lake Canyon Valley, 48 miles northwest of Lake Louise, Alberta.

Talbotina caelata, new species 107
4. Holotype cranidium (× 2.5).
Nolichucky shale; (loc. 27d) U. S. 11, 7 miles northeast of Rogersville, Tennessee.

Ellipsocephaloides argutus, new species 63
5. Imperfect cranidium (× 3).
6. Holotype cranidium (× 4).
Sabine formation; (loc. 12s) Ram Creek, 15 miles south of Canal Flats, British Columbia.

Ellipsocephaloides briscoensis, new species 63
7. Holotype cranidium (× 2.5).
Sabine formation; (loc. 17s) Sabine Mountain, Brisco Range, British Columbia.

Stenopilus bacca, new species 59
8, 9. A large cranidium (× 2).
10, 11. Dorsal and side views of a young cranidium (× 6).
12. Partially exfoliated cranidium (× 4).
13. Holotype cranidium and a smaller example (× 3).
Signal Mountain formation; (locs. 12i, j) 2 miles southwest of Signal Mountain, Wichita Mountains, Oklahoma.

Stenopilus aduncus, new species 60
14, 15. Dorsal and side views of the holotype cranidium (× 1.5).
16, 17. Partially exfoliated cranidium (× 1.5).
Signal Mountain formation; (loc. 12L) Pickens Ranch, Arbuckle Mountains, Oklahoma.

Bynumina caelata, new species 58
18-21. Dorsal and side views of two cranidia (× 4).
22. Holotype cranidium and associated pygidium (× 4).
Davis formation; (loc. 92d) Federal Lead Mine No. 4, Flat River, Missouri.

Bynumina missouriensis, new species 59
23, 24. Dorsal and side views of the holotype cranidium (× 5).
25. Another cranidia (× 4).
26. Surface with several cranidia (× 6).
Davis formation; (loc. 11k) Flat River, Missouri.

Bynumiella (?) *oklahomensis,* new species 58
27, 28. Side and dorsal views of the holotype cranidium (× 5).
Signal Mountain formation; (loc. 201j) 1 mile south of Royer Ranch, Arbuckle Mountains, Oklahoma.

PLATE 11

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Ellipsocephaloides silvestris, new species 64
1. Cranidium (× 4).
2. Holotype cranidium (× 4).
3. Two pygidia with which are associated the base of a cranidium and a libragene of *Ptychaspis* (× 4). (See also pl. 12, fig. 7.)
Honey Creek limestone; (loc. 91b) West Timbered Hills, Arbuckle Mountains, Oklahoma.

Ellipsocephaloides sawbackensis, new species 64
4. Holotype cranidium (× 5).
5. Large incomplete cranidium (× 5).
Lyell formation; (loc. 64x) Ranger Brook Canyon, Sawback Range, Alberta.

Cheilocephalus buttsi, new species 36
6. Holotype cranidium (× 1.5).
Ore Hill limestone; (loc. 107v) ½ mile northwest of Drab, Pennsylvania.

Ellipsocephaloides carus, new species 65
7. Cranidium (× 5).
8. Holotype cranidium (× 5).
Sabine formation; (loc. 12s) Ram Creek, 15 miles south of Canal Flats, British Columbia.

Ellipsocephaloides montis, new species 65
9, 10. Dorsal and side views of the holotype cranidium (× 2.5).
11. A small cranidium (× 5).
Both are associated with *Pseudagnostus.*
Sabine formation; (loc. 12s) Ram Creek, 15 miles south of Canal Flats, British Columbia.

Ellipsocephaloides bearensis, new species 65
12. Holotype cranidium (× 2).
St. Charles limestone; (loc. 66z) 5 miles west of St. Charles, Bear River Range, Idaho.

Ellipsocephaloides nitela, new species 66
13. Several cranidia (× 4). (See also pl. 12, figs. 1-3.)
Honey Creek limestone; (loc. 12m) 7 miles north of Springer, Arbuckle Mountains, Oklahoma.

Ellipsocephaloides butleri, new species 66
14, 15. Cranidia (× 2.5). Upper right cranidium of fig. 14 is the holotype.
Sawatch formation; (loc. 37x) near Gilman, Mosquito Range, Colorado.


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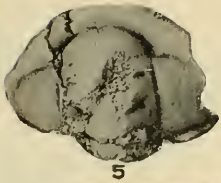
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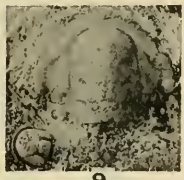
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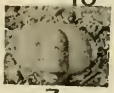
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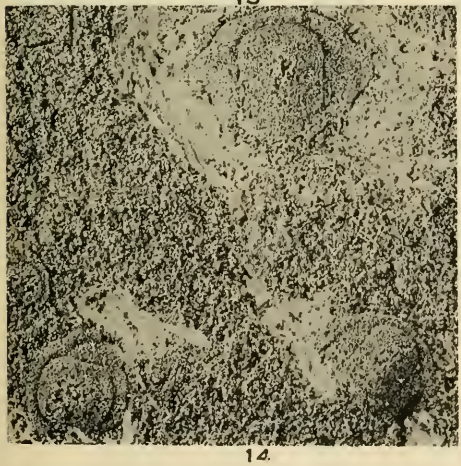
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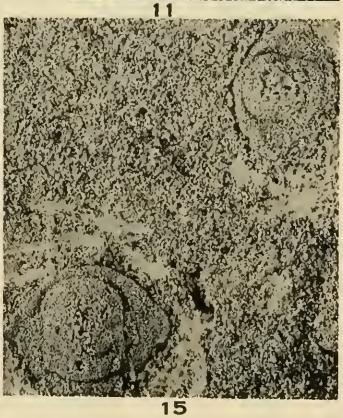
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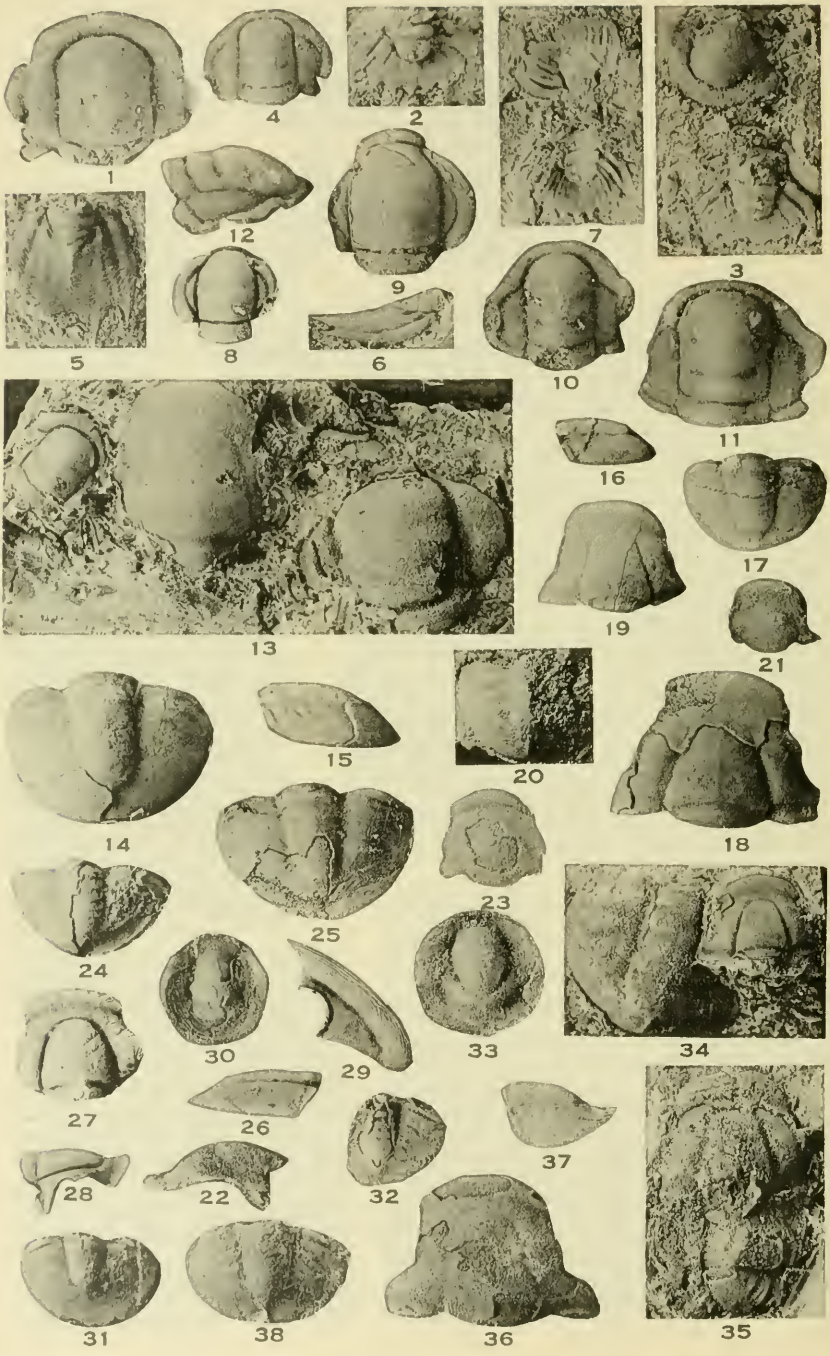

UPPER CAMBRIAN TRILOBITES

PAGE

Ellipsocephaloides nitela, new species 66
1. Holotype cranidium (× 5).
2. Pygidium (× 6).
3. Pygidium with full complement of spines, and cranidium (× 3). (See also pl. 11, fig. 13.)
Honey Creek limestone; (loc. 12m) 7 miles north of Springer, Arbuckle Mountains, Oklahoma.

Ellipsocephaloides monsensis, new species 66
4. Holotype cranidium (× 5).
5, 6. The pygidium (× 3).
Lyell formation; (loc. 64f) Mons Glacier, 50 miles northwest of Lake Louise, Alberta.

Ellipsocephaloides silvestris, new species 64
7. Well-preserved pygidia (× 5). (See also pl. 11, fig. 3.)
Honey Creek limestone; (loc. 91b) West Timbered Hills, Arbuckle Mountains, Oklahoma.

Calyptomma typicale, new species 38
8. Cranidium (× 4).
9. Holotype cranidium (× 4).
Red Lion formation; (loc. 150e) Boulder Creek, 1 mile north of Princeton, Montana.

Ellipsocephaloides declivis, new species 67
10. Cranidium (× 4).
11, 12. Dorsal and side views of the holotype cranidium (× 5). (See also fig. 13.)

Plethometopus albertensis, new species 47
13. Holotype cranidium, with cranidia of *Ellipsocephaloides declivis* (see figs. 10-12) and *Chariocephalus magnus* (see pl. 2, fig. 15). (× 4.)
Lyell formation; (loc. 20j) Tilted Mountain Brook, 9½ miles east of Lake Louise, Alberta.

Maryvillia wyomingensis (Resser) 67
14, 15. Dorsal and side views of the holotype pygidium (× 1.5).
Pilgrim formation; Dead Indian Creek, Clark Fork, Absaroka Range, Wyoming.
16, 17. Side and dorsal views of an exfoliated pygidium (× 1.5).
18. Partially exfoliated cranidium (× 1.5).
Pilgrim formation; (loc. 4r) Suce Creek, Mount Delano, Snowy Range, Montana.
19. Cranidium (× 1.5).
20. Pygidium (× 1.5).
Pilgrim formation; (loc. 151g) mouth of Clark Fork River, Absaroka Range, Wyoming. (See also pl. 14, fig. 1.)

Maryvillia violaensis, new species 68
21, 22. Dorsal and side views of a cranidium. (21, × 1.5; 22, × 3.)
23. Partially exfoliated cranidium (× 2.5).
24. Partially exfoliated pygidium (× 1.5).
25, 26. The holotype pygidium (× 1.5).
Maurice formation; (loc. 151k) Labarge Creek, near Viola, Uinta County, Wyoming.

Maryvillia utahensis, new species 68
27, 28. Dorsal and side views of the cranidium (× 2).
29. Libragene (× 2).
30. Hypostoma (× 5).
31. Holotype pygidium (× 1.5).
32. Incomplete pygidium (× 1.5).
Weeks formation; (loc. 32w) Fandango Spring Canyon, Dugway Range, Utah.

Maryvillia marjumensis, new species 68
33. Hypostoma (× 3).
34. Holotype pygidium associated with an exfoliated cranidium (× 1.5).
35. Associated cranidium and pygidium (× 1.5).
Weeks formation; (loc. 30i) 5 miles south of Marjum Pass, House Range, Utah.

Maryvillia loperi, new species 70
36. Cranidium (× 1.5).
37, 38. Side and dorsal views of the holotype pygidium.
Sawatch formation; (loc. 6a) Taylor Peak, 4 miles south of Ashcroft, Colorado.

PLATE 13

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Maryvillia alberta, new species 70
1, 2. Dorsal and side views of the holotype cranidium (× 2).
Sullivan formation; (loc. 64i) Glacier Lake Canyon Valley, 48 miles northwest of Lake Louise, Alberta.
3, 4. A pygidium referred to species (× 1.5).
Sullivan formation; (loc. 64c) Glacier Lake Canyon Valley, 48 miles northwest of Lake Louise, Alberta.

Meteoraspis banffensis, new species 72
5, 6. Dorsal and side views of the holotype cranidium (× 2).
7, 8. An exfoliated cranidium (× 2).
9, 10. Pygidium (× 4).
Sullivan formation; (loc. 66m) 4¾ miles northwest of Banff, Sawback Range, Alberta.

Maryvillia montis, new species 71
11. Cranidium (× 2).
12, 13. Side and dorsal views of the holotype pygidium.
Deadwood formation; (loc. 17L) ½ mile west of Deadwood, Black Hills, South Dakota.

Maryvillia hybrida, new species 71
14, 15. Cranidium (× 1.5).
16, 17. Dorsal and side views of the holotype pygidium (× 1.5).
Cap Mountain formation; (loc. 14d) Bartlett Hollow, Burnet County, Texas.

Coosia canadensis, new species 73
18, 19. Dorsal and side views of the holotype cranidium (× 1.5).
20. Pygidium (× 2).
Sullivan formation; (loc. 64i) Glacier Lake Canyon Valley, 48 miles northwest of Lake Louise, Alberta.

Coosella texana, new species 75
21, 22. Pygidium (× 1.5).
23, 24. Dorsal and side views of the holotype cranidium (× 1.5). (See also pl. 14, figs. 2-5.)
Cap Mountain formation; (loc. 14d) Bartlett Hollow, Burnet County, Texas.

Coosia albertensis, new species 73
25, 26. Pygidium. (25, × 2; 26, × 1.5.)
27, 28. Side and dorsal views of the holotype cranidium (× 1.5).
Sullivan formation; (loc. 65i) Glacier Lake Canyon Valley, 48 miles northwest of Lake Louise, Alberta.

Coosia dakotensis, new species 74
29, 30. Side and dorsal views of the holotype cranidium (× 1.5).
31. Pygidium, impression of the cranidium, and libragenes showing the wide doublure (× 1.5).
Deadwood formation; (loc. 17j) Galena, Black Hills, South Dakota.

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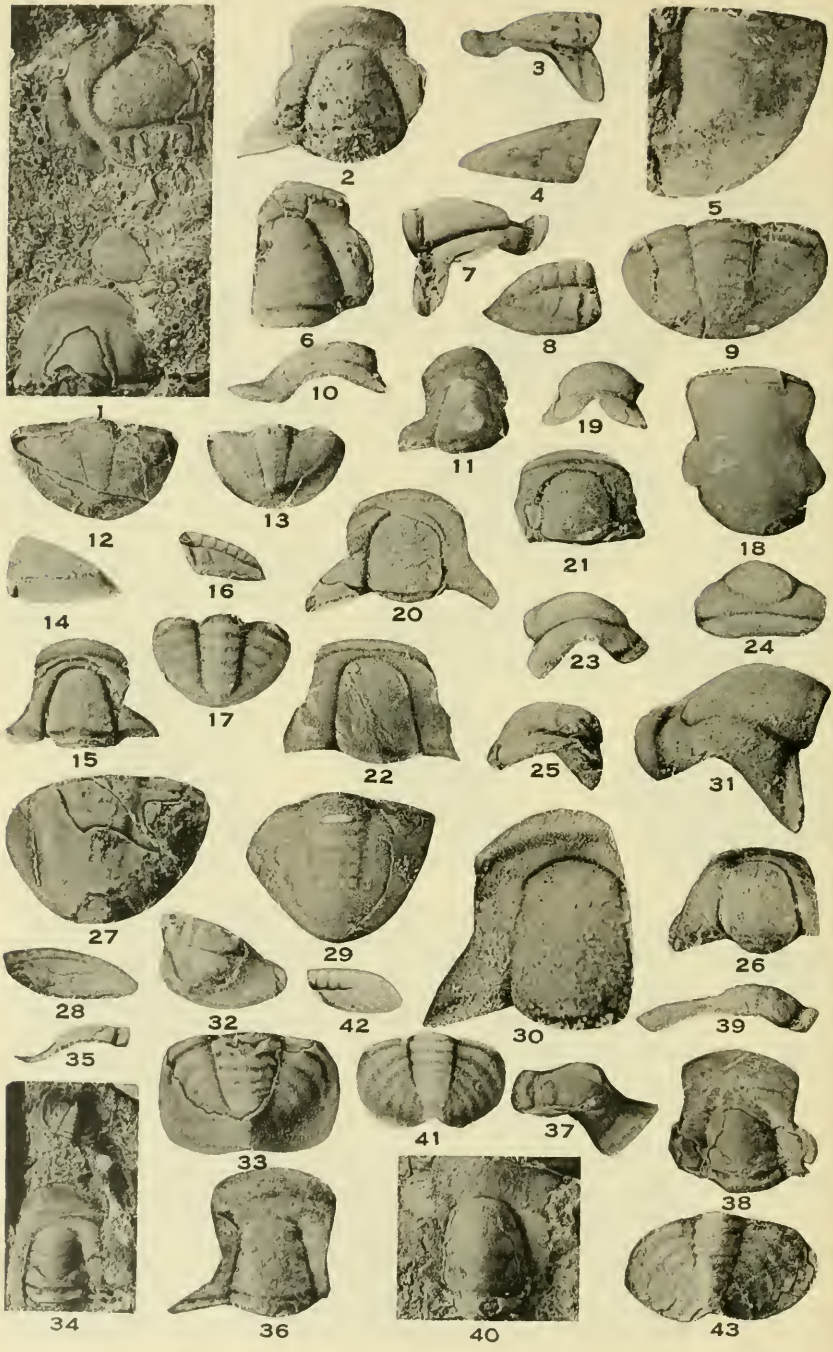

UPPER CAMBRIAN TRILOBITES

PLATE 14

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Maryvillia wyomingensis (Resser) 67

1. Partially exfoliated cranidium associated with the holotype of *Tricrepicephalus tripunctatus* (Whitfield). (See also pl. 12, figs. 14-20.)

Pilgrim formation; near Moss Agate Springs, Castle Mountains, Montana.

Coosella texana, new species 75

2, 3. Dorsal and side views of a nearly complete cranidium.

4, 5. Portion of pygidium. (See also pl. 13, figs. 21-24.)

Cap Mountain formation; (loc. 67a) Potatotop, 7 miles northwest of Burnet, Texas.

Coosella brevis, new species 76

6, 7. Dorsal and side views of the holotype cranidium (× 3).

8, 9. The pygidium (× 2).

Warrior limestone; (loc. 38e) 1 mile northwest of Benore, and 5 miles west of State College, Pennsylvania.

Blountia (?) *disparilis,* new species 61

10, 11. Side and dorsal views of the holotype cranidium. (10, × 2.5; 11, × 2.)

Sullivan formation; (loc. 64h) Glacier Lake Canyon Valley, 48 miles northwest of Lake Louise, Alberta.

Blountia plana, new species 60

12. Somewhat distorted pygidium (× 1.5).

13, 14. Dorsal and side views of the holotype pygidium (× 1).

Sullivan formation; (loc. 64c) Glacier Lake Canyon Valley, 48 miles northwest of Lake Louise, Alberta.

Maryvillia moosensis, new species 72

15. Holotype cranidium (× 2.5).

16, 17. Side and dorsal views of a pygidium (× 1.5).

Lynx formation; (loc. 61r) drift on Moose River, 10 miles northeast of Robson Pass, British Columbia.

Illaenurus albertensis, new species 38

18. Exfoliated cranidium (× 2.5). (See also pl. 6, figs. 8-12.)

Lyell formation; (loc. 20d) Tilted Mountain Brook, 9 miles east of Lake Louise, Alberta.

Blountiella alberta, new species 61

19, 20. Partially exfoliated cranidium (× 2.5).

21. Longitudinally shortened cranidium (× 3).

22-24. Dorsal, side, and front views of the holotype cranidium (× 3.5).

25, 26. Partially exfoliated cranidium (× 3).

Sullivan formation; (locs. 64b, c) Glacier Lake Canyon Valley, 48 miles northwest of Lake Louise, Alberta.

Blountia kindlei, new species 60

27. Pygidium retaining most of test (× 3.5).

28, 29. Large pygidium (× 2).

30, 31. Dorsal and side views of the holotype cranidium (× 5).

Warrior limestone; (loc. 38e) 1 mile northwest of Benore, 5 miles west of State College, Pennsylvania.

Pterocephalina texana, new species 76

32, 33. Side and dorsal views of the holotype pygidium (× 2).

Wilberns formation; (loc. 69) Honey Creek, 8 miles southeast of Llano, Texas.

Pterocephalina notha, new species 77

34. Cranidium and holotype pygidium.

35, 36. Small cranidium (× 2.5).

37, 38. Partially exfoliated cranidium.

Mendha limestone; (loc. 7j) 1 mile north of Italian Ranch foothills, north end of Quinn Canyon Range, Nevada.

Pterocephalina bilobata (Hall and Whitfield) 77

39, 40. Incomplete cranidium.

41, 42. Small pygidium (× 2).

43. Pygidium of normal size.

Secret Canyon shale; (loc. 61) south of Hamburg Mine, Eureka District, Nevada.

PLATE 15

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Pterocephalina pogonipensis, new species 78
1. Cranidium and holotype pygidium (× 2).
2. Side view of the holotype (× 2).
Secret Canyon shale; west side of Pogonip Mountain, White Pine District, Nevada.

Pterocephalina grata, new species 78
3, 4. Cranidium (× 3).
5, 6. Side and dorsal views of the holotype pygidium (× 2).
Secret Canyon shale; (loc. 23b) ridge east of Hamburg Ridge, Eureka District, Nevada.

Pterocephalina utahensis, new species 79
7. Large pygidium (× 1.5).
8, 9. Cranidium (× 2).
10, 11. Dorsal and side views of the holotype pygidium (× 2).
Orr formation; (loc. 33d) east side Fish Spring Range, Utah.

Coosia tridentensis, new species 74
12. Small pygidium (× 1.5).
13. Cranidia and pygidium (× 1.5).
14, 15. Holotype cranidium (× 1.5).
16. Incomplete cranidium (× 1.5).
17. Impression of pygidium (× 1.5).
Pilgrim formation; (loc. 20y) 3 miles north of Trident, Montana.

Berkeia comes, new species 90
18, 19. Incomplete cranidium (× 3).
20, 21. Dorsal and side views of the holotype cranidium (× 3).
Deadwood formation; (loc. 88a) Deadwood, Black Hills, South Dakota.

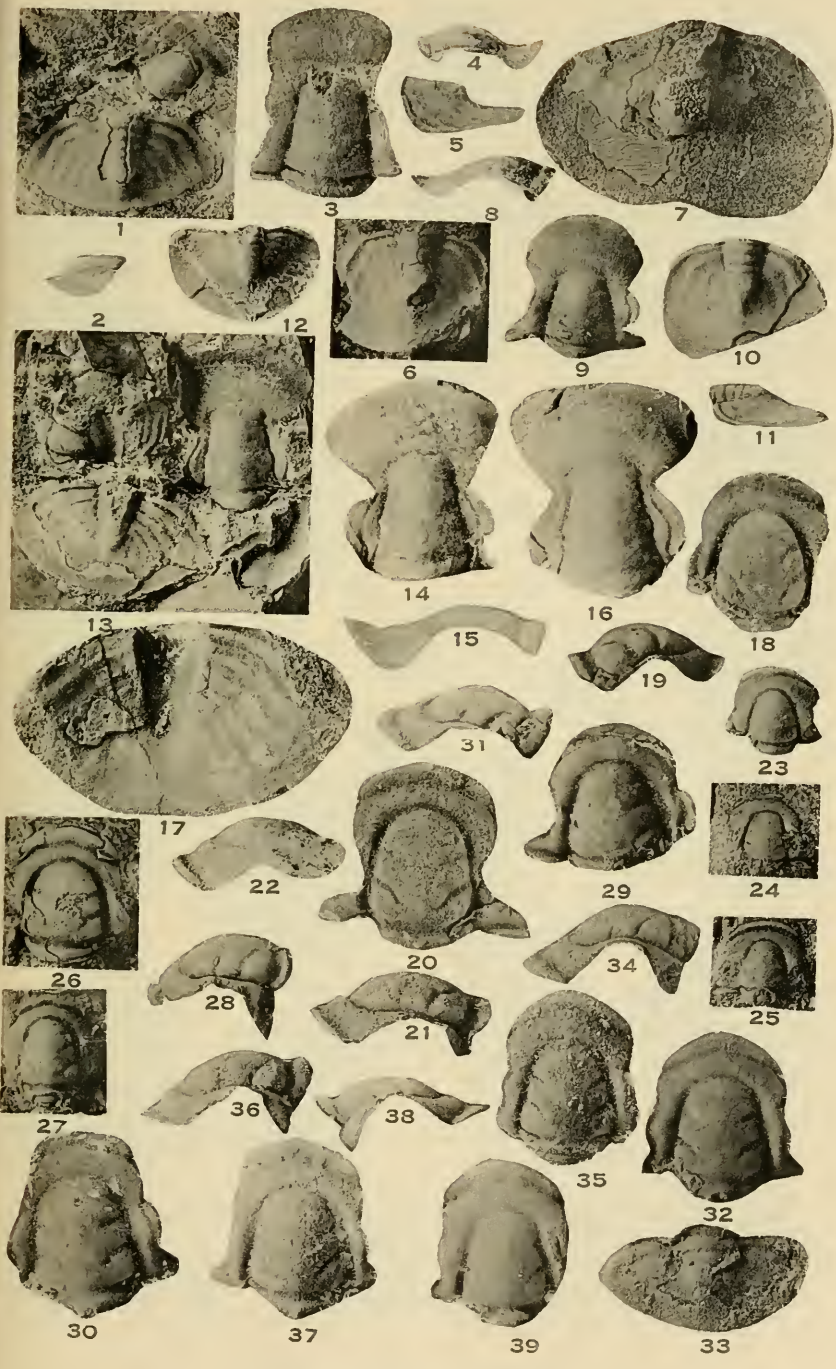
Berkeia saratogensis, new species 91
22, 23. Side and dorsal views of the holotype cranidium. (22, × 1.5; 23, × 3.)
24, 25. Two cranidia (× 1.5).
Potsdam sandstone; Greenfield, northwest of Saratoga, New York.

Berkeia nevadensis, new species 91
26. Holotype cranidium (× 2.5).
27. Cranidium (× 2.5).
Secret Canyon shale; (loc. 61) south of the Hamburg Mine, Eureka District, Nevada.

Berkeia retusa, new species 92
28, 29. Side and dorsal views of the holotype cranidium (× 3).
30. Cranidium (× 3).
Honey Creek limestone; (loc. 12p) 4 miles southeast of Hennepin, Arbuckle Mountains, Oklahoma.

Berkeia wichitaensis, new species 92
31, 32. Side and dorsal views of the holotype cranidium (× 3).
33. Pygidium (× 3).
Honey Creek limestone; (loc. 91L) Big Baldy, Wichita Mountains, Oklahoma.

Berkeia angustata, new species 93
34, 35. Side and dorsal views of the holotype cranidium (× 3).
36-39. Two cranidia (× 3).
Honey Creek limestone; (loc. 89y) West Timbered Hills, Arbuckle Mountains, Oklahoma.



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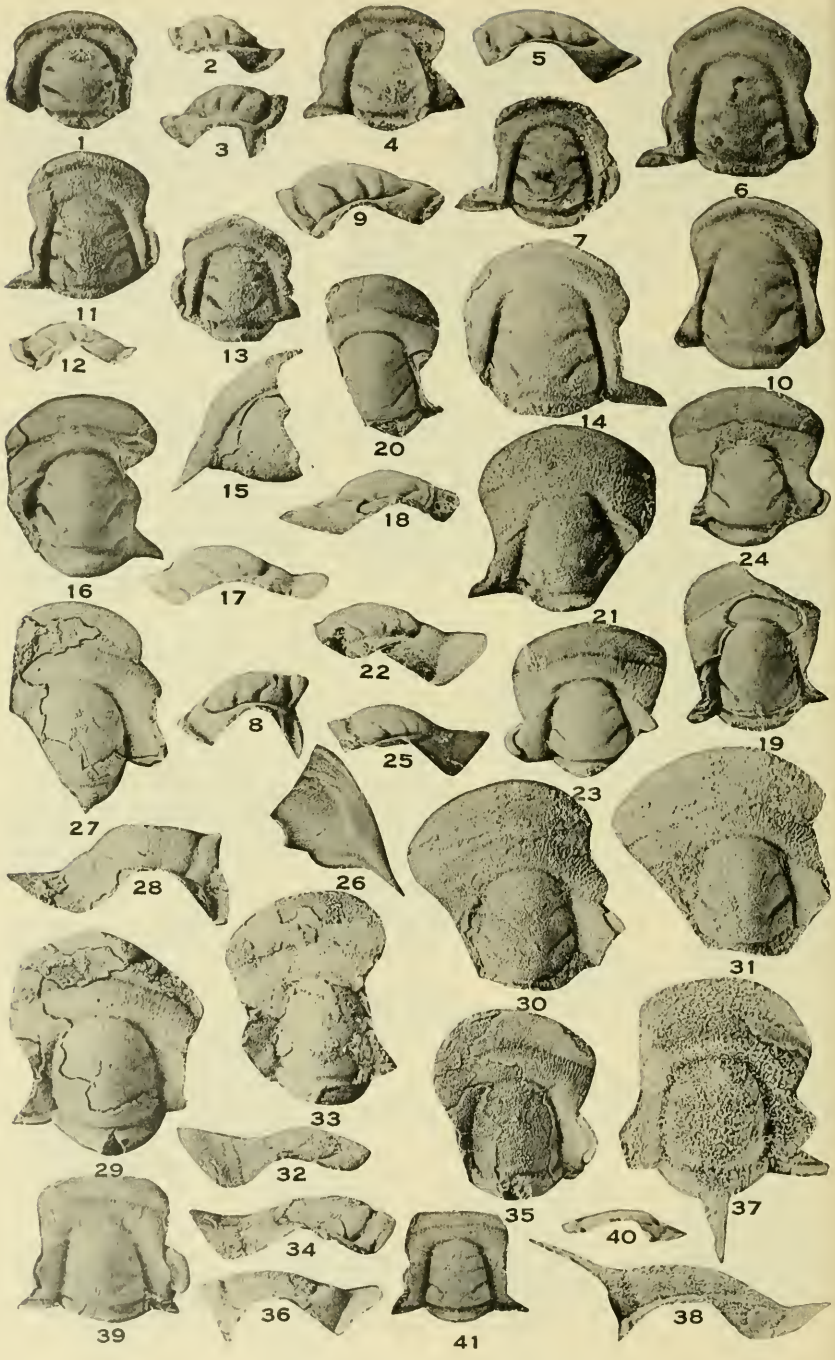

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PLATE 16

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Berkeia sculptilis, new species 93
1, 2. Incomplete cranidium (× 3).
3, 4. Side and dorsal views of the holotype cranidium (× 3).
Honey Creek limestone; (loc. 12k) Honey Creek, 7 miles north of Springer, Wichita Mountains, Oklahoma.

Berkeia jucunda, new species 93
5, 6. Side and dorsal views of the holotype cranidium (× 3).
7-10. Similar views of two other cranidia (× 3).
Davis formation; (loc. 11k) Federal Lead Mine No. 4, Flat River, Missouri.

Berkeia missouriensis, new species 94
11, 12. Dorsal and side views of the holotype cranidium (× 3).
13, 14. Two larger cranidia (× 2).
Davis formation; (loc. 11k) Federal Lead Mine No. 4, Flat River, Missouri.

Iddingsia nevadensis, new species 85
15. The associated libragene.
16, 17. Dorsal and side views of the holotype cranidium (× 1.5).
Secret Canyon shale; (loc. 61) south of Hamburg Mine, Eureka District, Nevada.

Iddingsia utahensis, new species 85
18, 19. Side and dorsal views of the holotype cranidium (× 1.5).
20. Incomplete cranidium (× 1.5).
Orr formation; (loc. 32t) Fandango Spring Canyon, Dugway Range, Utah.

Iddingsia missouriensis, new species 86
21, 22. Dorsal and side views of the holotype cranidium (× 2).
23. Cranidium (× 1.5).
24, 25. An exfoliated cranidium (× 1.5).
26. Libragene.
Davis formation; (loc. 11k) Federal Lead Mine No. 4, Flat River, Missouri.

Iddingsia bicincta, new species 87
27-29. Squeeze, side and dorsal views of holotype cranidium (× 1.5).
Honey Creek limestone; (loc. 9q) Blue Creek Canyon, Wichita Mountains, Oklahoma.

Iddingsia crassimarginata, new species 87
30-32. Squeeze, dorsal, and side views of holotype cranidium (× 1.5).
Davis formation; (loc. 11k) Federal Lead Mine No. 4, Flat River Missouri.

Iddingsia alpersensis, new species 88
33, 34. Cranidium (× 1.5).
35, 36. Dorsal and side views of the holotype cranidium (× 1.5).
37, 38. Small cranidium with neck spine (× 3).
Honey Creek limestone; (loc. 12p) 4 miles east of Alpers, Arbuckle Mountains, Oklahoma.

Iddingsia (?) *quinnensis,* new species 88
39. Holotype cranidium (× 1.5).
40, 41. Small cranidium (× 3).
Mendha limestone; (loc. 7j) 1 mile northwest of Italian Ranch foothills, Quinn Canyon Range, Nevada.

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Iddingsia anatina, new species 89
1, 2. Dorsal and side views of the holotype cranidium (× 2).
Honey Creek limestone; (loc. 9q) Blue Creek Canyon, Wichita Mountains, Oklahoma.

Iddingsia simplicitas, new species 89
3, 4. Side and dorsal views of the holotype cranidium.
5-8. Two other cranidia (× 1.5).
9. Libragene (× 1.5).
Honey Creek limestone; (loc. 89y) West Timbered Hills, Arbuckle Mountains, Oklahoma.

Burnetia intermedia, new species 80
10, 11. Dorsal and side views of the holotype cranidium (× 1.5).
Honey Creek limestone; (loc. 12p) 4 miles southeast of Hennepin, Arbuckle Mountains, Oklahoma.

Burnetia alta, new species 80
12, 13. Dorsal and side views of the holotype cranidium.
14. Libragene.
Davis formation; (loc. 11k) Federal Lead Mine No. 4, Flat River, Missouri.

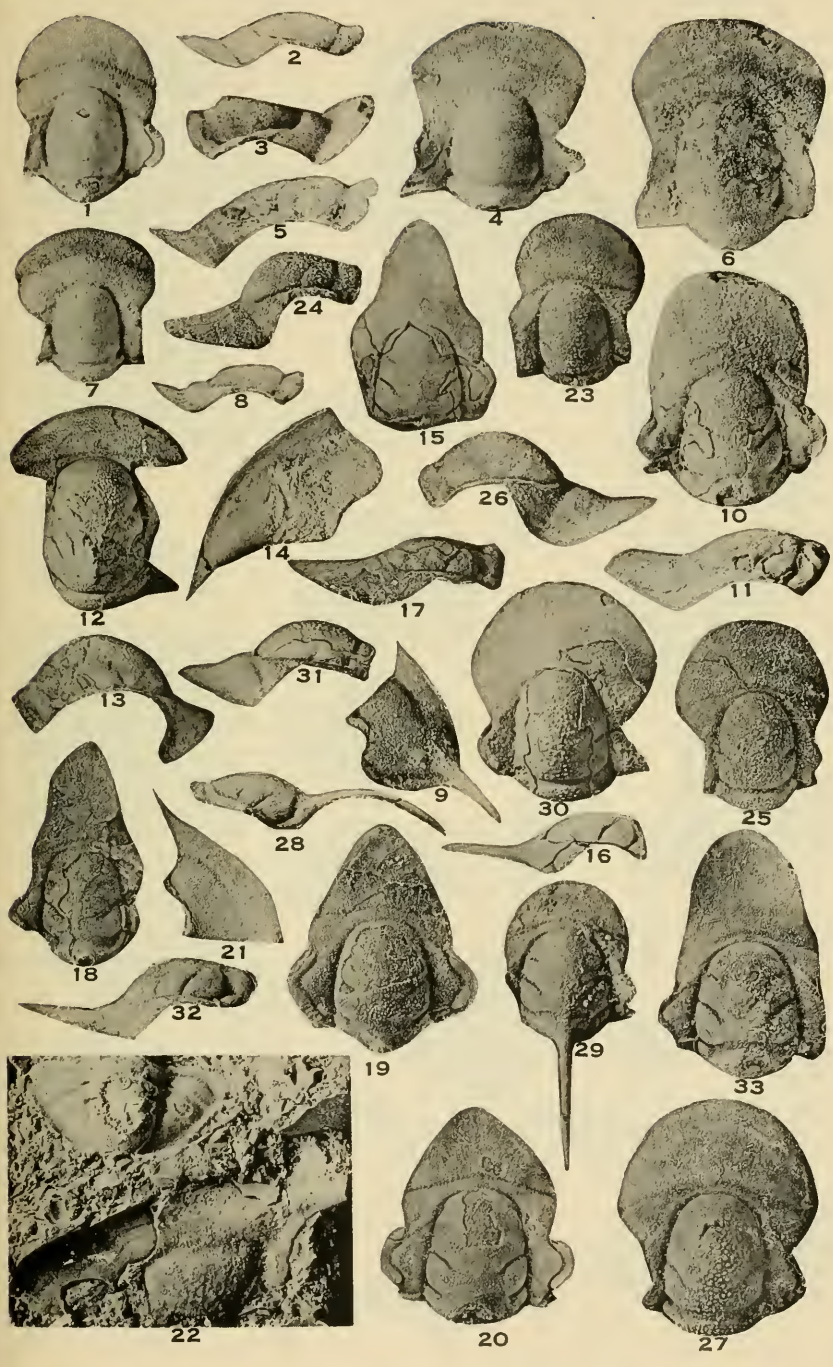
Burnetia extensa, new species 81
15, 16. Partially exfoliated cranidium (× 2).
17, 18. Side and dorsal views of the holotype cranidium (× 1.5).
19. Small cranidium (× 4).
20. Another cranidium (× 3).
21. Libragene (× 2).
22. Libragene and possible pygidium (× 2).
Honey Creek limestone; (loc. 89v) West Timbered Hills, Arbuckle Mountains, Oklahoma.

Burnetia exilis, new species 81
23. Small cranidium (× 1.5).
24, 25. More complete cranidium (× 2).
26, 27. Side and dorsal views of the holotype cranidium (× 1.5).
Honey Creek limestone; (loc. 89v) West Timbered Hills, Arbuckle Mountains, Oklahoma.

Burnetia curta, new species 83
28, 29. Side and dorsal views of the holotype cranidium (× 2).
Honey Creek limestone; (loc. 9q) Blue Creek Canyon, Wichita Mountains, Oklahoma.

Burnetia ectypa, new species 82
30, 31. Dorsal and side views of the holotype cranidium.
Honey Creek limestone; (loc. 89v) West Timbered Hills, Arbuckle Mountains, Oklahoma.

Burnetia lingula, new species 82
32, 33. Side and dorsal views of the holotype cranidium (× 1.5).
Honey Creek limestone; (loc. 89v) West Timbered Hills, Arbuckle Mountains, Oklahoma.



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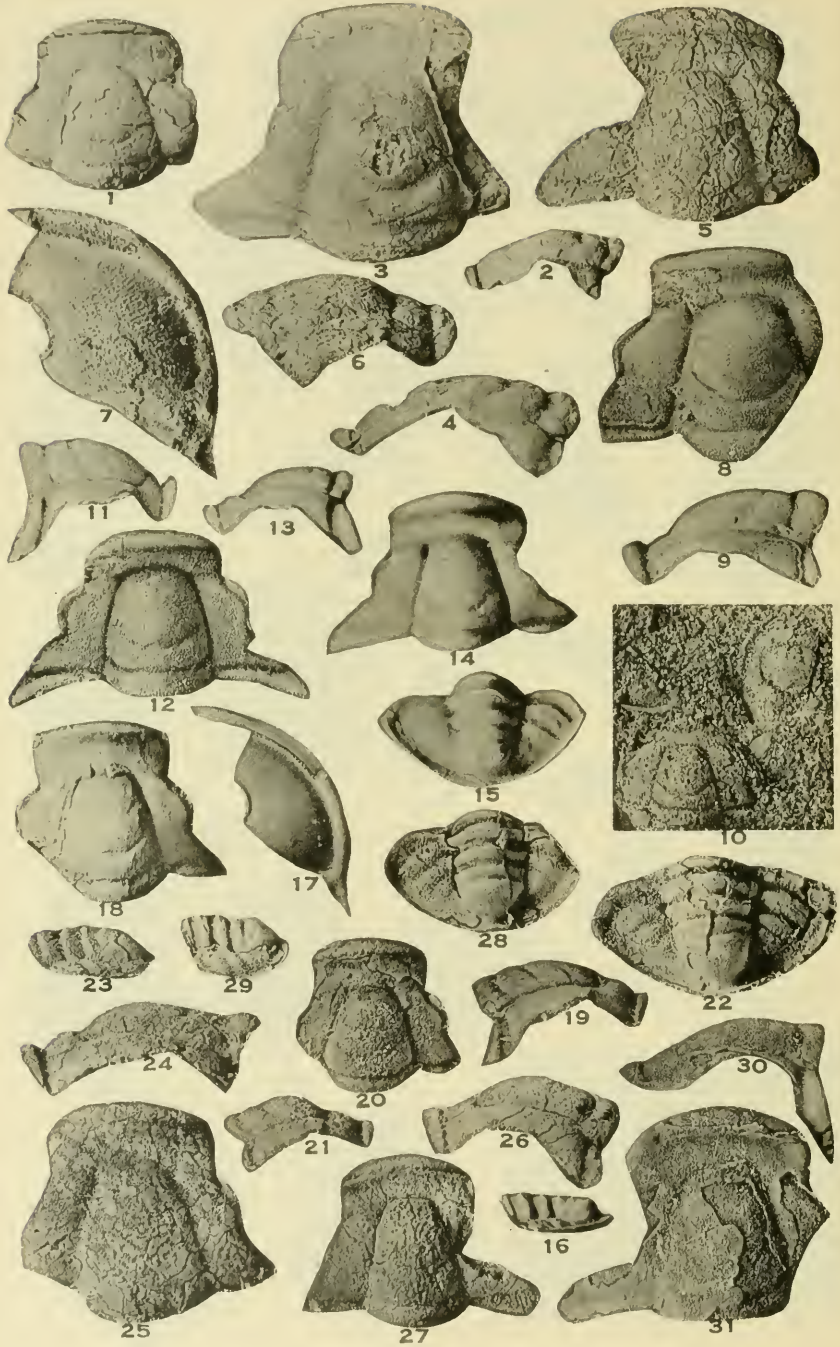

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PLATE 18

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Elvinia montis, new species 94
1, 2. Dorsal and side views of the holotype cranidium (× 1.5).
3, 4. Large exfoliated cranidium.
Snowy Range formation; (loc. 37r) Warm Spring Creek, Wind River Range, Wyoming.

Elvinia utahensis, new species 95
5, 6. Dorsal and side views of the holotype cranidium.
St. Charles limestone; (loc. 54e) Blacksmith Fork, Bear River Range, Utah.

Elvinia ruedemanni, new species 95
7. Libragene (× 1.5).
8, 9. Dorsal and side views of the holotype cranidium (× 1.5).
10. Small cranidium with *Berkeia saratogensis* (× 1.5).
Potsdam sandstone (Theresa member); Greenfield, west of Saratoga Springs, New York.

Elvinia granulata, new species 96
11, 12. Side and dorsal views of the holotype cranidium (× 2.5).
Secret Canyon shale; (loc. 63) northeast of Adams Hill, Eureka District, Nevada.

Elvinia missouriensis Resser 96
13, 14. Nearly complete cranidium.
15, 16. Pygidium.
17. Libragene.
Davis formation; (loc. 11k) Federal Lead Mine No. 4, Flat River, Missouri.

Elvinia gregalis, new species 96
18, 19. Dorsal and side views of the holotype cranidium (× 2).
20, 21. Smaller cranidium (× 1.5).
22, 23. Pygidium (× 1.5).
Honey Creek limestone; (loc. 9q) Blue Creek Canyon, Wichita Mountains, Oklahoma.

Elvinia longa, new species 97
24, 25. Side and dorsal views of the holotype cranidium.
26, 27. Small cranidium.
Honey Creek limestone; (loc. 9p) Blue Creek Canyon, Wichita Mountains, Oklahoma.

Elvinia bridgei Resser 97
28, 29. Squeeze of a pygidium.
30, 31. A large cranidium, with injury at left anterior angle. (See also pl. 19, figs. 1-5.)
Honey Creek limestone; (loc. 12p) 4 miles southeast of Hennepin, Arbuckle Mountains, Oklahoma.

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Elvinia bridgei Resser 97
1, 2. Partially exfoliated cranidium.
3, 4. Well-preserved cranidium.
5. Libragene. (See also pl. 18, figs. 28-31.)
Honey Creek limestone; (loc. 89v) West Timbered Hills, Arbuckle Mountains, Oklahoma. (This is the type locality.)

Elvinia vagans, new species 98
6, 7. Dorsal and side views of the holotype cranidium.
8, 9. Pygidium (× 1.5).
Honey Creek limestone; (loc. 99) 15 miles northwest of Fort Sill, Wichita Mountains, Oklahoma.

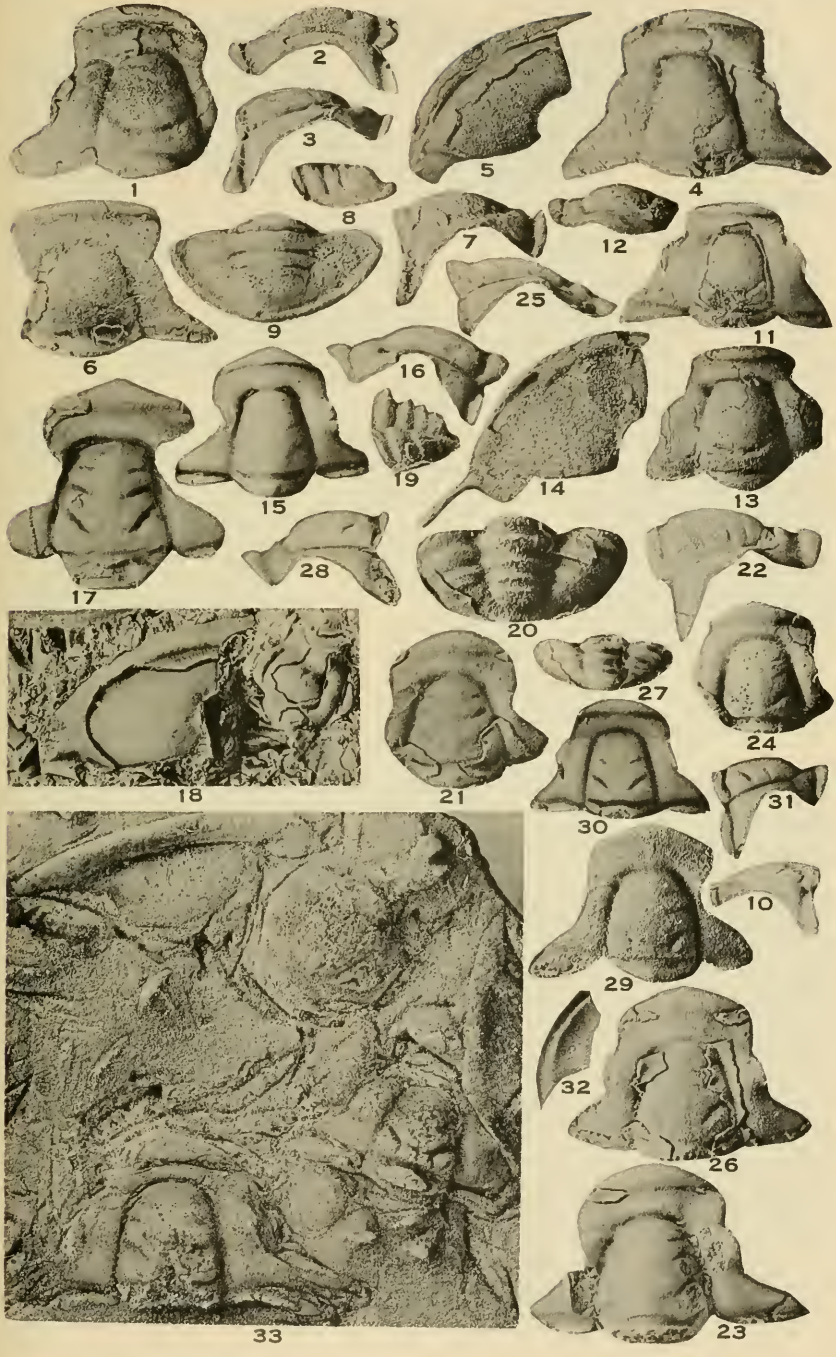
Elvinia brevifrons, new species 98
10, 11. Cranidium (× 1.5).
12, 13. Side and dorsal views of the holotype cranidium.
14. Libragene.
Honey Creek limestone; (loc. 12p) 4 miles east of Alpers, Arbuckle Mountains, Oklahoma.

Taenicephalus pealei, new species 99
15, 16. Small cranidium retaining the test (× 4).
17. Large exfoliated cranidium showing granules under anterior furrow.
18. Partly exfoliated head and libragene (× 3).
19, 20. Pygidium (× 2.5).
21. Exfoliated cranidium showing scattered granules (× 3).
22, 23. The holotype cranidium (× 3).
Dry Creek shale; (loc. 153) Horsehoe Hills, east of Logan, Montana.

Taenicephalus holmesi, new species 100
24. Exfoliated cranidium (× 2).
25, 26. Side and dorsal views of the holotype cranidium (× 3).
27. Pygidium (× 3).
Dry Creek shale; (loc. 66x) Gallatin Valley, northwestern Yellowstone National Park, Wyoming.

Taenicephalus libertyensis, new species 101
28, 29. Holotype cranidium (× 2.5).
30, 31. Small cranidium (× 4).
32. Libragene (× 2).
St. Charles limestone; (loc. 56g) 6 miles west of Liberty, Bear River Range, Idaho.

Taenicephalus cordillerensis Miller 101
33. Surface with cranidia and libragene (× 3).
Snowy Range formation; (loc. 37r) Warm Springs Creek, Wind River Range, Wyoming.



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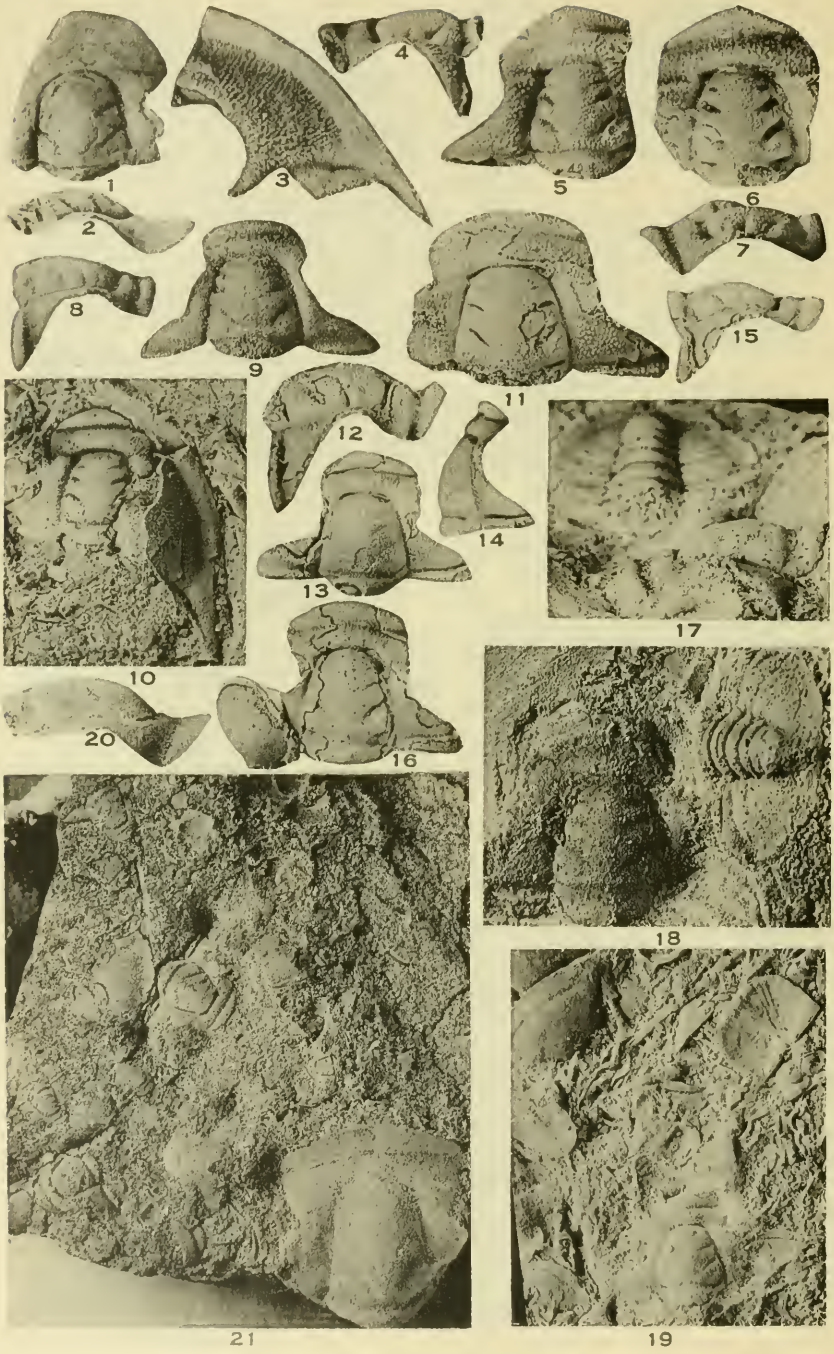

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Burnetia cava, new species 83
1, 2. Dorsal and side views of the holotype cranidium (× 2.5).
3. Libragene (× 3).
Ore Hill formation; (loc. 107v) ½ mile northwest of Drab, Pennsylvania.

Taenicephalus granulosus, new species 101
4, 5. Side and dorsal views of the holotype cranidium (× 2).
6, 7. A less complete cranidium (× 2.5).
St. Charles limestone; (loc. 4y) Two Mile Canyon, Wasatch Mountains, Idaho.

Taenicephalus maladensis, new species 102
8, 9. Side and dorsal views of an exfoliated cranidium (× 3).
10. The holotype cranidium and libragene (× 2.5).
St. Charles limestone; (loc. 54x) Two Mile Canyon, 2 miles south of Malad, Wasatch Mountains, Idaho.

Taenicephalus ornatus, new species 102
11, 12. Dorsal and side views of the holotype cranidium (× 3).
St. Charles limestone; (loc. 54e) Blacksmith Fork, Bear River Range, Utah.

Taenicephalus hyrumensis, new species 104
13, 14. Dorsal and side views of the holotype cranidium retaining most of test (× 2).
15. Exfoliated cranidium and hypostoma (× 2).
16. Side view of the cranidium in fig. 15 (× 2).
17, 18. Two different views of a cranidium and associated pygidium (× 2.5).
St. Charles limestone; (loc. 55h) Blacksmith Fork, Bear River Range, Utah.

Taenicephalus speciosus, new species 100
19. Holotype cranidium and libragene, associated with *Billingsella exasperata* Bell. Portion of another cranidium lies under the libragene. (× 1.5.)
Dry Creek shale; (loc. 62r) Abiathar Mountain, northeastern Yellowstone National Park, Wyoming.

Burnetia edwardsi, new species 84
20, 21. Side and dorsal views of the holotype cranidium and examples of *Taenicephalus shumardi* and *Orygmaspis eryon.*
Franconia sandstone; 2 miles west of Clifton, Monroe County, Wisconsin.

PLATE 21

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Taenichephalus striatifrons, new species 103
1. Holotype cranidium (× 4.5).
2, 3. A larger cranidium (× 2).
St. Charles limestone; (loc. 54e) Blacksmith Fork, Bear River Range, Utah.

Taenicephalus utahensis, new species 103
4, 5. Exfoliated cranidium (× 2.5).
6. Holotype cranidium (× 2.5).
St. Charles limestone; (loc. 54e) Blacksmith Fork, Bear River Range, Utah.

Taenicephalus modestus, new species 104
7. Holotype cranidium (× 3).
St. Charles limestone; (loc. 55h) Blacksmith Fork, Bear River Range, Utah.

Taenicephalus texanus, new species 104
8, 9. Side and dorsal views of the holotype cranidium (× 2.5).
10-12. Three other cranidia in various states of preservation (× 2.5).
Wilberns formation; (loc. 68) Packsaddle Mountain, 11 miles southeast of Llano, Texas.

Taenicephalus wichitaensis, new species 105
13. Exfoliated cranidium (× 2).
14, 15. Dorsal and side views of the holotype cranidium (× 3).
16, 17. Two other cranidia (× 2.5).
Honey Creek limestone; (loc. 9q) Blue Creek Canyon, 15 miles northwest of Fort Sill, Wichita Mountains, Oklahoma.

Taenicephalus quinnensis, new species 105
18, 19. Incomplete cranidium (× 1.5).
20, 21. A pygidium (× 2).
22. Holotype cranidium (× 2.5).
23. Libragene (× 2).
Mendha limestone; (loc. 7j) 1 mile north of Italian Ranch foothills, Quinn Canyon Range, Nevada.

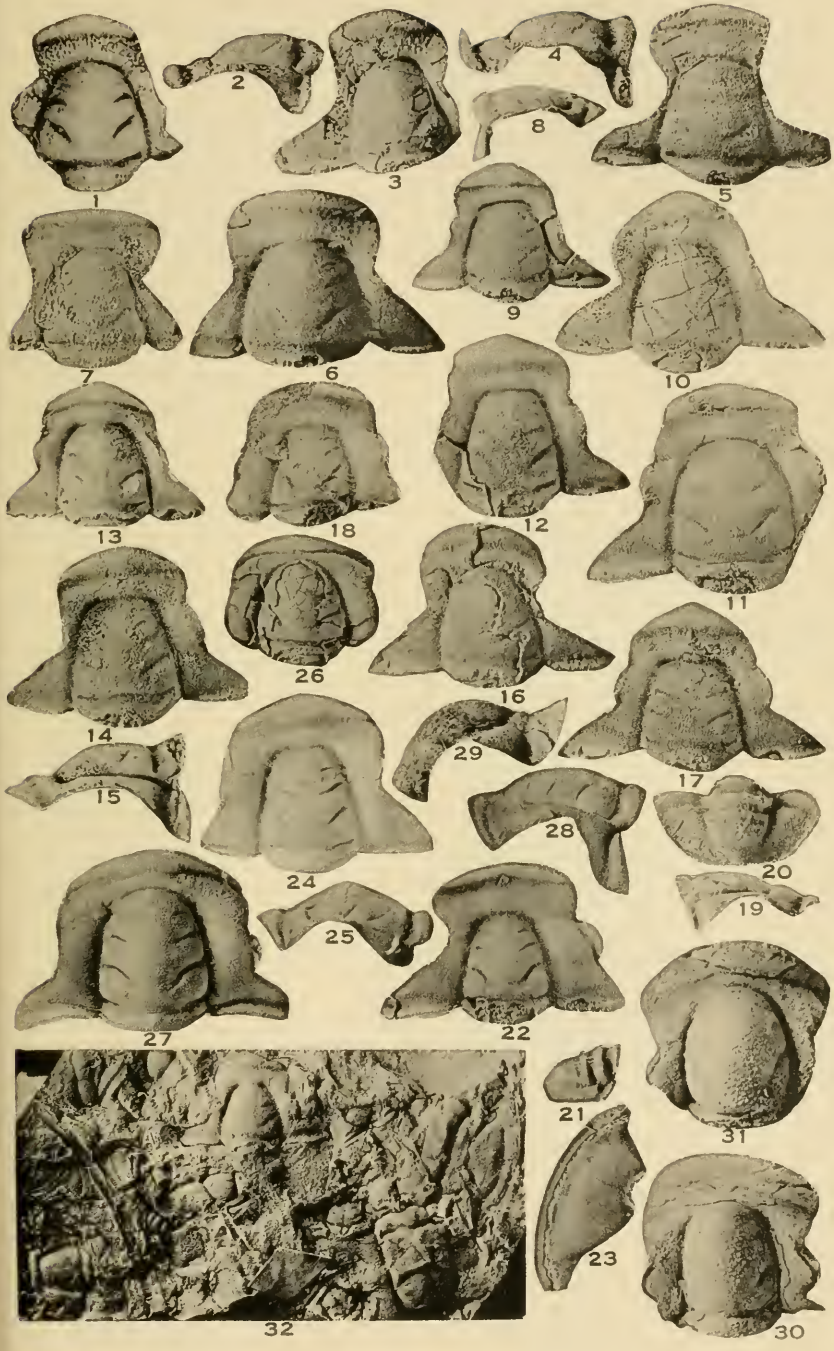
Taenicephalus castlensis, new species 106
24, 25. Dorsal and side views of the holotype cranidium (× 2).
Dry Creek formation; (loc. 62s) Castle Peak, north of Squaw Creek, Gallatin Range, Montana.

Talbotina ulrichi, new species 107
26. Holotype cranidium (× 2).
Wilberns formation; (loc. 14b) Cold Creek, opposite north end of Sponge Mountain, Texas.

Talbotina candida, new species 107
27, 28. Dorsal and side views of the holotype cranidium (× 2).
Wilberns formation; (loc. 14b) Cold Creek, opposite north end of Sponge Mountain, Texas.

Burnetia pennsylvanica, new species 84
29, 30. Side and dorsal views of the holotype cranidium.
31. Smaller cranidium (× 2).
Ore Hill formation; (loc. 107e) 1 mile south of Ore Hill, Pennsylvania.

Taenicephalus wyomingensis, new species 106
32. Holotype and other cranidia, and libragene (× 1.5).
Snowy Range formation; head of Buffalo Fork, west side of Big Horn Mountains, Wyoming.



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