

BRIGHAM

YOUNG

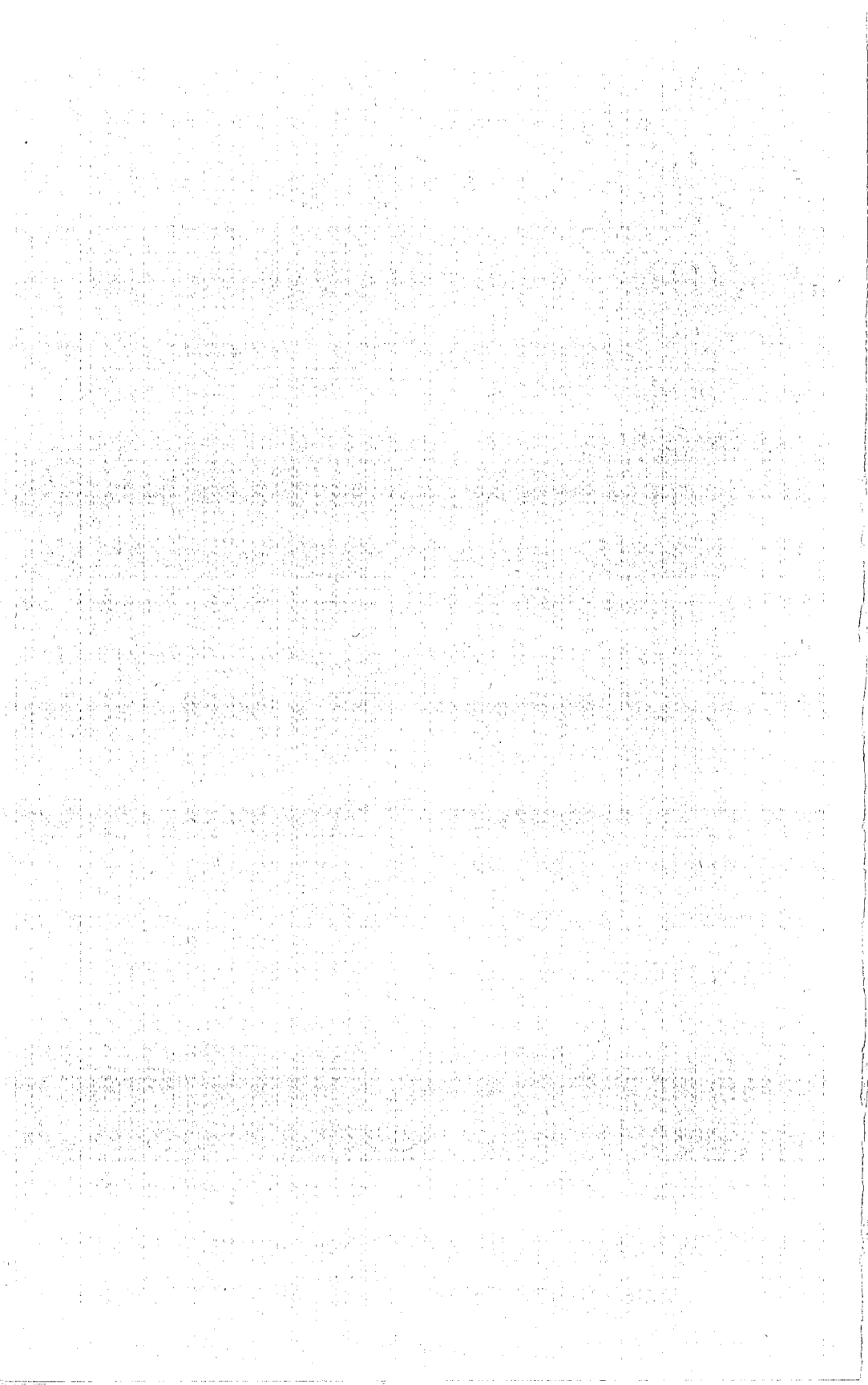
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CONTENTS

Lower and Middle Ordovician Stratigraphic Sections in the Ibex Area, Millard County, Utah	Lehi F. Hintze	3
Lower Ordovician Pliomerid Trilobites from Western Utah	Eugene J. Demeter	37
Silicified Trilobite Zonation in the Lower Fillmore Formation in Western Utah	Forrest M. Terrell	67
An Ordovician (Arenigian) Trilobite Faunule of Great Diversity from the Ibex Area, Western Utah	George E. Young	91
The Mechanical Significance of Deformation within Overthrust Plates	Gary W. Crosby	117
Skeleton of a Hypsilophodontid Dinosaur (<i>Nanosaurus</i> [?] <i>rex</i>) from the Upper Jurassic of Utah	Peter M. Galton and James A. Jensen	137
Pre-Needles Range Silicic Volcanism, Tunnel Spring Tuff (Oligocene) West-Central Utah	Arthur V. Bushman	159
Mica Pyroxenite Inclusions in Limburgite, Hopi Buttes Volcanic Field, Arizona	Paul H. Lewis	191
Publications and maps of the Geology Department		227



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An Ordovician (Arenigian) Trilobite Faunule of Great Diversity from the Ibex Area, Western Utah

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ABSTRACT.—A lower Ordovician (Arenigian) faunal horizon, five inches thick, from Zone H of the Fillmore Limestone in western Utah has yielded a greater variety of Lower Ordovician trilobites than any other bed of similar thickness in the western United States. The trilobite faunule consists of 21 species and 18 genera. Nine new species and one new subspecies are named. Seven of the new species may represent new genera but have been questionably assigned to established genera. The most abundant species are *Shumardia exophthalmus* Ross, *Ischyrotoma ovata* (Hintze), *I. blanda* (Hintze), *Pseudocybele lemurei* Hintze and *Trigonocera typica* Ross. One nearly complete *Shumardia exophthalmus* Ross, with four thoracic segments, was found. *Protopliomerops* (?) *quattuor* Hintze is divided into subspecies. Ranges are increased for *S. exophthalmus* Ross and *Trinodus* sp. Eleven pygidia remain unassigned.

Thirty species of conodonts are recognized from this horizon. The most abundant are *Gothodus communis* Ethington & Clark, *Oepikodus quadratus* (Graves & Ellison), *Oistodus linguatus* Lindstrom, *Scandodus furnishi* Lindstrom and *Scolopodus* (?) *rex* Lindstrom.

CONTENTS

Text	page	1952	page
Introduction	92	<i>Remopleuridiella angularis</i> n. sp. ..	112
Acknowledgments	92	<i>Shumardia exophthalmus</i> Ross,	
Location	92	1967	114
Stratigraphy	93	<i>Trigonocera typica</i> Ross, 1951	114
Paleontological results	93	<i>Trinodus</i> sp.	114
Systematic paleontology	96	References cited	114
<i>Amblycranium</i> (?) <i>linearis</i> n.			
sp.	96	Text-figures	page
<i>Amblycranium</i> (?) sp. 2	97	1. Index map	92
<i>Bathyrurellus</i> (?) <i>teretus</i> n. sp.	97	2. Stratigraphic section	94
<i>Benthamaopsis distinctus</i> n. sp.	98	3. Complete <i>Shumardia exophthalmus</i>	95
<i>Carolinites killaryensis utahensis</i>			
Hintze, 1952	98	Plates	page
<i>Diacanthaspis</i> (?) <i>trispineus</i> n.		1. <i>Carolinites</i> , <i>Benthamaopsis</i> ,	
sp.	98	<i>Remopleuridiella</i> , and <i>Shumardia</i>	101
<i>Goniotelina</i> (?) <i>plicolabeonius</i>		2. Genus <i>Bathyrurellus</i> , <i>Ischyrotoma</i> , <i>Presbynileus</i> , <i>Ptyocephalus</i> and <i>Trigonocera</i>	103
n. sp.	99	3. Genus <i>Kanoshia</i> <i>Protopliomerops</i> , <i>Pseudocybele</i> and <i>Trinodus</i>	105
<i>Goniotelus</i> (?) <i>unicornis</i> n. sp. ..	100	4. Genus <i>Goniotelus</i> , <i>Amblycranium</i> and <i>Psalikilopsis</i>	107
<i>Ischyrotoma blanda</i> (Hintze),		5. <i>Diacanthaspis</i> and <i>Goniotelina</i>	109
1952	102	6. Unassigned pygidia	111
<i>Ischyrotoma ovata</i> (Hintze),		7. Unassigned librigenae and unassigned hypostomata	113
1952	102		
<i>Kanoshia</i> (?) <i>depressus</i> n. sp.	102	Tables	page
<i>Presbynileus elongatus</i> (Hintze),		1. H-20 trilobite fauna	95
1952	104	2. H-20 conodont fauna	96
<i>Protopliomerops quattuor brevis</i>			
n. subsp.	106		
<i>Psalikilopsis</i> (?) <i>alticapitis</i> n.			
sp.	106		
<i>Pseudocybele altinasuta</i> Hintze,			
1952	108		
<i>Pseudocybele lemurei</i> Hintze,			
1952	110		
<i>Ptyocephalus accliva</i> (Hintze),			

INTRODUCTION

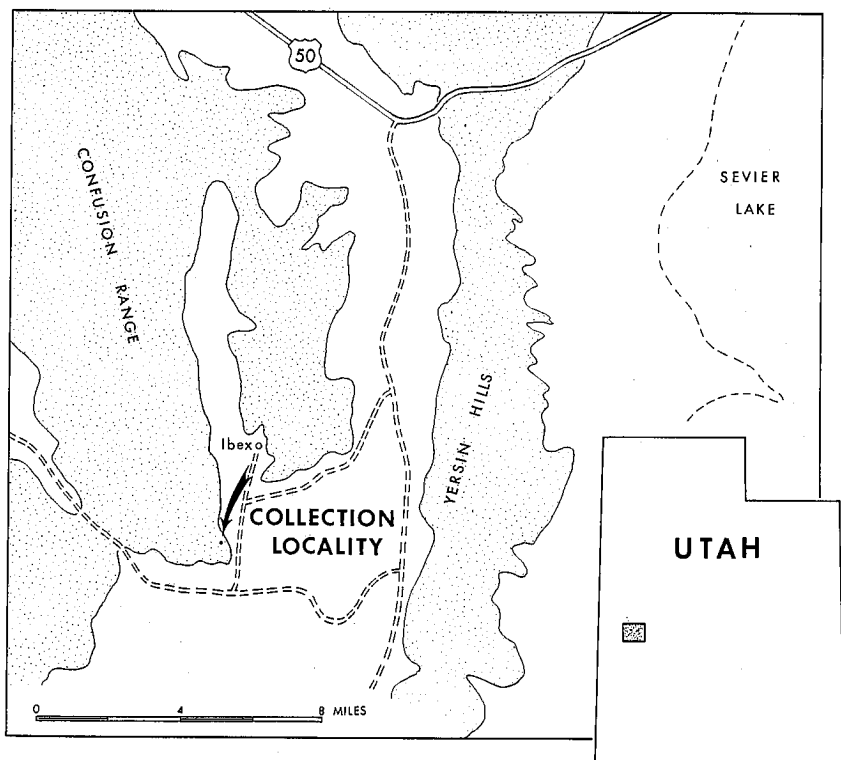
Study of Ordovician sections in 1951 revealed one horizon in the "H section" (Hintze, 1951, p. 50) which contained several well-preserved species of trilobites. Blocks from this horizon were collected for the present study and were dissolved with HCL. Silicified trilobites were sorted from the residue. Representatives of each species were photographed. Trilobite plates and descriptions comprise the bulk of this paper.

Acknowledgments

Valuable assistance from several faculty members has been greatly appreciated. Particular thanks is given to Dr. L. F. Hintze for his suggestions, comments, and encouragement and to Dr. J. K. Rigby for his guidance in preparation of the plates and illustrations. Dr. R. L. Ethington is thanked for his identification of the conodont fauna. Field collecting was done under National Science Foundation Grant GB-3154 to L. F. Hintze.

Location

The collection locality is in the southeast end of the Confusion Range, about 80 miles from Delta, Utah (Text-fig. 1). The base of this section, re-



TEXT-FIGURE 1.—Index map showing the locality for the H-20 fauna which was collected at the southeastern end of the Confusion Range, approximately 90 miles southwest of Delta, Utah.

ferred to as "Section H," is located in the SE $\frac{1}{4}$, SE $\frac{1}{4}$, NE $\frac{1}{4}$, Sec. 6 T. 23 S. R. 14 E. This section was first measured by Hintze in 1951, at which time the fossil horizon of present concern was recorded as locality H-20. The H-20 horizon is 434 feet above the base of the section (Hintze, 1951, p. 52). Remeasurement in 1965 showed the section to be thicker than originally had been recorded. Based on yellow-painted 1965 numbers the H-20 horizon is located 588 feet above the base of Hintze's measured section "H".

STRATIGRAPHY

Section "H" starts with the base of member three (Hintze, 1973b) of the Fillmore Limestone and extends through member six (Text-fig. 2). The Fillmore Limestone, along with the House Limestone below and several formations above, comprises the Pogonip Group. Age of the Fillmore Limestone is Early Ordovician, Tremadocian-Arenigian (Hintze, 1973a, p. 51). At section H, the Fillmore Limestone is mostly calcisiltite, calcarenite, and calcilutite with abundant intraformational conglomerate throughout. The particular bed of H-20, however, is a bioclastic, sparitic limestone about five inches thick, with a one-inch band of silty calcilutite near the top of the bed. The sparitic limestone is free from silt and clay, containing only unabraded, and mostly silicified, bioclastic material. The H-20 bed is in the calcarenite member (member 5) of the Fillmore Limestone and is part of the "*Trigonocera typica* Zone" or "Zone H" (Hintze, 1951, 1952).

PALEONTOLOGICAL RESULTS

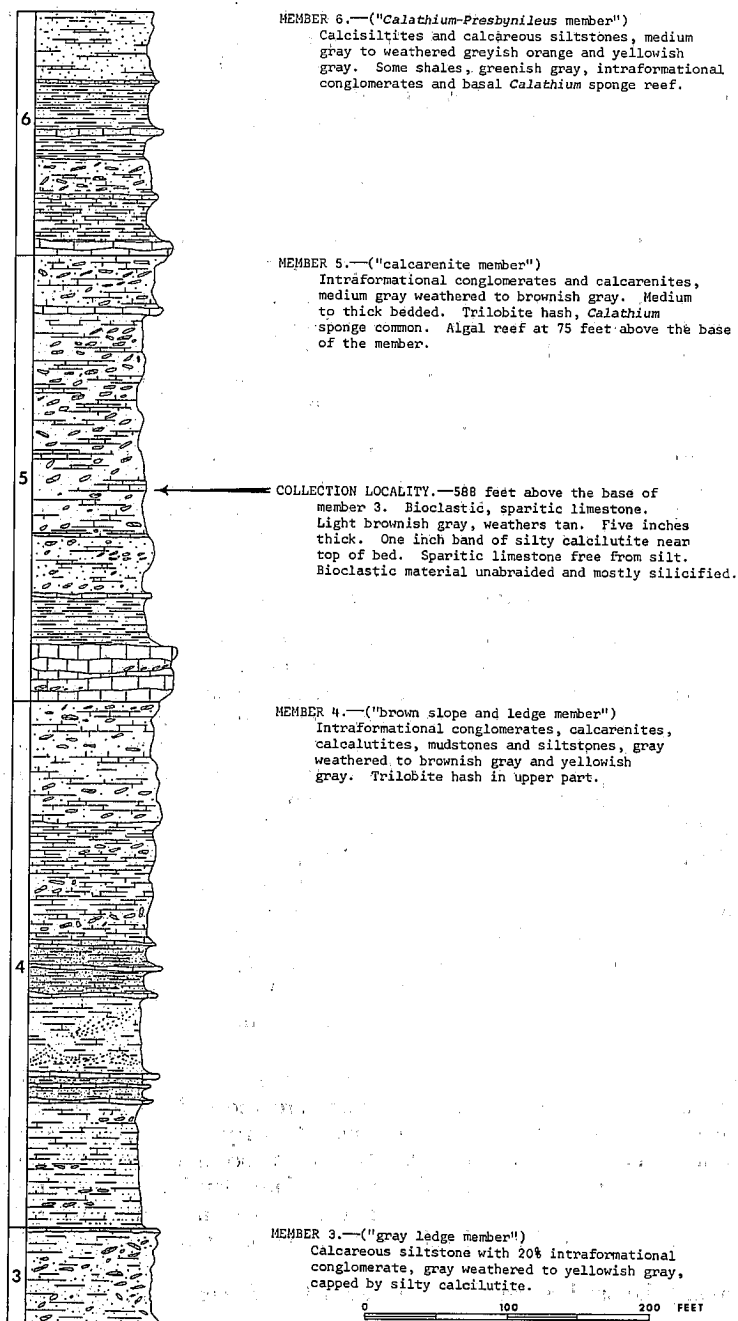
Residues from the dissolved blocks of the H-20 bed have yielded an abundance and variety of trilobites. The fauna contains at least 21 species and 18 genera of trilobites and includes an additional 11 unassigned pygidia, 11 unassigned librigena, and 6 unassigned hypostoma. Among the 21 species of identified trilobites, 8 species are believed to represent new genera, although they have been questionably assigned to already established genera. Seven of these, along with two other species of more certain generic affinity, are named. One subspecies is named.

Relative abundance of species was determined by counting cephalons of each form present, with the exception of *Presbrynileus elongatus*, which was determined by a hypostome count. It was found that *Ischyrotoma ovata* (Hintze), *I. blanda* (Hintze), *Shumardia exophthalmus* Ross, are the most abundant, with *Pseudocybele lemurei* Hintze and *Trigonocera typica* Ross being quite common. The other forms are rare (Table 1). *Trigonocera typica* Ross is quite large and distinct and can be seen in hand sample, making it a good choice for the name of the zone.

One *Shumardia* specimen was found that is nearly complete. The librigena and the anterior portion of the cranidium are the only parts missing. This specimen has only four thoracic segments (Text-fig. 3), in contrast with the commonly reported six-segment forms. It is possible, however, that this specimen represents the meraspid stage in late development (Whittington, 1957, p. 443). *S. exophthalmus* Ross is extended from Zone J down to Zone H. *Trinodus* sp. also has a local range extension from Zone G₂ (?) up to Zone H.

Among the smallest trilobite fragments found were 41 protaspids. Several

G. E. YOUNG
SECTION H, FILLMORE LIMESTONE
LOWER ORDOVICIAN



TEXT-FIGURE 2.—Stratigraphic column showing the stratigraphic position of the collection in the Fillmore Limestone, Pogonip Group. The collection came from 588 feet above the base of member three, based on the 1965 measured section. This same horizon is listed as 434 feet above the base in Utah Geol. Survey Bull. 39.

TABLE 1

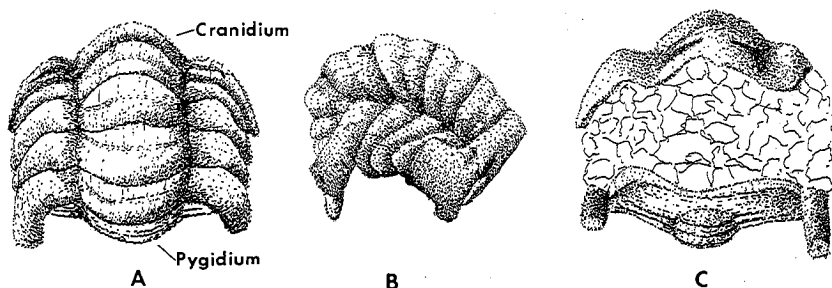
H-20 TRILOBITE SPECIES AND THE QUANTITY OF EACH COLLECTED

Species	Plate No.	Abundance
<i>Amblycranium</i> (?) <i>linearis</i> n. sp.	4	11
<i>Amblycranium</i> (?) sp. 2	4	3
<i>Bathyporellus</i> (?) <i>teretus</i> n. sp.	2	7
<i>Benthamaspis distinctus</i> n. sp.	1	23
<i>Carolinites killaryensis utahensis</i> Hintze, 1952	1	6
<i>Diacanthaspis</i> (?) <i>trispineus</i> n. sp.	5	14
<i>Goniotelina</i> (?) <i>plicolabeonus</i> n. sp.	5	60
<i>Goniotelus</i> (?) <i>unicornis</i> n. sp.	4	2
<i>Ischyrotoma blanda</i> (Hintze), 1952	2	214
<i>Ischyrotoma ovata</i> (Hintze), 1952	2	367
<i>Kanoshia</i> (?) <i>depressus</i> n. sp.	3	35
<i>Presbynilaeus elongatus</i> (Hintze), 1952	2	62
<i>Protoplimerops quattuor brevis</i> n. subsp.	3	43
<i>Psalikilopsis</i> (?) <i>alticapitis</i> n. sp.	4	77
<i>Pseudocybele altinasuta</i> Hintze, 1952	3	23
<i>Pseudocybele lemurei</i> Hintze, 1952	3	136
<i>Ptycephalus accliva</i> (Hintze), 1952	2	43
<i>Remopleuridiella angularis</i> n. sp.	1	2
<i>Shumardia exophthalmus</i> Ross, 1967	1	395
<i>Trigonocera typica</i> Ross, 1951	2	108
<i>Trinodus</i> sp.	3	1

immature hypostomes similar to those mentioned by Whittington (1957, p. 440) were found.

Associated with the trilobites are brachiopods, gastropods, ostracods, graptolites (in silty calcilitite layer), sponges, conodonts, and possible bivalve forms as evidenced by double-convex steinkerns.

The conodont fauna is useful in establishing correlation and in comparing trilobite zones with conodont zones. Heavy residue sent to R. L. Ethington resulted in identification of nearly 30 species of conodonts belonging to at least 9 different genera. The most abundant species are *Gothodus communis* Ethington & Clark, *Oepikodus quadratus* (Graves & Ellison), *Oistodus Linguatus* Lindstrom, *Scandodus furnishi* Lindstrom, and *Scolopodus* (?) *rex* Lindstrom. His complete results are given in Table 2.



TEXT-FIGURE 3.—Complete specimen of *Shumardia exophthalmus* Ross, x30. A, dorsal view; B, lateral view; C, ventral view. BYU 2171.

TABLE 2

H-20 CONODONT SPECIES AND QUANTITY OF EACH SPECIES AS IDENTIFIED BY
R. L. ETHINGTON

Species	Abundance
<i>Acontiodus coniformis</i> Fahroeus	8
<i>Acontiodus coniformis</i> n. subsp.	1
<i>Acontiodus</i> n. sp.	4
aff. <i>Distacodus stola</i> Lindstrom	1
<i>Drepanodus arcuatus</i> Pander	6
<i>Drepanodus homocurvatus</i> Lindstrom	6
<i>Drepanodus</i> sp.	3
(?) <i>Drepanodus</i> sp.	3
<i>Gothodus communis</i> Ethington & Clark	15
<i>Oepikodus quadratus</i> (Graves & Ellison)	19
<i>Oistodus lanceolatus</i> Pander	1
<i>Oistodus linguatus</i> Lindstrom	15
<i>Oistodus longiramis</i> Lindstrom	1
<i>Oistodus parallelus</i> Pander	1
<i>Oistodus</i> n. sp.	12
<i>Oistodus</i> aff. <i>O. multicorrugatus</i> Harris	4
<i>Paltodus jeffersonensis</i> Branson & Mehl	1
<i>Paltodus</i> n. sp.	3
<i>Scandodus furnishi</i> Lindstrom	21
<i>Scandodus</i> n. sp.	24
<i>Scolopodus gracilis</i> Ethington & Clark	7
<i>Scolopodus pseudoquadratus</i> Branson & Mehl	2
<i>Scolopodus quadraplicatus</i> Branson & Mehl	7
(?) <i>Scolopodus rex</i> Lindstrom	167
(?) <i>Scolopodus rex paltodiformis</i> Lindstrom	-
(?) <i>Ulrichodina</i> spp.	2
New genus A (blade)	3
New genus B (bar), sp. A	18
New genus B (bar), sp. B	11
New genus B (bar), sp. C	21

SYSTEMATIC PALEONTOLOGY

For convenience of reference, trilobite genera and species are listed alphabetically.

AMBLYCRANIUM (?) LINEARUS n. sp.

Plate 4, figs. 9-15

Description and discussion.—Cephalon is semicircular in outline with diverging genal spines carried on the librigena. The surface is coarsely pustulate with four pairs of spines forming two rows along the glabellar axis. A fifth pair of large spines is on the occipital ring. The spines on the glabella increase in size posteriorly. The two large spines in the occipital ring of the mature form (Pl. 4, figs. 14-15) are about the length of the glabella and project posterodistally. Although figure 9 (Pl. 4) is a small specimen, its ornamentation is similar to that on the larger specimen (Pl. 4, figs. 14-15). The glabella forms a high dome when viewed both anteriorly and laterally. In lateral view, however, the anterior portion of the glabella becomes vertical.

The glabella is widest across the midline, with the anterior portion rounded and the posterior portion contracting slightly, forming a pear shape. The lateral axial furrow and occipital furrow are well defined. The occipital ring is small. Palpebral lobes are about one-third the length of the glabella and are centered on the midline. The posterolateral limbs extend well beyond the palpebral lobes when viewed anteriorly. The preglabellar field is small, and the anterior border forms a convex triangular tongue-like projection.

Thorax and pygidium unknown.

This species differs from *A. (?) populus* Ross (1951, p. 67-68; Pl. 13, figs. 19-22) in the pear-shaped glabella; shorter preglabellar field, triangular anterior border and higher glabella. *Gontiotelina hesperia* Ross, 1967 (p. 19; Pl. 6, figs. 10-15) has a similar triangular anterior border. However, *A. (?) linearus* differs in that its glabella is more oval (with the widest point being at the midline), its palpebral lobes are smaller, and its posterolateral limbs are larger. *A. (?) linearus* has some similarities to *Ischyrotoma*. Both have an anterior border projection and a high-domed glabella. *A. (?) linearus* differs from *Ischyrotoma* in that the glabella of *A. (?) linearus* is pear shaped instead of elliptical, the anterior projection is more angular, and the palpebral lobes and posterolateral limbs are larger. *A. (?) linearus* differs from specimens of *A. (?)* sp. no. 2 in the presence of spines on the glabella and occipital ring. The similarity of these two species, however, may imply that they are only opposite gender forms.

Repository.—Holotype, BYU 2105, cranium; Paratypes, BYU 2106, cranium BYU 2108; librigena; additional specimen is BYU 2107.

AMBLYCRANIUM (?) sp. 2

Plate 4, figs. 16-20

Description and discussion.—This specimen is very similar to *A. (?) linearus*, except that the spines are replaced by four pairs of short knobs on the glabella. The glabella is markedly pear shaped. Ornamentation is absent on the occipital ring. The librigena differs from that of *A. (?) linearus* in lacking the spinous texture. The similarity of these two species may imply that they are opposite gender forms or that they are in slightly different stages of development.

Thorax and pygidium unknown.

Repository.—Figured specimens are BYU 2109, 2110.

BATHYURELLUS (?) TERETUS n. sp.

Plate 2, figs. 5, 8-10, 13-14

Description and discussion.—Cranidium is characterized by a smooth, dome-shaped surface. The glabella is more long than wide and is outlined by parallel axial furrows, an occipital furrow, and a subtriangular-shaped preglabellar furrow. Immature specimens have a more rounded glabella. Viewed anteriorly, the glabella is dome shaped. The occipital ring is large, wider than the glabella. Posterolateral limbs are narrow and extend slightly beyond the palpebral lobes. Palpebral lobes form horizontal platforms that exceed semicircles in outline. Palpebral lobes extend from the occipital furrow to slightly beyond the glabellar midline. The anterior area of the fixigena forms a convex sloping surface which, in dorsal view, expands anteriorly to equal the width of the

cranium across the palpebral lobes. The anterior area is widest at the anterior border and narrowest just anterior of the palpebral lobes. The mature specimen is lacking the complete anterior border, making positive identification as to the genus *Bathyuirellus* difficult. The immature specimen has a narrow anterior border that may or may not be characteristic of the mature form. This specimen is similar to the specimen *Bathyuirellus* (?) sp. described by Hintze (1952, p. 140; Pl. 10, fig. 6). The only obvious difference is the rounded characteristic of the facial suture anterior of the palpebral lobe on *B. (?) teretus*.

Librigena, thorax, and pygidium not known.

Repository.—Holotype, BYU 2071, cranium; additional specimens are BYU 2072.

BENTHAMASPIS DISTINCTUS n. sp.

Plate 1, figs. 9-17

Description and discussion.—Cranidium dominated by a wide glabella which exceeds half the width of the cranium. Sides of glabella are parallel, anterior portion rounded and vertical. Occipital furrow is distinct. Posterolateral limbs are short and narrow. Palpebral lobes are slightly less than one-third the glabellar width in mature specimen. Immature specimen has larger ratio of palpebral width to glabellar width. Palpebral lobes slope from the axial furrow down to the eyes when viewed anteriorly. Eyes are more than half glabellar length. Librigena has no border furrow. Anterior border is nearly vertical on the mature specimen, forming a rimlike structure. This rim structure is absent on immature specimens because the anterior border is flattened out to the horizontal. The three specimens, figures 14, 15, 16 (Pl. 1), show the transition of the anterior border from the horizontal in immature forms to vertical in adult stage. *B. distinctus* differs from *B. diminutive* Hintze, 1952 (p. 142-3; Pl. 13, figs. 9-12) in that all furrows are more distinct, the glabella is parallel sided instead of divergent, and the palpebral lobes are narrower. This species also differs from *B. problematic* Peulsen (Moore, 1959, p. 0-295) in that the occipital furrow is distinct and the cranium is more dome shaped.

Thorax and pygidium not known.

Repository.—Holotype, BYU 2178, cranium; Paratype 2181; additional figured specimens are BYU 2179, 2180, 2182.

CAROLINITES KILLARYENSIS UTAHENSIS Hintze, 1952

Plate 1, figs. 18-20, 23-24, 28-31

Carolinites killaryensis utahensis Hintze, 1952, p. 145; Pl. 20, figs. 10-13.

Discussion.—The figured specimen differs only slightly from those described by Hintze (1952). The fixigena is slightly wider, the glabella slightly lower, and the telson shorter. Also figured is an immature specimen.

Repository.—Figured specimens are BYU 2060, 2061, 2062, 2063.

DIACANTHASPIS (?) TRISPINEUS n. sp.

Plate 5, figs. 1-14

Description and discussion.—Cephalon is semi-elliptical with long genal spines. Short spines cover the cephalon everywhere except on the anterior border and

posterior margin. Cranidium is trapezoidal. Glabella has parallel to subparallel sides. Lobes are indistinct; however, in ventral view two short nodes may reflect possible lateral glabellar furrows. The anterior portion of the glabella, in lateral view, becomes nearly vertical at the anterior border furrow. No preglabellar field is present. Occipital furrow is broad and distinct. Occipital ring, lacking the numerous short spines, carries three large spines that project vertically, then become horizontal as they curve posteriorly. Median spine is shortest. Adjacent spines project posterodistally. Fixigena is broad and is concave upward to the elevated palpebral lobe. Anterior border is straight, narrow, curled, and wider than the glabella.

Librigena has long genal spine covered with smaller spines. Border has short horizontal spines. Small spherical eye is elevated.

Pygidium is semi-elliptical, more granular than spiny in appearance. There are four axial segments and the terminal piece. Each axial segment carries two short spines on the crest, which decreases in size posteriorly. Axial, pleural, and intrapleural furrows are well defined. Each pleura has a terminal spine equal in length to the pleura. Two short spines are on the border and are posterior to the terminal piece.

Thorax (not illustrated) has two spines projecting at about 60 degrees from the axis and one spine projecting distally from the point of flexure of the pleura. The pleura beyond the point of flexure is spinelike. Each spine has smaller spines on it as does the genal spine.

This specimen is similar to *D. ulrichi* Whittington, 1956 (p. 225-28; Pl. 8) in carapace texture, parallel-sided glabella, and straight anterior border. It differs from *D. ulrichi*, however, in lacking spines on the anterior border and posterior margin, and in lacking distinct glabellar lobes. Postero-lateral limbs of *D. (?) trispineus* are narrower and shorter than those of *D. ulrichi*. Occipital ring has median spine instead of the node found on *D. ulrichi*. The pygidium of *D. (?) trispineus* has more axial segments. *D. (?) trispineus* resembles *D. cooperi* Whittington (1941, p. 502-9, Pl. 74, figs. 1-30) in the semielliptical outline of the cephalon, subparallel glabella, spiny carapace, and similar librigena and pygidium. It differs in several important areas. The prominent glabellar lobes of *D. cooperi* are absent on *D. (?) trispineus*, the only indication of lobes being the small nodes seen in ventral view. The occipital ring has three spines, and the palpebral lobes are more anterior on *D. (?) trispineus*. See Hintze, 1952, Pl. 19, fig. 16 for additional figure of *D. (?) trispineus*.

Repository.—Holotype, BYU 2114, cranidium; Paratypes, BYU 2113, cranidium, BYU 2117, pygidium, BYU 2119, librigena; additional specimens are BYU 2115, 2116, 2118, 2120.

GONIOTELINA (?) PLICOLABEONUS n. sp.

Plate 5, figs. 15-22

Description and discussion.—Cephalon is semicircular in dorsal view. In lateral view with palpebral lobe horizontal, the cephalon is almost dome shaped. The glabella is slightly more long than wide, and is dome shaped when viewed from anterior. Glabella is widest at midpoint, and axial furrows are subelliptical in immature forms to subparallel with rounded anterior in mature forms. The occipital ring is one-fourth the length of the glabella, and the

occipital furrow is deep. Palpebral lobes are large and semicircular. Eye is very distinct. Border furrow is deep, except at genal angle, where it is indistinct. Border area forms a tight double recurved tubular tongue along the anterior border. Rounded genal angle. Opisthoparian suture.

The assigned pygidium is subtriangular with a thick terminal spine three times the length of the major portion of the pygidium. The axial portion is distinct, containing two axial rings and the terminal axial piece.

G. (?) plicolabeonius differs from previously described *Bathyporellus (?) teretus* in several aspects. The glabellar outline is oval, not straight sided with subangular anterior portion as with *B. (?) teretus*. *G. (?) plicolabeonius* has palpebral lobes that are proportionately smaller and has a well-defined rim and the anterior border is folded.

Repository.—Holotype, BYU 2121, cranidium; Paratypes, BYU 2124, pygidium, BYU 2123, pygidium, BYU 2125; librigena; additional specimens are BYU 2122, 2126.

GONIOTELUS (?) UNICORNIS n. sp.

Plate 4, figs. 21-24

Description and discussion.—Cranidium is dominated by a large glabella with subparallel axial furrows which expand slightly anteriorly. The glabella terminates in a large hornlike project which extends beyond the anterior margin of the cranidium for about half the length of the glabella. The occipital ring is well defined but narrow. The palpebral lobes begin anterior of the midline, project posterodistally for about one-third of the glabellar length, then curve inward forming a teardrop-shaped palpebral lobe. The entire cranidium has a granular appearance.

Librigena, thorax, and pygidium not known.

Repository.—Holotype, BYU 2111, cranidium; Paratype, BYU 2112.

EXPLANATION OF PLATE 1

CAROLINITES, BENTHAMASPIS, REMOPLEURIDIELLA, AND SHUMARDIA

FIGS. 1-8.—*Shumardia exoptthalmus* Ross, 1967.

1. Librigena: dorsal view, x11, BYU 2176.

2-4. Cranidium: lateral, anterior, and dorsal views, x10, BYU 2174.

5, 6. Librigena: ventral and lateral views, x11, BYU 2177.

7, 8. Pygidium: posterior and dorsal views, x11, BYU 2175.

FIGS. 9-17.—*Benthamaspis distinctus*, n. sp.

9, 10, 14. Cranidium: lateral, anterior, and dorsal views, x5, BYU 2178, Holotype.

11, 12, 16. Cranidium: lateral, anterior, and dorsal views, x11, BYU 2180.

13. Librigena: dorsal view, x4, BYU 2181, Paratype.

15. Cranidium: dorsal view, x7, BYU 2179.

17. Librigena: ventral view, x5, BYU 2182.

FIGS. 18-20, 23, 24, 28-31.—*Carolinites killaryensis utabensis* Hintze, 1952.

18. Cranidium, immature: dorsal view, x11, BYU 2063.

19, 20, 24. Cranidium: lateral, anterior, and dorsal views, x6, BYU 2060.

23, 28. Librigena: dorsal and ventral views, x4, BYU 2062.

29-31. Pygidium: dorsal, posterior, and lateral views, x4, BYU 2061.

FIGS. 21-22, 25-27.—*Remopleuridiella angularis*, n. sp.

21, 22, 26. Cranidium: anterior, lateral, and dorsal views, x11, BYU 2064, Holotype.

25, 27. Librigena: ventral and dorsal view, x7, BYU 2065, Paratype.

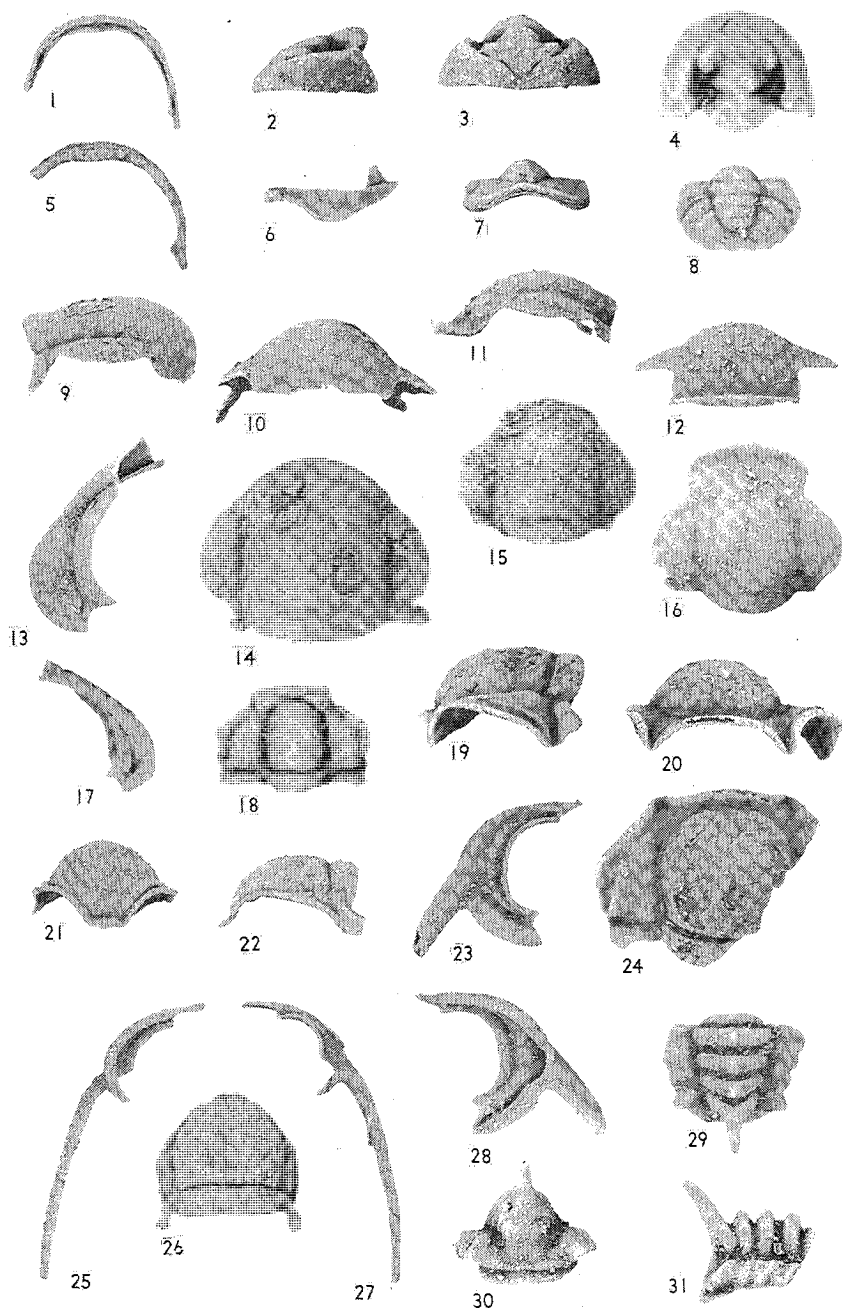


PLATE 1

ISCHYROTOMA BLANDA (Hintze), 1952

Plate 2, figs. 1-2

Dimeropygiella blanda Hintze, 1952, p. 155-6; Pl. 19, figs. 6-8.

Discussion.—This specimen is figured only for comparison. It does not differ from that originally described by Hintze, 1952. Juvenile forms of *Ischyrotoma* are common. Their cranidia are narrower and more triangular than the adult forms.

Repository.—Figured specimens are BYU 2066, 2067.

ISCHYROTOMA OVATA (Hintze), 1952

Plate 2, figs. 3-4, 6-7

Dimeropygiella ovata Hintze, 1952, p. 155; Pl. 19, figs. 1-4.

Discussion.—Specimens figured only for comparison. Pygidium figured could be either *I. ovata* or *I. blanda*.

Repository.—Figured specimens are BYU 2068, 2069, 2070.

KANOSHIA (?) DEPRESSUS n. sp.

Plate 3, figs. 21-27

Description and discussion.—*K. (?) depressus* is similar to *K. insolita* (Poulsen) (*Pliomera insolita* n. sp. Poulsen, 1927, p. 307-8; Pl. 20, fig. 32 and

EXPLANATION OF PLATE 2

BATHYURELLUS, ISCHYROTOMA, PRESBYNILEUS, PTYOCEPHALUS,
AND TRIGONOCERA

- FIGS. 1, 2.—*Ischyrotoma blanda* (Hintze), 1952.
 1. Librigena: dorsal view, x4, BYU 2067.
 2. Cranidium: dorsal view, x4, BYU 2066.
 FIGS. 3, 4, 6, 7.—*Ischyrotoma ovata* (Hintze), 1952.
 3. Librigena: dorsal view, x5, BYU 2069.
 4. Cranidium: dorsal view, x6, BYU 2068.
 6, 7. Pygidium: posterior and dorsal views, x7, BYU 2070.
 FIGS. 5, 8-10, 13, 14.—*Bathyurellus (?) teretus*, n. sp.
 5, 8, 13. Cranidium: anterior, dorsal, and lateral views, x4, BYU 2071, Holotype.
 9, 10, 14. Cranidium, immature: anterior, dorsal, and lateral views, x11, BYU 2072.
 FIGS. 11, 12, 15, 16.—*Trigonocera typica* Ross, 1951.
 11. Librigena: dorsal view, x2, BYU 2075.
 12. Cranidium: dorsal view, x3, BYU 2073.
 15. Hypostome: ventral view, x4, BYU 2076.
 16. Pygidium: dorsal view, x2, BYU 2074.
 FIGS. 17, 18, 22.—*Presbynileus elongatus* (Hintze), 1952.
 17. Hypostome: ventral view, x3, BYU 2078.
 18, 22. Pygidium: posterior and dorsal views, x3, BYU 2077.
 FIGS. 19-21, 23, 24.—*Ptyocephalus accliva* (Hintze), 1952.
 19. Cranidium: dorsal view, x3, BYU 2079.
 20. Librigena: dorsal view, x3, BYU 2082.
 21. Hypostome: ventral view, x6, BYU 2083.
 23. Pygidium: dorsal view, x4, BYU 2080.
 24. Pygidium: ventral view, BYU 2081.

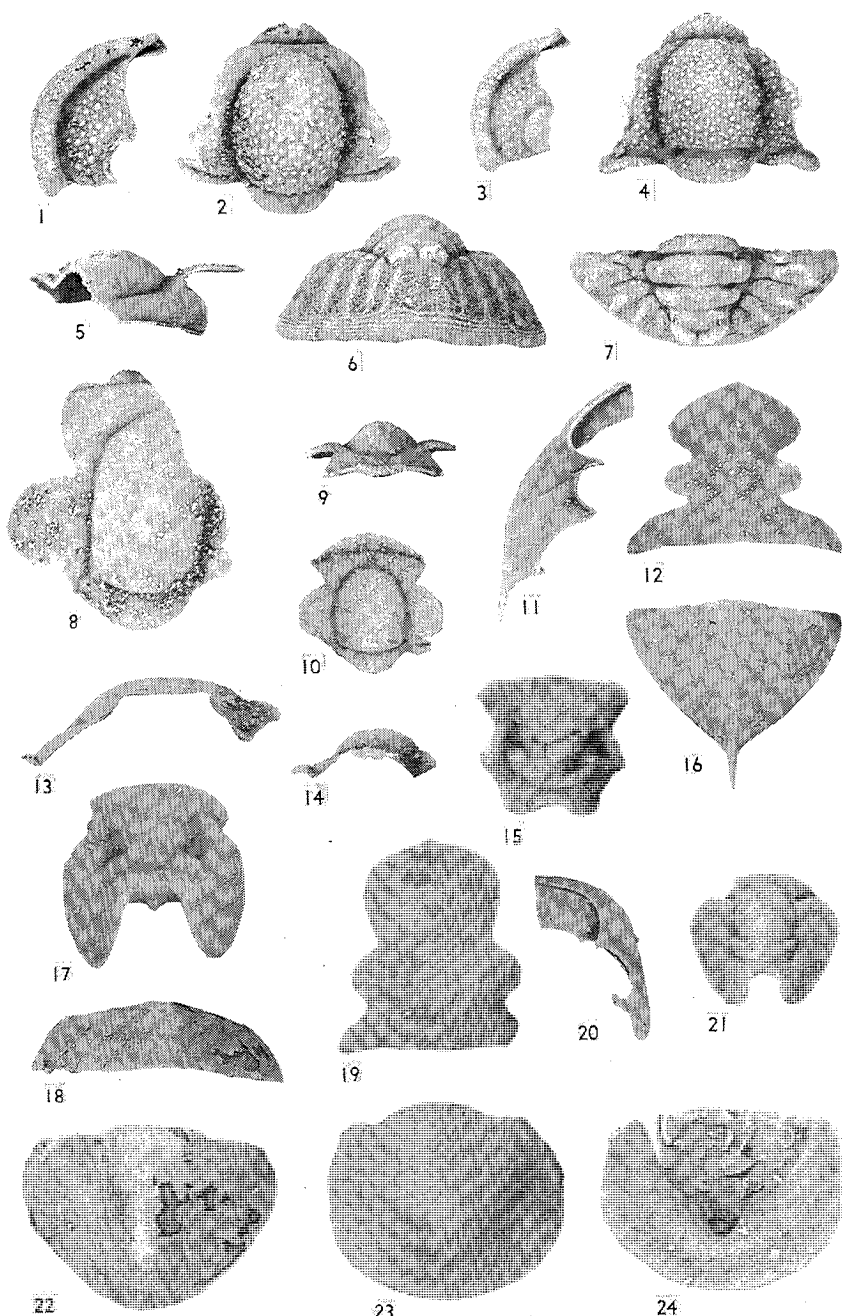


PLATE 2

Pseudomera cf. *P. insolita* (Poulsen), Hintze, 1952, p. 222-3; Pl. 23, figs. 5-13). Both have a low, flat glabella, a rounded anterior border, and a relatively straight occipital furrow. It differs from *K. insolita* in having a genal spine on the immature specimen which may or may not be present on the adult form. The third lateral glabellar furrow is much less distinct, and the occipital ring is wider, on *K. (?) depressus*. This specimen also differs from *Ectenonotus whittingtoni* Ross (1967, p. 24; Pl. 7, figs. 33-34, Pl. 8, figs. 1-22). That the glabella of *K. (?) depressus* in lateral view is low and flat with the palpebral lobe no higher than the glabella is not true for *E. whittingtoni*. *E. whittingtoni* also lacks the rounded anterior border and straight occipital furrow of *K. (?) depressus*.

The hypostome assigned to *K. (?) depressus* is more rectangular than that of *E. whittingtoni* but lacks the bifurcation and wide posterior border of *Kanoshia* as figured in the treatise (Moore, 1959, p. o-444).

The pygidium of *K. (?) depressus* is similar to that of *E. whittingtoni*.

Repository.—Holotype, BYU 2098, cranidium; Paratypes, BYU 2099, cranidium, BYU 2100, pygidium, BYU 2173, pygidium (not figured); additional specimen is BYU 2101.

PRESBYNILEUS ELONGATUS (Hintze), 1952

Plate 2, figs. 17-18, 22

Paranileus elongatus Hintze, 1952, p. 199; Pl. 12, figs. 2-5.

Discussion.—Species figured only for comparative purposes.

Repository.—Figured specimens are BYU 2077, 2078.

EXPLANATION OF PLATE 3

KANOSHIA, PROTOPLIOMEROPS, PSEUDOCYBELE, AND TRINODUS

FIGS. 1, 5-7, 9, 10.—*Protopliomerops quattuor brevis*, n. subsp.

1, 5, 6. Cranidium: anterior, dorsal, and lateral views, x5, BYU 2085, Holotype.

7. Hypostome: ventral view, x10, BYU 2087, Paratype.

9-10. Pygidium: dorsal and lateral views, x7, BYU 2086, Paratype.

FIGS. 2-4.—*Trinodus* sp.

2-4. Pygidium: dorsal, posterior, and lateral views, x10, BYU 2084.

FIGS. 8, 11, 12.—*Pseudocybele lemurei* Hintze, 1952.

8. Cranidium: dorsal view, x3, BYU 2088.

11. Hypostome: ventral view, x7, BYU 2090.

12. Pygidium: dorsal view, x7, BYU 2089.

FIGS. 13-20.—*Pseudocybele altinasuta* Hintze, 1952.

13. Cranidium, immature: dorsal view, x11, BYU 2097.

14. Cranidium: dorsal view, x2, BYU 2092.

15, 18. Cranidium: dorsal and lateral views, x4, BYU 2091.

16. Librigena: dorsal view, x3, BYU 2094.

17. Hypostome: ventral view, x7, BYU 2096.

19. Pygidium: dorsal view, x4, BYU 2093.

20. Librigena: ventral view, x5, BYU 2095.

FIGS. 21-27.—*Kanoshia (?) depressus*, n. sp.

21, 22. Cranidium: dorsal and anterior views, x4, BYU 2098, Holotype.

23. Hypostome: ventral view, x8, BYU 2101.

24. Pygidium: dorsal view, x2, BYU 2100, Paratype.

25-27. Cranidium: dorsal, lateral, and anterior views, x11, BYU 2099, Paratype.

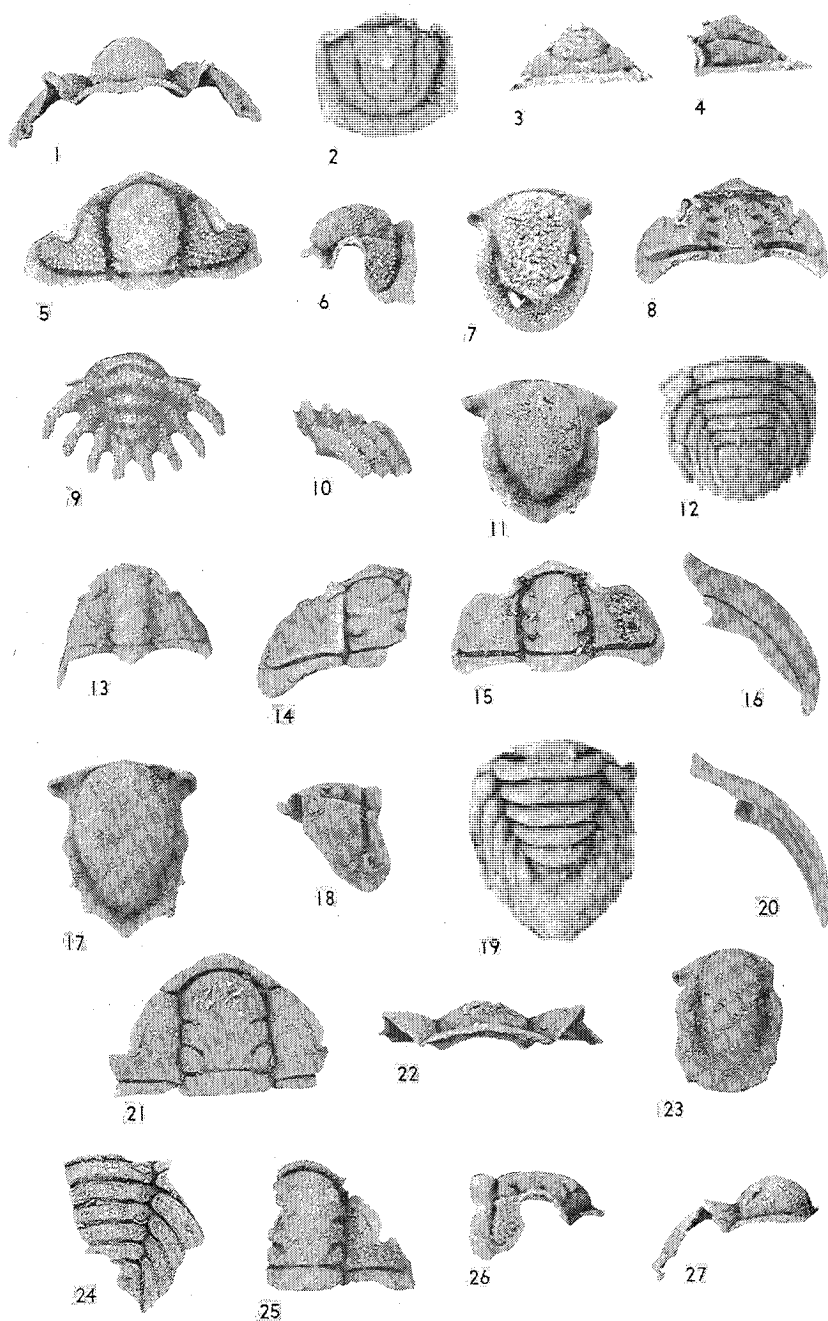


PLATE 3

PROTOPLIOMEROPS QUATTUOR BREVIS n. subsp.

Plate 3, figs. 1, 5-7, 9-10

Protopliomerops (?) *quattuor* Hintze, 1952, p. 209; Pl. 21, figs. 9-14.*Protopliomerops* sp. 4, Hintze, 1952, p. 210; Pl. 21, figs. 4, 8.

Description and discussion.—*P. quattuor*, as figured by Hintze (1952), can be divided into two subspecies. His specimen figure 11 and *P. quattuor brevis* are the same. These specimens, however, have almost indistinct lateral glabellar furrows. Figure 9 (Hintze, Pl. 21) has very distinct glabellar furrows. Further evidence is the pygidium assigned by Hintze. Pygidium figure 14 (Hintze, Pl. 21), found at H-23 is very similar to, if not the same as, the pygidium assigned to *P. quattuor brevis*. Assignment to *P. quattuor brevis* was made because of similar abundance and similar surface ornamentation.

The conclusion is that *P. quattuor*, figure 11 (Hintze, Pl. 21) and *P. sp. 4* (Hintze, Pl. 21), all from Zone H, are the same species and are distinct from the other specimens figured under *P. quattuor* Hintze, 1952. The *Protopliomerops* specimens of Zone H should be grouped as the subspecies *P. quattuor brevis*.

Repository.—Holotype, BYU 2085, cranidium; Paratypes, BYU 2086, pygidium, BYU 2087, hypostome.

PSALIKILOPSIS (?) ALTICAPITIS n. sp.

Plate 4, figs. 1-8

Description and discussion.—In dorsal view the cranidium is trapezoidal in outline, formed by the straight, subtubular anterior border, posterodistal slanting opisthoparian sutures, and straight posterior border. The glabella is subelliptical in dorsal view, with the axial length longer than the width. Viewed anteriorly, the glabella is a high bulbous structure exceeding a hemisphere. In lateral view the preglabellar furrow is indistinct, causing the glabella and frontal area to be continuous and form a high arched dome from the anterior furrow to the occipital ring. There are no lateral glabellar furrows present. The occi-

EXPLANATION OF PLATE 4
GONIOTELUS, AMBLYCRANIUM, AND PSALIKILOPSIS

FIGS. 1-8—*Psalikilopsis* (?) *alticapitis*, n. sp.

1-3. Cranidium: anterior, dorsal, and lateral views, x8, BYU 2102, Holotype.

4, 5, 8. Cranidium: lateral, dorsal, and anterior views, x7, BYU 2103.

6, 7. Cranidium: lateral and dorsal views, x10, BYU 2104.

FIGS. 9-15—*Amblycranium* (?) *lineatus*, n. sp.

9, 13. Cranidium: dorsal and anterior views, x10, BYU 2105, Holotype.

10. Librigena: dorsal view, x10, BYU 2108, Paratype.

11, 12. Cranidium: dorsal and lateral views, x10, BYU 2107.

14, 15. Cranidium: dorsal and lateral views, x3, BYU 2106, Paratype.

FIGS. 16-20—*Amblycranium* (?) sp. 2.

16, 18, 20. Cranidium: anterior and dorsal views, x3, BYU 2109.

17, 19. Librigena: ventral and dorsal views, x8, BYU 2110.

FIGS. 21-24—*Goniotelus* (?) *unicornis*, n. sp.

21, 22. Cranidium: lateral and anterior views, x8, BYU 2111, Holotype.

23, 24. Cranidium: lateral and dorsal views, x11, BYU 2112, Paratype.

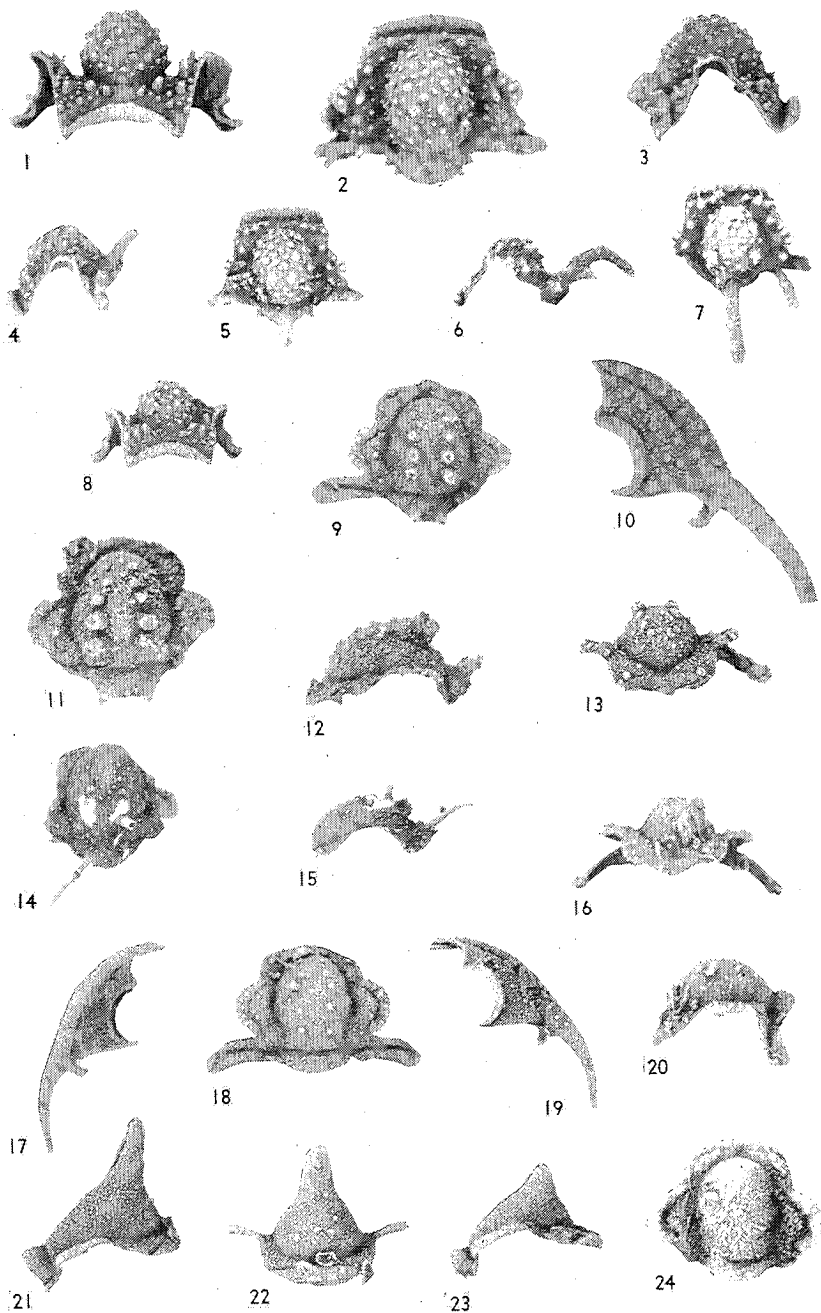


PLATE 4

tal ring is distinct, and the mesial tubercle forms a large hooked spine of about the same length as the cranidium. Midway out on each side of the posterior border is a spine that is slightly smaller than the mesial spine. These posterior border spines curve upward and project posteriorly. The lateral areas of the fixigena are flexed upward in a resupinate curve which elevates the palpebral lobes to one-third the height of the glabella. The palpebral lobes are short and narrow, and they lie on the midline of the glabella. The entire cranidium is coarsely tuberculated.

Librigena, thorax, and pygidium not known.

This specimen was placed in *Psalikilopsis* because of the similarity of the high oblate glabella, absence of lateral furrows, thin palpebral lobes and tubular anterior border. This specimen differs from *Psalikilops* (Moore, 1959, p. 278) in the presence of the medial and lateral spines and in the elevated palpebral lobes. Although spiny forms are common among the Odontopleuridae, I did not place this specimen there because the ovate glabella, the absence of lateral lobes, and the single spine on the occipital ring do not resemble features on other genera assigned to Odontopleuridae.

For additional figures of *P* (?) *alticapitis* see Hintze, 1952, Pl. 19, figs. 12-13.

Repository.—Holotype, BYU 2102; cranidium, Paratype, BYU 2174, cranidium (not figured); additional specimens are BYU 2103, 2104.

PSEUDOCYBELE ALTINASUTA Hintze, 1952

Plate 3, figs. 13-20

Pseudocybele altinasuta Hintze, 1952, p. 216; Pl. 24, figs. 1-2.

Discussion.—Mature cranidium specimens of *P. altinasuta*, as figured on Plate 3, are identical to those figured by Hintze in 1952. Figure 13 (Young; Pl. 3) is believed to be a juvenile form of *P. altinasuta*. The librigena is figured with *P. altinasuta* because the deep border furrow found on the posterior border

EXPLANATION OF PLATE 5 DIACANTHASPIS AND GONIOTELINA

Figs. 1-14.—*Diacanthaspis* (?) *trispineus*, n. sp.

1, 2, 4. Cranidium: anterior, lateral, and dorsal views, x10, BYU 2113, Paratype.

3, 6. Cranidium: anterior and dorsal views, x10, BYU 2114, Holotype.

5. Librigena: ventral view, x10, BYU 2120.

7. Librigena: dorsal view, x10, BYU 2119, Paratype.

8, 10, 11. Pygidium: dorsal, posterior, and lateral views, x5, BYU 2117, Paratype.

9, 12. Pygidium: dorsal and posterior views, x4, BYU 2116.

13. Pygidium: ventral view, x6, BYU 2118.

14. Cranidium: ventral view, x8, BYU 2115.

Figs. 15-22.—*Goniotelina* (?) *plicolabeonus*, n. sp.

15. Cranidium: dorsal view, x10, BYU 2122.

16. Librigena: dorsal view, x3, BYU 2125, Paratype.

17-19. Cranidium: dorsal, lateral, and anterior views, x3, BYU 2121, Holotype.

20. Librigena: ventral view, x3, BYU 2126.

21. Pygidium: dorsal view, x8, BYU 2123, Paratype.

22. Pygidium: lateral view, x10, BYU 2124, Paratype.

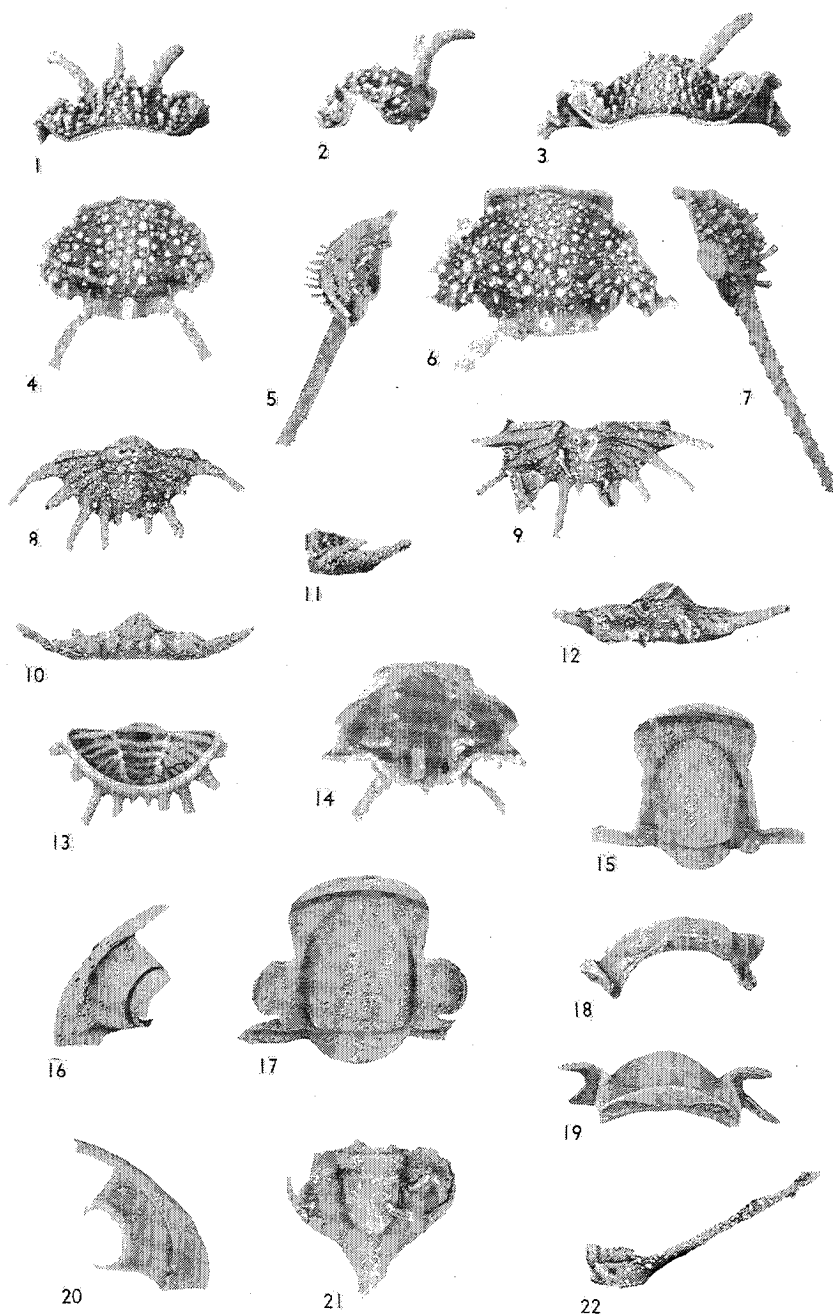


PLATE 5

and anterior border of the cranium is also present on the librigena. The pygidium figured with *P. altinasuta* is similar to the pygidium assigned to *P. nasuta* (Ross, 1951, p. 138-40). A possible slight difference is in the pronounced concave upper portion of the triangular axial segment which terminates the axial lobe of the pygidium. This further reveals the close ancestral relationship of *P. altinasuta* and *P. nasuta*.

Repository.—Figured specimens are BYU 2091, 2092, 2093, 2094, 2095, 2096, 2097.

PSEUDOCYBELE LEMUREI Hintze, 1952

Plate 3, figs. 8, 11-12

Pseudocybele lemurei Hintze, 1952, p. 217; Pl. 24, figs. 3-7.

Discussion.—This specimen is the same as that described by Hintze, 1952, and is added for comparison. The hypostome of *P. lemurei* is similar to *P. altinasuta* except that it is shorter than a hypostome of *P. altinasuta* of the same width. The pygidium differs from *P. altinasuta*, not only in the ways described by Hintze (1952, p. 217), but also in the absence of the concave upper portion of the triangular-shaped terminal axial piece.

Repository.—Figured specimens are BYU 2088, 2089, 2090.

PTYOCEPHALUS ACCLIVA (Hintze), 1952

Plate 2, figs. 19-21, 23-24, Plate 6, fig. 2

Kirkella accliva Hintze, 1952, p. 185-6; Pl. 14, figs. 6, 16-17.

Discussion.—The cranium of *P. accliva* is similar to that of *P. yersini* Hintze (1952, p. 184). The major difference is that the palpebral lobe is larger on *P. accliva* and slopes downward slightly instead of being horizontal. Glabella of *P. accliva*, as of *P. yersini*, is low and indistinct.

EXPLANATION OF PLATE 6
UNASSIGNED PYGIDIA

Figures on this plate are not described.

- 1.—*Ischyrotoma* (?) pygidium, immature: dorsal view, x11, BYU 2127.
- 2.—*Ptyocephalus accliva* (Hintze), pygidium, immature: dorsal view, x8, BYU 2128.
- 3.—Unassigned pygidium 1, immature: dorsal view, x8, BYU 2129.
- 4.—Unassigned pygidium 2, immature: dorsal view, x11, BYU 2130.
- 5, 9, 12.—Unassigned pygidium 3: posterior, dorsal, and ventral views, x3, BYU 2131.
- 6.—Unassigned pygidium 4, immature: dorsal view, x11, BYU 2132.
- 7.—*Ischyrotoma* (?) pygidium, immature: dorsal view, x11, BYU 2133.
- 8.—Unassigned pygidium 5, immature: dorsal view, x11, BYU 2134.
- 10, 11, 13.—Unassigned pygidium 6, two specimens, figs. 10, 13: dorsal and lateral views, x4, BYU 2135; fig. 11: dorsal view, x4, BYU 2136.
- 14, 15.—Unassigned pygidium 7, two specimens, fig. 14, immature: dorsal view, x10, BYU 2137; fig. 15: dorsal view, x7, BYU 2138.
- 16.—Unassigned pygidium 8: dorsal view, x9, BYU 2139.
- 17, 20.—Unassigned pygidium 9: dorsal and ventral views, x4, BYU 2140.
- 18, 21.—Unassigned pygidium 10: dorsal and ventral views, x2, BYU 2141.
- 19, 22.—Unassigned pygidium 11, two specimens: dorsal and ventral views, both x3, BYU 2142, 2143.

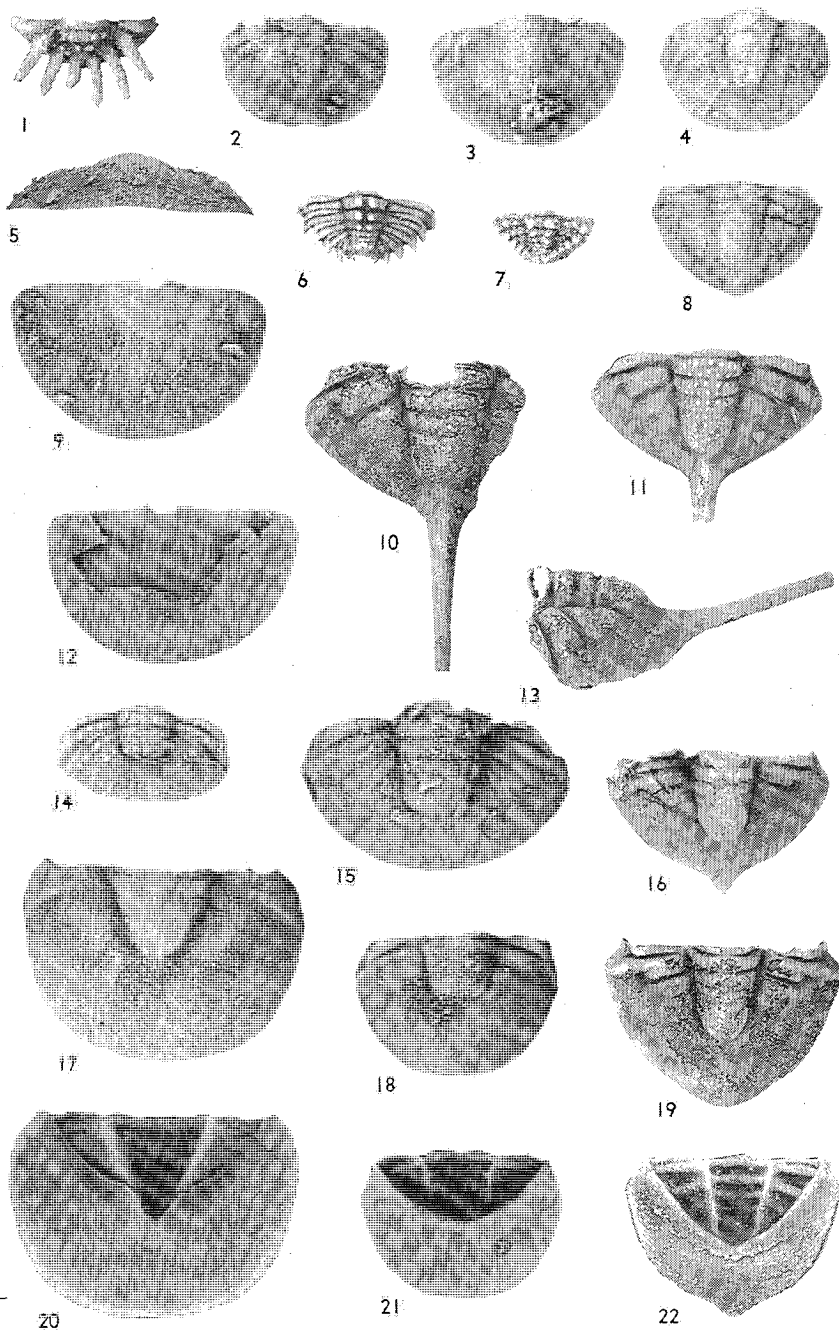


PLATE 6

Hypostome and librigena of *P. accliva* and *P. yersini* are similar.

Pygidium of *P. accliva* differs from *P. yersini* in being narrower and more oval shaped.

Repository.—Figured specimens are BYU 2079, 2080, 2081, 2082, 2083, 2128.

REMOPLEURIDIELLA ANGULARIS n. sp.

Plate 1, figs. 21-22, 25-27

Description and discussion.—*R. angularis* has a wide based, pentamerus-shaped cranidium. This shape is the major difference between the cranidium of *R. angularis* and *R. caudalimbata* Ross (1951, p. 86-87). The cranidium is smooth and is slightly more long than wide. The glabella is domed, occupying almost all of the dorsal surface of the cranidium. The glabella is widest at its midpoint. The occipital ring occupies the posterior quarter of the cranidium. The posterolateral limbs are rolled and project towards the posterior. The palpebral lobes are long and narrow, being widest near the occipital furrow and extending to the midpoint of the glabella. The anterior border forms a narrow tongue-like projection. The facial suture is opisthoparian.

Assigned librigena are narrower, and the genal spine is more posterior, than those of *R. caudalimbata*. At the narrowest point the eyes occupy nearly all the dorsal surface. The doublure is slightly rolled and is almost as wide as the narrow parts of the librigena.

Thorax and pygidium not known.

EXPLANATION OF PLATE 7
UNASSIGNED LIBRIGENAE AND UNASSIGNED HYPOSTOMATA

Figures on this plate are not described.

- 1-3.—Unassigned librigena 1, three specimens: ventral, dorsal, and dorsal views, x5, x4, x2, BYU 2144, 2145, 2146.
- 4-6.—Unassigned librigena 2, three specimens: dorsal, dorsal, and ventral views, all x5, BYU 2147, 2148, 2149.
- 7.—Unassigned librigena 3: dorsal view, x5, BYU 2150.
- 8.—Unassigned librigena 4: dorsal view x8, BYU 2151.
- 9.—Unassigned librigena 5: dorsal view, x5, BYU 2152.
- 10, 11.—*Ischyrotoma* (?), librigena, two specimens: dorsal and ventral views, both x10, BYU 2153, 2154.
- 12.—Unassigned librigena 6: dorsal view, x5, BYU 2155.
- 13.—Unassigned librigena 7: dorsal view, x3, BYU 2156.
- 14.—Unassigned librigena 8, immature: dorsal view, x11, BYU 2157.
- 15, 16.—Unassigned librigena 9, two specimens: dorsal and ventral views, x5, x2, BYU 2158, 2159.
- 17, 18.—Unassigned librigena 10, two specimens: dorsal and ventral views, x9, x7, BYU 2160, 2161.
- 19, 20.—Unassigned librigena 11, two specimens: dorsal and ventral views, both x5, BYU 2162, 2163.
- 21.—Unassigned hypostome 1: ventral view, x8, BYU 2164.
- 22.—Unassigned hypostome 2: ventral view, x3, BYU 2165.
- 23.—Unassigned hypostome 3: ventral view, x8, BYU 2166.
- 24.—Unassigned hypostome 4: ventral view, x4, BYU 2167.
- 25, 26.—Unassigned hypostome 5: ventral and dorsal views, x3, BYU 2168.
- 27, 28.—Unassigned hypostome 6, two specimens: ventral and dorsal views, both x7, BYU 2169, 2170.

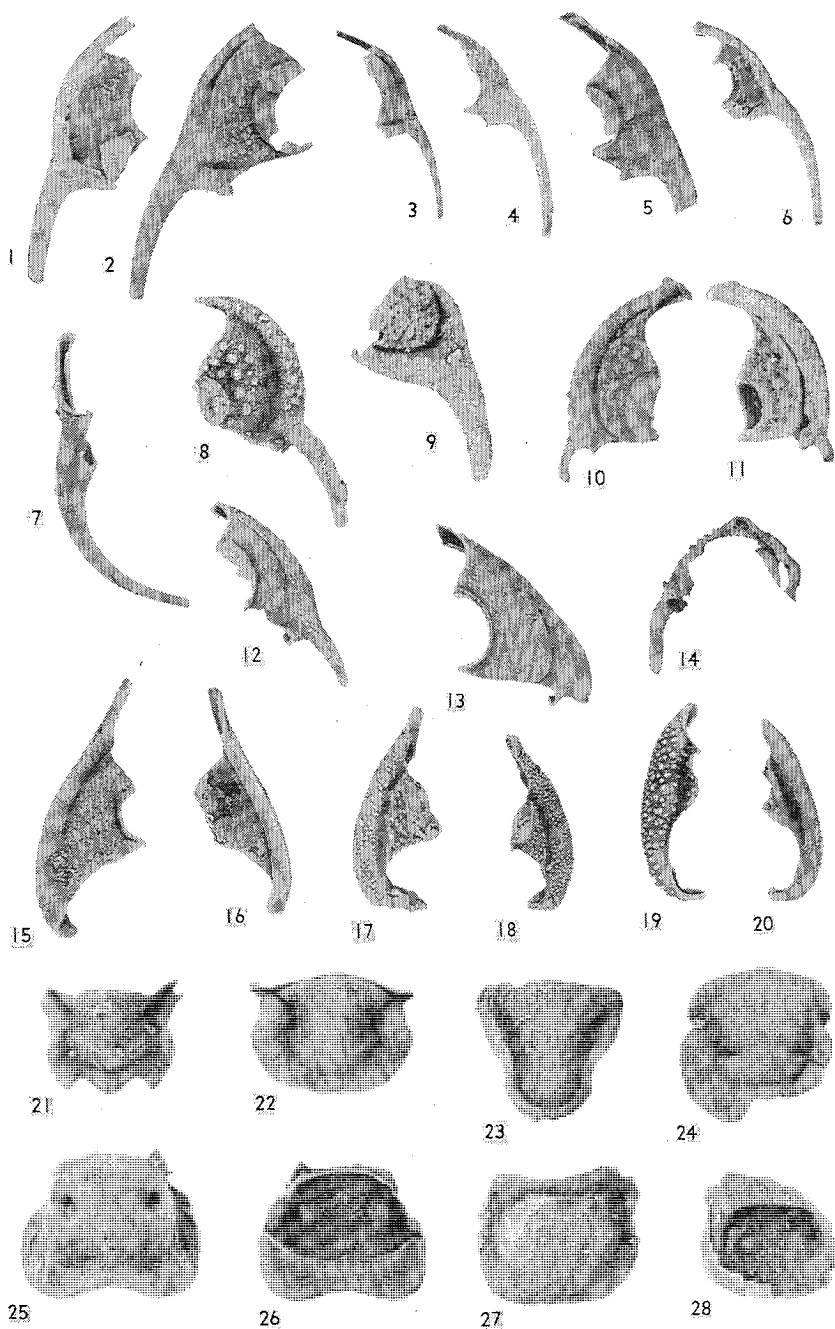


PLATE 7

Repository.—Holotype, BYU 2064, cranidium; Paratype, BYU 2065, librigena.

SHUMARDIA EXOPHTHALMUS Ross, 1967

Plate 1, figs. 1-8

Shumardis exopthalmus Ross, 1967, p. 9-10; Pl. 10, figs. 23-33.

Discussion.—This specimen is added for comparison. Figured with this specimen is the librigena which separates from the cranidium by a marginal suture. The librigena do not separate but remain attached to each other, forming a horseshoe shape. The posterior portion of the librigena has an upward projection which would probably aid in attachment. A nearly complete specimen was found, and it had four thoracic segments (BYU 2171).

Repository.—Figured specimens are BYU 2174, 2175, 2176, 2177.

TRIGONOCERA TYPICA Ross, 1951

Plate 2, figs. 11-12, 15-16

Trigonocera typica Ross, 1951, p. 104-5; Pl. 26, figs. 5-13.

Discussion.—This specimen is figured for comparison. The hypostome assigned to *T. typica* is similar to *T. piochensis* Hintze (1952, p. 238; Pl. 11, fig. 12), except that the slight posterior projection at the center is less distinct in *T. typica*.

Repository.—Figured specimens are BYU 2073, 2074, 2075, 2076.

TRINODUS sp.

Plate 3, figs. 2-4

Trinodus sp. Ross, 1967, p. 9; Pl. 3, figs. 19-20.

Discussion.—This pygidium differs only slightly from that described by Ross (1967, p. 9). The posterolateral spines appear to be less pronounced, and the border between these two spines is less arcuate, giving the specimen a rectangular outline. The specimen is slightly wider than it is long. The median node and axial rings are the same as those described by Ross on *T. sp.*

Repository.—Figured specimen is BYU 2084.

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