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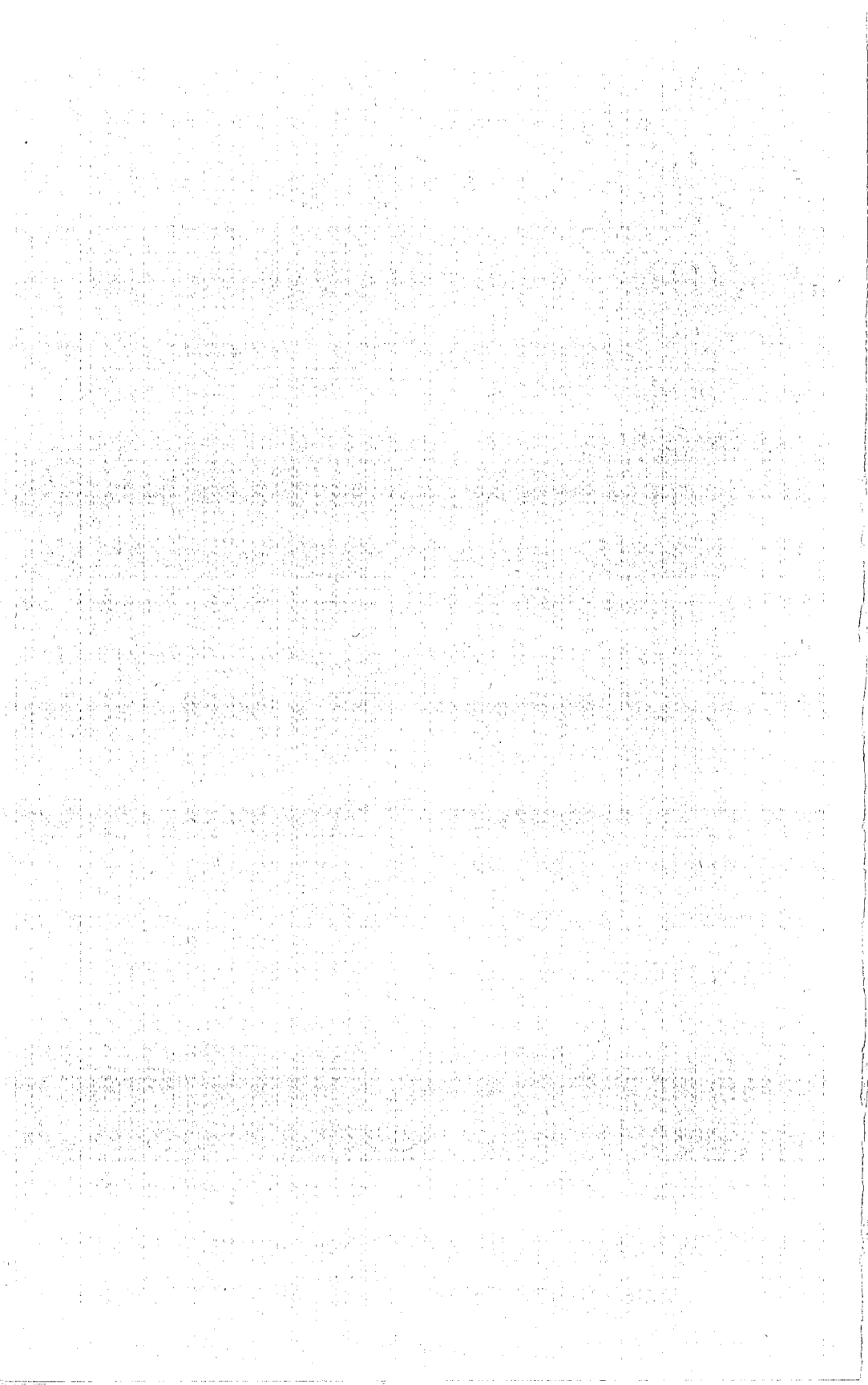
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# GEOLOGY STUDIES

Volume 20: Part 4 — December 1973

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Editor

J. Keith Rigby

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# Silicified Trilobite Zonation in the Lower Fillmore Formation in Western Utah

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**ABSTRACT.**—Silicified trilobite faunas of the lower 400 feet of the Fillmore Formation (Lower Ordovician) of a section near Skull Rock Pass at the south end of the House Range, Utah, enable partial correlation with a section near Crystal Peak in the southern Confusion Range, Utah. The faunas include what appear to be new species. Because identifiable specimens are sparse, correlation is difficult and therefore sketchy in some horizons. Zones comparable to the "D" and "E" zones of Ross (1951) and the *Leiostrigium-Kainella* and *Tesselacauda* zones of Hirtze (1952) are recognized. Zone "D" ranges through the basal 100 feet of the Fillmore Formation and is characterized by *Pseudokainella* sp. A, *Protopliomerops* (?), n. sp., *Parabystricurus* n. sp., *Hillyardina* sp., and two asaphidlike species. Above the "D" zone a 66-foot section of intraformational conglomerates is assigned to neither the "D" nor the "E" zone because it lacks identifiable specimens. Zone "E" is divided into two subzones, "E<sub>1</sub>" and "E<sub>2</sub>". "E<sub>1</sub>" ranges from 166 to 308 feet above the base of the Fillmore Formation and is characterized by *Amblycranium variabile*, *Hystricurus robustus*, and *Parabystricurus carinatus*. "E<sub>2</sub>" ranges from 308 to 400 feet (approximately) above the base of the Fillmore Formation and is characterized by *Hystricurus flectimembrus*, *Hystricurus* sp. A, *Leiostrigium formosa*, and three new species of *Hystricurus*. Zone "E<sub>2</sub>" may eventually prove to be a lower part of the "F" zone, not recognizable in this study.

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## INTRODUCTION

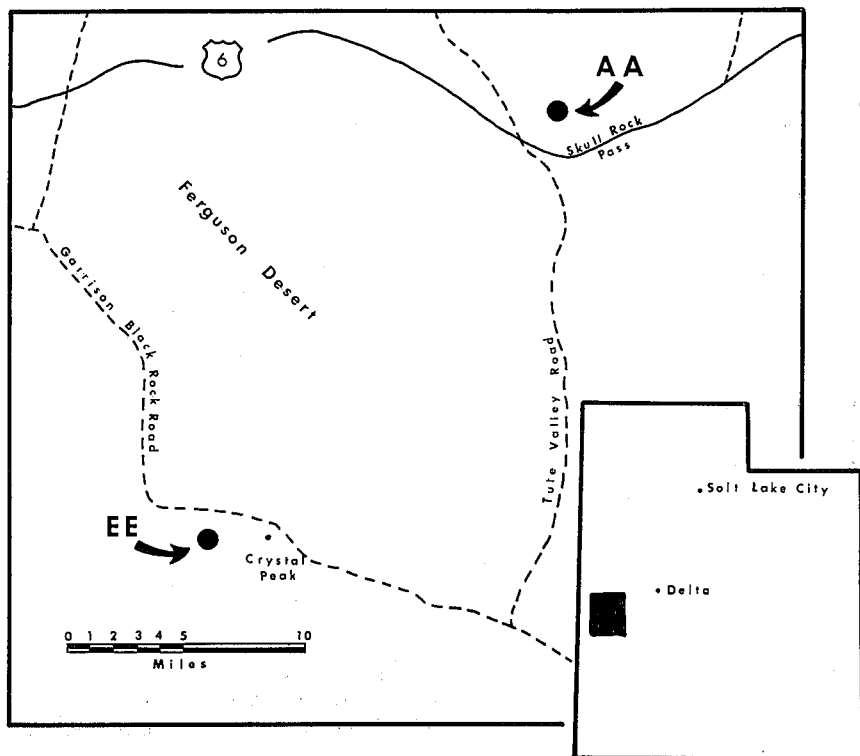
The relatively well exposed and fossiliferous Ordovician strata of the eastern Great Basin in the western United States have long attracted the interest of geologists and paleontologists who hope to construct a more nearly

complete Ordovician faunal succession. Much work in recent years has been devoted to various aspects of the Ordovician fauna, including individual studies on nearly every major faunal group.

The present study, an attempt to correlate two measured sections using their trilobite faunas, confirms many of the findings of Ross (1951) and Hintze (1952) in their earlier extensive studies of the trilobite fauna and adds some other aspects, including the recognition of unnamed species.

#### Location

Studied sections are located in western Utah on fault blocks within the Great Basin. Section AA (SW $\frac{1}{4}$  Sec. 13, T. 20S., R. 14 W.) is located south of Notch Peak on the southern margin of the House Range, near Skull Rock Pass. Access is by a graded sheepherders' road that turns northward off U.S. Highway 6 near Skull Rock Pass. Section EE (NW $\frac{1}{4}$  Sec. 28, T. 23 S., R. 16 W.) is located three miles west of Crystal Peak on the southern margin of the Confusion Range. Access is by a graded sheepherders' road trending southward from Garrison-Black Rock Road at a point approximately two miles east of the turn-off to Pine Pass Reservoir (Text-fig. 1).



TEXT-FIGURE 1.—Index map of studied sections.

## Methods

Both sections were measured using a Jacob's Staff, a hand level, and a Brunton compass and were marked at 10-foot intervals using yellow highway paint. Large, 5- to 10-pound, samples were collected at each fossiliferous horizon. Samples were leached in an acid bath of dilute hydrochloric acid to extract the silicified trilobite remains. Leached samples were picked using a binocular microscope and small camel's-hair brush to locate and remove identifiable trilobite remains.

## Acknowledgments

Greatly appreciated are the constant guidance and the encouragement of Dr. L. F. Hintze throughout this study and through whose efforts the project was initiated and financed. Dr. J. K. Rigby provided advice on illustrating techniques and editorial comments on the manuscript. Eugene Demeter made helpful comments on identification of pliomeric trilobites.

Especially appreciated are the efforts of my wife, Marcie, who typed the manuscript and assisted in plate preparation.

Financial support was provided by National Science Foundation grant GB-3154 to L. F. Hintze.

## CORRELATION OF SECTIONS

Precise correlation between section EE and AA is difficult and somewhat sketchy though they are only approximately 25 miles apart. Use of lithologic correlation is impossible because of the typical gradational and lenticular character of even the most resistant beds (Hintze, 1951, p. 13). Thus, correlation was attempted on the basis of their contained trilobite faunas. Bed-by-bed correlation with trilobites met with only limited success. (Compare Tables 1 and 2). While a similar general pattern of faunal distribution ap-

TABLE 1  
TRILOBITE DISTRIBUTION - SECTION AA

form	footage												
	2	13	40	140	170	225	245	300	325	330	350	360	370
<i>Amblycranium variabile</i>	-	-	-	-	-	*	*	*	-	-	*	*	-
<i>Hillyardina</i> sp. A	-	-	-	-	-	*	-	*	*	*	*	*	*
<i>Hystricurus acumensis</i>	-	-	-	-	-	-	-	-	-	*	-	*	*
<i>Hystricurus flectimembrus</i>	-	-	-	-	-	-	-	*	-	-	-	*	*
<i>Hystricurus oculilunatus</i>	-	-	-	-	-	*	-	-	-	-	*	*	-
<i>Hystricurus politus</i>	-	-	-	-	-	-	-	-	-	-	-	*	-
<i>Hystricurus</i> sp. A	-	-	-	-	-	-	-	-	*	*	*	*	-
<i>Hystricurus</i> sp. C	-	-	-	-	-	-	-	-	-	-	*	-	-
<i>Hystricurus</i> sp. J	-	-	-	-	-	*	-	-	-	-	*	-	-
<i>Hystricurus</i> sp. L	-	-	-	-	-	-	-	-	-	-	*	-	-
<i>Leiostrigium formosa</i>	-	-	-	-	-	-	-	*	*	-	*	-	-
<i>Paenebaltella vultulata</i>	-	-	-	*	-	*	-	-	-	-	-	-	-
<i>Parahystricurus bispectus</i>	-	-	-	-	-	-	-	-	-	-	*	-	-
<i>Parahystricurus carinatus</i>	-	-	-	-	-	*	-	-	-	-	-	-	-
<i>Parahystricurus pustulosus</i>	-	-	-	-	-	*	-	-	-	-	-	-	-
<i>Pilekia</i> (?) <i>trio</i>	-	-	-	-	-	-	-	-	-	-	-	*	-
<i>Rossaspis superciliosa</i>	-	-	-	-	-	-	-	-	-	-	-	*	*
<i>Pilekia</i> (?) sp.	-	-	-	-	-	-	-	-	-	-	?	*	-
<i>Pilekia loella</i>	-	-	-	-	-	-	-	-	-	-	*	?	-
<i>Pseudoclandia fluxafissura</i>	-	-	-	-	-	-	-	-	-	*	*	*	*
<i>Shumardia</i> sp.	*	-	*	-	*	-	-	-	*	*	*	*	*
<i>Tesselacauda depressa</i>	?	?	-	-	-	-	*	-	-	*	*	*	*

TABLE 2  
TRILOBITE DISTRIBUTION - SECTION EE

form	footage					
	9	100	225	310	315	425
<i>Amblycranium variabile</i>	-	-	*	*	-	-
<i>Hillyardina</i> sp. A	-	-	-	*	*	*
<i>Hystricurus acumensis</i>	-	-	-	-	-	*
<i>Hystricurus flectimembrus</i>	-	-	-	-	*	*
<i>Hystricurus oculilunatus</i>	-	-	-	-	-	*
<i>Hystricurus robustus</i>	-	-	*	-	*	*
<i>Hystricurus</i> sp. A	-	-	-	*	*	-
<i>Hystricurus</i> sp. B	-	-	-	?	?	*
<i>Hystricurus</i> sp. C	-	-	*	-	-	-
<i>Hystricurus</i> sp. J	-	-	-	*	*	*
<i>Hystricurus</i> sp. K	-	-	-	?	-	-
<i>Leiostegium formosa</i>	-	-	-	*	*	-
<i>Paenebellerella vultulata</i>	-	-	*	-	*	*
<i>Parahystricurus carinatus</i>	-	-	*	-	-	*
<i>Parahystricurus pustulosus</i>	-	-	-	-	-	*
<i>Rossaspis superciliosa</i>	-	-	-	-	-	*
<i>Protoplimerops</i> sp. 5	-	-	-	-	-	*
<i>Pilekia laella</i>	-	-	-	-	*	-
<i>Pseudoclelandia fluxafissura</i>	-	-	*	*	*	*
<i>Pseudohystricurus obesus</i>	-	*	-	-	-	*
<i>Pseudokainella</i> sp. A	-	*	-	-	-	-
<i>Shumardia</i> sp.	-	-	-	*	*	-
<i>Tesselacauda depressa</i>	?	-	*	*	*	*

pears to exist between the two sections, the agreement hoped for is not evident. The two sections have 14 species in common, but each section has numerous forms not found in the other. Thus, as for refining the ability to correlate the two sections, this study adds little detail to the general zonation already reported by Ross (1951) and Hintze (1952).

Paleontologic work completed on these two sections is perhaps more detailed than has been done on any of the other sections in the area, yet refinement in correlation has not been proportionately improved. It is felt that this is owing to two inherent problems in this study. First, large portions of both sections consist of intraformational conglomerate which was either barren of any trilobite remains or contained only fragments abraded and broken beyond recognition. This eliminates very quickly much of the detail that might be obtained where a more nearly continuous faunal sequence existed. Second, trilobites are known to be regionally provincial. It is obvious from the character of the rocks that the environment of deposition of these strata was very shallow or of a very high energy level, which could mean rapid lateral changes in environmental parameters, as is indicated by observed rapid lateral lithologic changes (Hintze, 1951). It is suggested that trilobites may also be facies fossils locally, thus severely restricting and perhaps eliminating the possibility of their being used for detailed correlation until detailed distribution of facies is understood, even though faunal zonation can be recognized over much of the eastern Great Basin.



## SUBDIVISION OF THE "E" ZONE

Faunal zones comparable to the "D" and "E" zones of Ross (1951) and the *Leiostegium-Kainella* and *Tesselacauda* zones of Hintze (1952) are recognized in this study. The "D" zone is poorly represented in both sections because of a lack of identifiable specimens and abundance of intraformational conglomerate but the zone appears to occupy the basal 100 feet of the Fillmore Formation. *Pseudokainella* sp. A(?), *Protopliomerops* (?) n. sp., *Parabystricurus* n. sp., *Hillyardina* sp. and two asaphidlike species characterize this poorly defined zone. Overlying the "D" zone is a section of intraformational conglomerate approximately 66 feet thick and nearly devoid of identifiable specimens. This "barren zone" is not presently assignable to either the "D" or the "E" zone.

The "E" zone is well defined in both sections and includes from approximately 166 to approximately 400 feet above the base of the Fillmore Formation. At a point approximately 308 feet above the base of the Fillmore Formation there is a distinct change in faunal associations here considered useful for distinguishing two sub-zones of the "E" zone. Zone "E<sub>1</sub>" ranges from 166 to 308 feet above the base of the Fillmore Formation and is characterized by *Amblycranium variable* Ross, 1951, *Hystricurus robustus* Ross, 1951, and *Parabystricurus carinatus* Ross, 1951. Zone "E<sub>2</sub>" ranges from 308 to approximately 400 feet above the base of the Fillmore Formation and is characterized by *Hystricurus flectimembrus* Ross, 1951, *Hystricurus* sp. A., *Leiostegium formosa* Hintze, 1952, and three new species of *Hystricurus*. Regional extent of these subzones is not presently known.

Perhaps related to these subzones is the interesting pattern of rapidly increasing numbers of species upward in the section (Text-fig. 2). The increase begins near the "D—E" zone boundary and then accelerates near the "E<sub>1</sub>—E<sub>2</sub>" subzone boundary. This is also apparent in Demeter's Text-figure 5 (1973). This phenomenon is related to a decrease in intraformational conglomerate and corresponding increase in "algal-reef" zones upward, perhaps indicating a slight increase in water depth, or at least a decrease in energy level during deposition, and conditions more favorable for a more abundant fauna as well as greater possibility of their preservation.

## SYSTEMATIC PALEONTOLOGY

Genus AMBLYCRANIUM Ross, 1951  
AMBLYCRANIUM VARIABLE Ross, 1951

Plate 4, figs. 5 and 6

*Amblycranium variable* Ross, 1951, p. 64, Pl. 13, figs. 10-18.

*Discussion.*—This genus is represented in both section AA and section EE by *A. variable* Ross, 1951; however, specimens found here differ from those found by Ross in that these are nearly twice as large as his. Librigena are much more abundant than cranidia. Pygidia are not known.

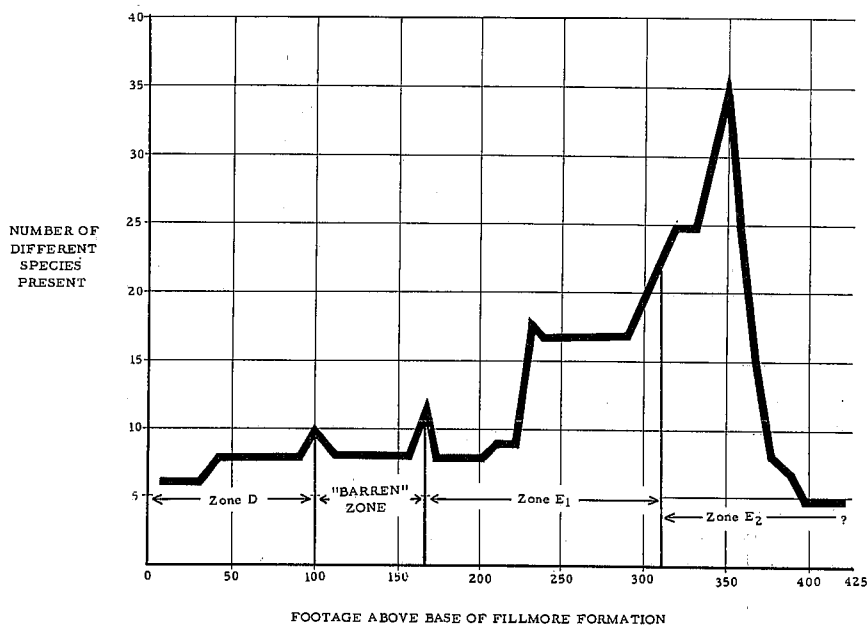
*Occurrence.*—Zone E, sections AA and EE, Lower Fillmore Formation, Utah.

*Repository.*—Figured specimens are BYU 1649 and 1650.

Genus HILLYARDINA, Ross, 1951  
HILLYARDINA sp. A Hintze, 1951

Plate 3, figs. 1-5

*Hillyardina* sp. A of Hintze, 1952, p. 162, Pl. 8, figs. 5, 6.



TEXT-FIGURE 2.—Graph relating stratigraphic level to number of species in the lower Fillmore Formation.

*Discussion.*—Ross (1951) described two new genera, *Hillyardina* and *Hyperbolochilus* in his work on the F zone of the Ordovician of northeastern Utah. These genera are, as noted by Ross, somewhat similar, being differentiated by shape of glabella, course of anterior facial sutures, a preglabellar median furrow, and the presence of a raised boss in the posterolateral corner of the ocular platform. Hintze (1952), upon finding *Hillyardina* sp. A with both an anteriorly expanding brim (characteristic of *Hyperbolochilus*) and a boss in the corner of the ocular platform (characteristic of *Hillyardina*), suggested that the differences between *Hyperbolochilus* and *Hillyardina* as noted by Ross are perhaps specific rather than generic. Material collected for this study has yielded cranidia which are similar to *Hyperbolochilus* except the cranial brim is not as greatly expanded. Also, this form has a faint preglabellar medial furrow similar to that of *Hillyardina*. Librigena associated with this form are nearly identical to those described by Hintze (1952) for *Hillyardina* sp. A. However, it is noted that the characteristic raised boss in the posterolateral corner of the ocular platform is highly variable, ranging from a very faint, nearly unnoticeable boss to a large, prominent one. Also associated with this cranidia is another librigena similar to that of *Hillyardina*, but having a shorter and wider genal spine that curves slightly abaxially before assuming the normal curvature of the *Hillyardina* genal spine. It is believed that these findings further evidence that differences between *Hyperbolochilus* and *Hillyardina* may be specific rather than generic. As yet, no pygidium has been assigned.

*Occurrence.*—Zone E, sections AA and EE, Fillmore Formation, Utah.

*Repository*.—Figured specimens are BYU 1630, 1631, 1632, 1634, and 1635.

Genus HYSTRICURUS Raymond, 1913  
HYSTRICURUS ACUMENSIS Ross, 1951  
Plate 1, figs. 1, 4-6, and 8

*Hystricurus acumensis* Ross, 1951, p. 50, Pl. 11, figs. 6, 7, 10, 11, 12, 15.

*Discussion*.—*H. acumensis* Ross, 1951 occurs as generally well preserved specimens as shown by Plate 1, figure 1, in which cranidia and librigena are still articulated. This is the only partially articulated specimen in the entire study. Specimens of this species and that of *H. flectimembrus* occur together, and it appears that a continuous series of forms exists between them—as might be suspected from the closeness of their similarities as described by Ross (1951). The feature which appears gradational is the acuminate front of the cephalon and accompanying course facial suture marginal to this. If this is true elsewhere as well, it might be suitable for *H. acumensis* to be classified as a variant of *H. flectimembrus*.

It should also be noted that while the cephalon of Plate 1, figure 1 resembles that of *H. acumensis* Ross, 1951, the librigena seems more like that of *H. flectimembrus* Ross, 1951, though not exactly like either form. It is clear that more study must be done before either the characteristic features of these species can be delimited or the determination of separate species is warranted.

Pygidium (Pl. 1, fig. 4) is similar to that assigned by Ross, 1951 to this species.

*Occurrence*.—Zone "E", sections AA and EE, Lower Fillmore Formation, Utah.

*Repository*.—Figured specimens are BYU 1600, 1603, 1604, 1605, and 1607.

HYSTRICURUS FLECTIMEMBRUS Ross, 1951  
Plate 1, figs. 2, 3, and 7

*Hystricurus flectimembrus* Ross, 1951, p. 48, Pl. 10, figs. 25, 26, 29-33; Pl. 11, figs. 16-18, 20-33.

*Discussion*.—Species has been discussed with *H. acumensis* above. Pygidium (Pl. 1, fig. 7) is assigned to this species tentatively.

*Occurrence*.—Zone "E", sections AA, and EE, Lower Fillmore Formation, Utah.

*Repository*.—Figured specimens are BYU 1601, 1602, and 1606.

HYSTRICURUS OCULILUNATUS Ross, 1951  
Plate 1, figs. 11 and 12

*Hystricurus oculilunatus* Ross, 1951, p. 47, Pl. 10, figs. 1-3, 5, 8, 9, 12.

*Discussion*.—Cranidia of this form are generally poorly preserved. Pygidia are not known.

*Occurrence*.—Zone "E", sections AA and EE, Lower Fillmore Formation, Utah.

*Repository*.—Figured specimens are BYU 1610 and 1611.

## HYSTRICURUS POLITUS (?) Ross

Plate 2, figs. 5 and 16

*Hystricurus politus* Ross, 1951, p. 45, Pl. 9, figs. 23, 24, 28, 32-33; Pl. 15, figs. 1-6.

*Discussion*.—Specimen illustrated (Pl. 2, fig. 5) is very fragmentary, making identification difficult. Specimen is tentatively considered *H. politus*; however, is much more coarsely pustulose, and has a deeper palpebral furrow than is generally associated with *H. politus*.

*Occurrence*.—Zone "E", section AA, Lower Fillmore Formation, Utah.

*Repository*.—Figured specimen is BYU 1618.

## HYSTRICURUS ROBUSTUS Ross, 1951

Not figured

*Hystricurus robustus* Ross, 1951, p. 51, Pl. 10, figs. 11, 13-16, 20; Pl. 14, fig. 27.

*Occurrence*.—Zone "E", section EE, Lower Fillmore Formation, Utah.

EXPLANATION OF PLATE 1  
SPECIES OF *HYSTRICURUS*

- FIG. 1.—Cranidium and attached librigena, dorsal view, *Hystricurus acumensis* Ross, 1951, x3, BYU 1600, zone "E".
- FIG. 2.—Cranidium, dorsal view, *Hystricurus flectimembrus* Ross, 1951, x6, BYU 1601, zone "E".
- FIG. 3.—Librigena, dorsal view, *Hystricurus flectimembrus* Ross, 1951, x3, BYU 1602, zone "E".
- FIG. 4.—Pygidium, dorsal view, *Hystricurus* cf. *acumensis* Ross, 1951, x11, BYU 1603, zone "E".
- FIG. 5.—Cranidium, dorsal view, *Hystricurus acumensis* Ross, 1951, x5, BYU 1604, zone "E".
- FIG. 6.—Librigena, dorsal view, *Hystricurus acumensis* Ross, 1951, x6, BYU 1605, zone "E".
- FIG. 7.—Pygidium, dorsal view, *Hystricurus* cf. *flectimembrus* Ross, 1951, x8, BYU 1606, zone "E".
- FIG. 8.—Pygidium, dorsal view, *Hystricurus* cf. *acumensis* Ross, 1951, x6, BYU 1607, zone "E".
- FIG. 9.—Cranidium, dorsal view, *Hystricurus* sp. A of Ross, 1951, x8, BYU 1608, zone "E".
- FIG. 10.—Librigena, dorsal view, *Hystricurus*, sp. A of Ross, 1951, x5, BYU 1609, zone "E".
- FIG. 11.—Librigena, dorsal view, *Hystricurus oculilunatus* Ross, 1951, x6, BYU 1610, zone "E".
- FIG. 12.—Cranidium, dorsal view, *Hystricurus oculilunatus* Ross, 1951, x5, BYU 1611, zone "E".
- FIG. 13.—Cranidium, dorsal view, *Hystricurus* sp. A of Ross, 1951, x10, BYU 1612, zone "E".
- FIG. 14.—Cranidium, dorsal view, *Hystricurus oculilunatus* Ross, 1951, x3, BYU 1613, zone "E".
- FIG. 15.—Pygidium, lateral view, *Hystricurus oculilunatus* Ross, 1951, x5, BYU 1614, zone "E".
- FIG. 16.—Pygidium, dorsal view, *Hystricurus oculilunatus* Ross, 1951, x5, BYU 1614, zone "E".

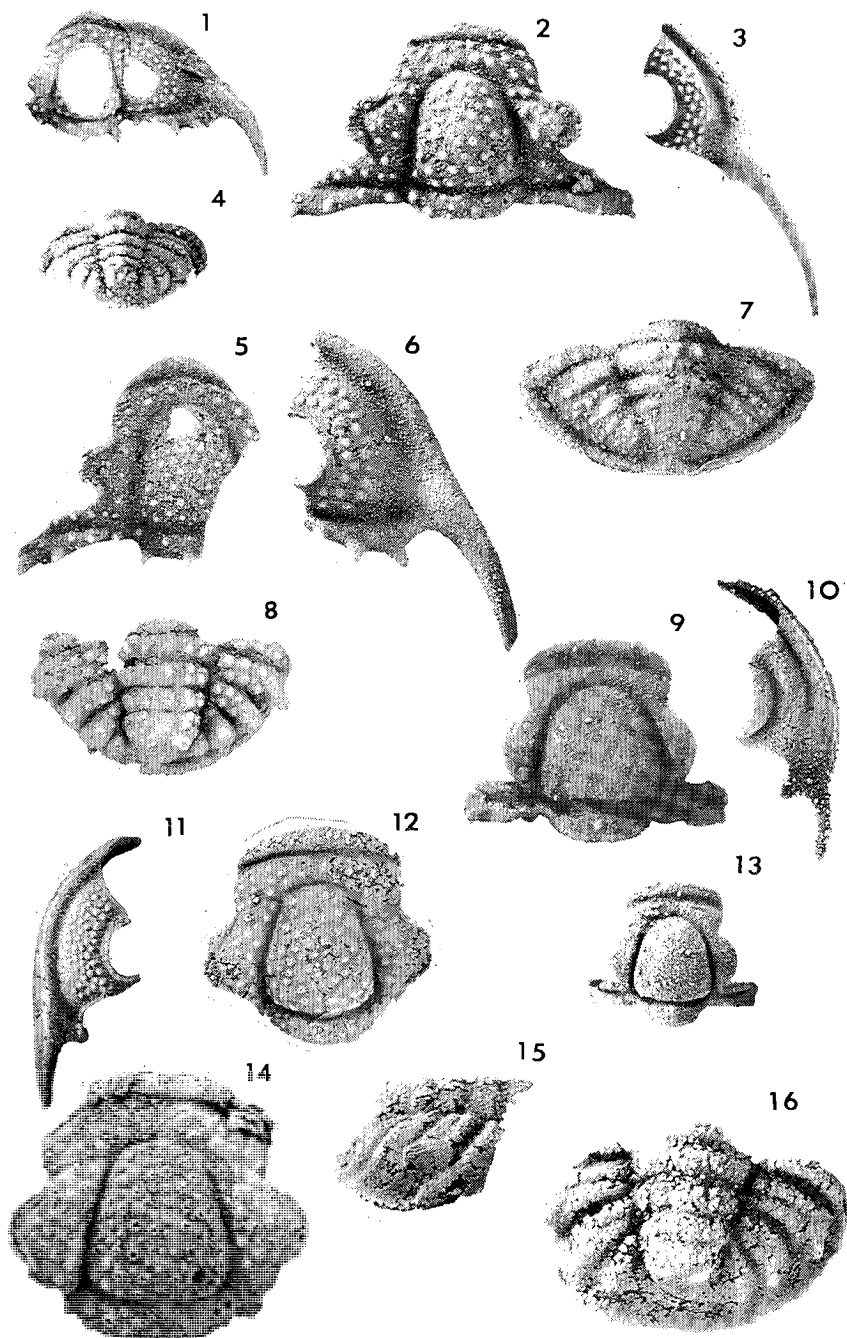


PLATE 1

## HYSTRICURUS sp. A of Ross, 1951

Plate 1, figs. 9, 10, and 13

*Hystricurus* sp. A of Ross, 1951, p. 53, Pl. 9, figs. 31, 34, 37.

*Discussion.*—This common form of the "E" zone is generally well preserved. A poorly preserved cranidium was originally designated *H.* sp. A by Ross. Librigena of fig. 10 is assigned to this species. Pygidium is still unknown. Cranidium is very smooth and unpustulose. Glabellar marginal furrows and anterior border furrows are deep and relatively wide. Rim concave. Pits in dorsal furrow anterior of midpoint of glabella noted by Ross not present. Further description follows that of Ross (1951, p. 53). Librigena assigned on basis of similarity of facial sutures, concavity of brim, surface texture, continuity of anterior border furrow with lateral border furrows, and coincidence of occurrence.

*Occurrence.*—Zone "E", sections AA and EE, Lower Fillmore Formation, Utah.

*Repository.*—Figured specimens are BYU 1608, 1609, and 1612.

## HYSTRICURUS sp. B (?) of Ross, 1951

Plate 2, fig. 10

*Hystricurus* sp. B of Ross, 1951, p. 53, Pl. 10, figs. 18, 19, 23, 24, 27, 28.

## EXPLANATION OF PLATE 2

HYSTRICURUS, PSEUDOHYSTRICURUS, PARAHYSTRICURUS,  
AND TESSELACAUDA

- FIG. 1.—Cranidium, dorsal view, *Hystricurus* (?) sp., x8, BYU 1615, zone "E".  
 FIG. 2.—Cranidium, dorsal view, *Pseudohystricurus* sp. of Ross, 1951, x6, BYU 1616, zone "E".  
 FIG. 3.—Cranidium, dorsal view, unassigned, x5, BYU 1617, zone "E".  
 FIG. 4.—Cranidium, lateral view, *Pseudohystricurus* sp. of Ross, 1951, x7, BYU 1616, zone "E".  
 FIG. 5.—Cranidium, dorsal view, *Hystricurus* (?) *politus* Ross, 1951, x10, BYU 1618, zone "E".  
 FIG. 6.—Cranidium, dorsal view, *Tesselacauda depressa* Ross, 1951, x6, BYU 1619, zone "E".  
 FIG. 7.—Cranidium, dorsal view, *Hystricurus*, sp. L, x8, BYU 1620, zone "E".  
 FIG. 8.—Cranidium, dorsal view, *Hystricurus* (?) sp., x4, BYU 1666, zone "E".  
 FIG. 9.—Pygidium, dorsal view, *Tesselacauda depressa* Ross, 1951, x11, BYU 1622, zone "E".  
 FIG. 10.—Cranidium, dorsal view, *Hystricurus*, sp. B. (?) of Ross, 1951, x8, BYU 1623, zone "E".  
 FIG. 11.—Cranidium, dorsal view, *Parahystricurus pustulosus* Ross, 1951, x7, BYU 1624, zone "E".  
 FIG. 12.—Cranidium, lateral view, *Hystricurus* sp. J, x5, BYU 1625, zone "E".  
 FIG. 13.—Hypostome, ventral view, *Tesselacauda depressa* Ross, 1951, x11, BYU 1626, zone "E".  
 FIG. 14.—Cranidium, dorsal view, *Hystricurus* sp. J, x5, BYU 1627, zone "E".  
 FIG. 15.—Cranidium, dorsal view, *Hystricurus* sp. J, x5, BYU 1625, zone "E".  
 FIG. 16.—Cranidium, dorsal view, *Hystricurus politus* Ross, 1951, x10, BYU 1628, zone "E".

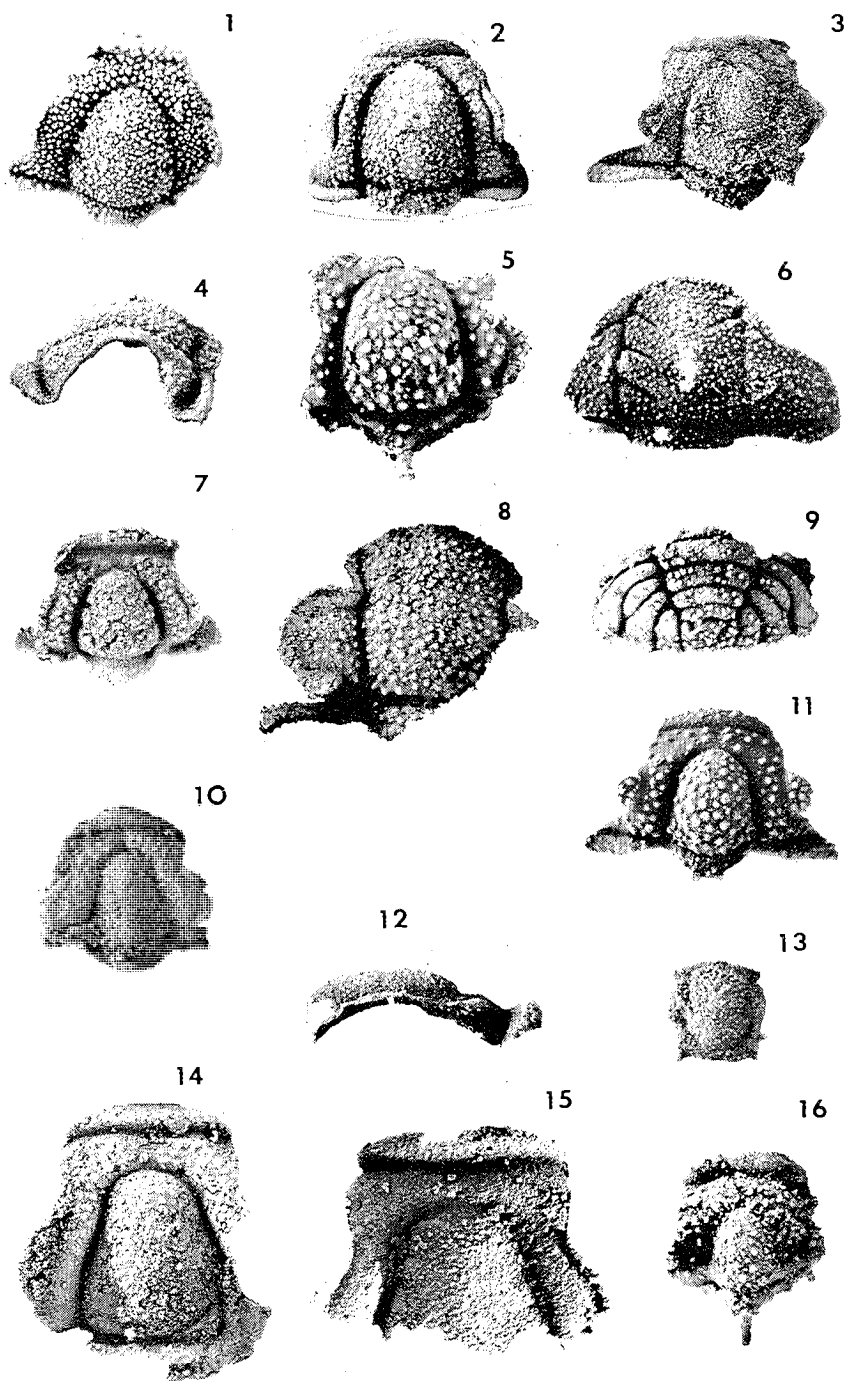


PLATE 2

*Discussion*.—Specimen is an immature and rather fragmentary cranidium. Resembles closely the form referred to as *H. sp. B* by Ross, 1951.

*Occurrence*.—Zone "E", section EE, Lower Fillmore Formation, Utah.

*Repository*.—Figured specimen is BYU 1623.

HYSTRICURUS sp. C of Ross, 1951

Not figured

*Hystricurus* sp. C of Ross, 1951, p. 54, Pl. 10, figs. 17, 21, 22.

*Occurrence*.—Zone "E", sections AA and EE, Lower Fillmore Formation, Utah.

HYSTRICURUS sp. J

Plate 2, figs. 12, 14, and 15

*Occurrence*.—Zone "E", section EE, Lower Fillmore Formation, Utah.

*Repository*.—Figured specimen is BYU 1628.

HYSTRICURUS sp. K

Plate 4, fig. 2

*Discussion*.—Common hystricurid form previously undescribed. Known only from cranidium. Coarsely pustulose with deep glabellar furrows containing two pairs of pits. Posterior pair of pits is near midlength of glabella, and anterior pair approximately adjacent anterior margin of palpebral lobe. Pits are likely incipient to development of glabellar furrows. Glabellar width decreases anteriorly beyond posterior pair of glabellar furrow pits. Brim concave. Preglabellar field narrow so that preglabellar furrow and anterior border furrow nearly join. Prominent palpebral furrows.

*Occurrence*.—Zone "E", section EE, Lower Fillmore Formation, Utah.

*Repository*.—Figured specimen is BYU 1645.

HYSTRICURUS sp. L

Plate 2, fig. 7

*Discussion*.—Small hystricurid of unknown species. May represent immature form of known species, but affinity uncertain.

*Occurrence*.—Zone "E", section AA, Lower Fillmore Formation, Utah.

*Repository*.—Figured specimen is BYU 1620.

HYSTRICURUS (?) sp.

Plate 2, fig. 1

*Discussion*.—Coarsely pustulate form tentatively assigned to the genus *Hystricurus*. Librigena of Plate 3, figure 6 may be related.

*Occurrence*.—Zone "E", section AA, Lower Fillmore Formation, Utah.

*Repository*.—Figured specimen is BYU 1615.



## HYSTRICURUS (?) sp.

Plate 2, fig. 8

*Discussion*.—Unusually shaped cranidium questionably assigned to the genus *Hystericurus*. Only one specimen found.

*Occurrence*.—Zone "D", section AA, Lower Fillmore Formation, Utah.

*Repository*.—Figured specimen is BYU 1621.

## HYSTRICURUS (?) sp.

Plate 5, figs. 7 and 8

*Discussion*.—Two librigena of somewhat similar form are tentatively assigned to the genus *Hystericurus*.

*Occurrence*.—Zone "E", section AA, Lower Fillmore Formation, Utah.

*Repository*.—Figured specimens are BYU 1664 and 1665.

## HYSTRICURUS (?) sp.

Plate 4, fig. 8

*Discussion*.—Immature cranidium possibly referable to *H. flectimembrus*.

*Occurrence*.—Zone "E", section EE, Lower Fillmore Formation, Utah.

*Repository*.—Figured specimen is BYU 1652.

Genus LEIOSTEGIUM Raymond, 1913  
LEIOSTEGIUM FORMOSA Hintze, 1952  
Plate 3, figs. 9, 10, 12, and 13

*Leiostegium formosa* Hintze, 1952, p. 189, Pl. 8, figs. 8-10.

*Discussion*.—This genus is relatively common in some horizons in the studied sections; however, generally only the pygidium is found. Figured is a specimen of the cranidium better preserved and more nearly complete than was originally described by Hintze (1952); however, no modifications of the original description are necessary.

*Occurrence*.—Zone "E", subzone "E<sub>2</sub>", sections AA and EE, Lower Fillmore Formation, Utah.

*Repository*.—Figured specimens are BYU 1639, 1640, 1642, and 1643.

Genus PAENEBELTELLA Ross, 1951  
PAENEBELTELLA VULTULATA Ross, 1951  
Plate 5, figs. 2 and 3

*Paenebeltella vultulata* Ross, 1951, p. 79, Pl. 18, figs. 1, 2, 5, 6; Pl. 19, fig. 10.

*Discussion*.—Form is common in section EE and ranges through the entire section, including the "D" zone, an occurrence not previously noted; however, it is limited to the "E<sub>1</sub>" subzone in section AA, a more "normal" occurrence. Pygidia are not recognized.

*Occurrence*.—Zone "E", subzone "E<sub>1</sub>", section AA, and zones "D" through "E<sub>2</sub>", section EE, Lower Fillmore Formation, Utah.

*Repository*.—Figured specimens are BYU 1659 and 1660.

Genus *PARAHYSTRICURUS* Ross, 1951  
*PARAHYSTRICURUS* cf. *BISPICATUS* Hintze, 1952

Plate 5, fig. 5

*Parahystericurus bispicatus* Hintze, 1952, p. 195, Pl. 8, figs. 3-4.

*Discussion*.—Only a single librigena of this species was encountered and because of poor preservation can be only tentatively assigned to this species.

*Occurrence*.—Zone "E", section AA, Lower Fillmore Formation, Utah.

*Repository*.—Figured specimen is BYU 1662.

*PARAHYSTRICURUS CARINATUS* (?) Ross, 1951

Plate 4, figs. 11 and 14

*Parahystericurus carinatus* Ross, 1951, p. 60, Pl. 13, figs. 23-27, 30-32, 35-37.

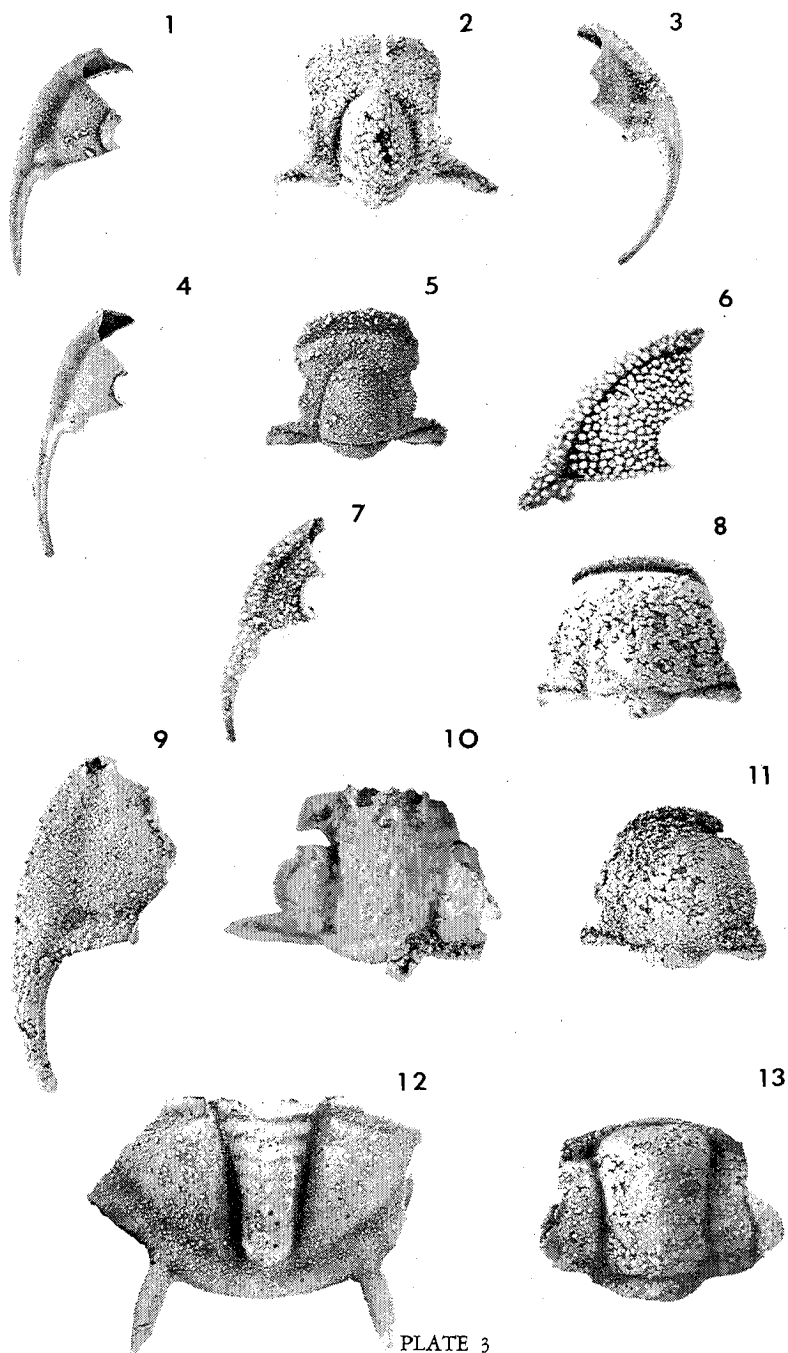
*Discussion*.—Only librigena referable to this species were found.

*Occurrence*.—Zone "E", sections "AA" and "EE", Lower Fillmore Formation, Utah.

*Repository*.—Figured specimen is BYU 1655.

#### EXPLANATION OF PLATE 3 *HILLYARDINA*, *LEIOSTEGIUM*, AND UNASSIGNED FRAGMENTS

- FIG. 1.—Librigena, dorsal view, *Hillyardina* sp. A of Hintze, 1952, x3, BYU 1630, zone "E".  
 FIG. 2.—Cranidium, dorsal view, *Hillyardina* sp. A of Hintze, 1952, x4, BYU 1631, zone "E".  
 FIG. 3.—Librigena, dorsal view, *Hillyardina* cf. sp. A of Hintze, 1952, x5, BYU 1632, zone "E".  
 FIG. 4.—Librigena, dorsal view, *Hillyardina* sp. A of Hintze, 1952, x5, BYU 1634, zone "E".  
 FIG. 5.—Cranidium, dorsal view, *Hillyardina* sp. A of Hintze, 1952, x9, BYU 1635, zone "E".  
 FIG. 6.—Librigena, dorsal view, unassigned, x7, BYU 1636, zone "E".  
 FIG. 7.—Librigena, dorsal view, unassigned, x10, BYU 1637, zone "D".  
 FIG. 8.—Cranidium, dorsal view, unassigned, x10, BYU 1638, zone "E".  
 FIG. 9.—Librigena, dorsal view, *Leiostegium formosa* Hintze, 1952, x4, BYU 1639, zone "E".  
 FIG. 10.—Cranidium, dorsal view, *Leiostegium formosa* Hintze, 1952, x2, BYU 1640, zone "E".  
 FIG. 11.—Cranidium, dorsal view, unassigned, x6, BYU 1641, zone "E".  
 FIG. 12.—Pygidium, dorsal view, *Leiostegium formosa* Hintze, 1952, x4, BYU 1642, zone "E".  
 FIG. 13.—Cranidium, dorsal view, *Leiostegium formosa* Hintze, 1952, x3, BYU 1643, zone "E".



## PARAHYSTRICURUS PUSTULOSUS Ross, 1951

Plate 2, fig. 11; Plate 4, figs. 9, 10, and 12

*Parahystricurus pustulosus* Ross, 1951, p. 60, Pl. 12, figs. 17-32; Pl. 14, figs. 23, 24, 26.

*Discussion.*—Librigena of Plate 4, figures 9 and 12 are possibly an aberrant form of this species. It is similar in all respects except for the termination of its genal spine, which appears somewhat stunted. This might be considered a pathologic occurrence if it were not so abundant.

*Occurrence.*—Zone "E", sections AA and EE, Lower Fillmore Formation, Utah.

*Repository.*—Figured specimens are BYU 1624, 1653, and 1654.

## PARAHYSTRICURUS sp.

Plate 5, fig. 4

*Discussion.*—Parahystricurid librigena of this form are common in section EE. Assignment of a specific name is delayed until an associated cranidium is found.

*Occurrence.*—Zone "E", section EE, Lower Fillmore Formation, Utah.

*Repository.*—Figured specimen is BYU 1661.

EXPLANATION OF PLATE 4  
VARIOUS PLIOMERID TRILOBITES

- FIG. 1.—Cranidium, dorsal view, unassigned, x8, BYU 1644, zone "E".  
 FIG. 2.—Cranidium, dorsal view, *Hystricurus* sp. K, x9, BYU 1645, zone "E".  
 FIG. 3.—Librigena, dorsal view, *Pseudokainella* sp. A (?) Hintze, 1952, x8, BYU 1647, zone "D".  
 FIG. 4.—Cranidium, dorsal view, *Pseudoclelandia fluxafissura* Ross, 1951, x9, BYU 1648, zone "E".  
 FIG. 5.—Cranidium, dorsal view, *Amblycranium variabile* Ross, 1951, x9, BYU 1649, zone "E".  
 FIG. 6.—Librigena, dorsal view, *Amblycranium variabile* Ross, 1951, x11, BYU 1650, zone "E".  
 FIG. 7.—Cranidium, dorsal view, *Pseudoclelandia fluxafissura* Ross, 1951, x8, BYU 1651, zone "E".  
 FIG. 8.—Cranidium, dorsal view, *Hystricurus* (?), immature, x11, BYU 1652, zone "E".  
 FIG. 9.—Librigena, dorsal view, *Parahystricurus pustulosus* (?) Ross, 1951, x7, BYU 1653, zone "E".  
 FIG. 10.—Librigena, dorsal view, *Parahystricurus pustulosus* Ross, 1951, x9, BYU 1654, zone "E".  
 FIG. 11.—Librigena, lateral view, *Parahystricurus carinatus* Ross, 1951, x6, BYU 1655, zone "E".  
 FIG. 12.—Librigena, dorsal view, *Parahystricurus pustulosus* (?) Ross, 1951, x7, BYU 1653, zone "E".  
 FIG. 13.—Pygidium, dorsal view, unassigned, x3, BYU 1656, zone "D".  
 FIG. 14.—Librigena, dorsal view, *Parahystricurus carinatus* Ross, 1951, x6, BYU 1655, zone "E".  
 FIG. 15.—Cranidium, dorsal view, *Pilekia* (?) *trio* Hintze, 1952, x8, BYU 1657, zone "E".

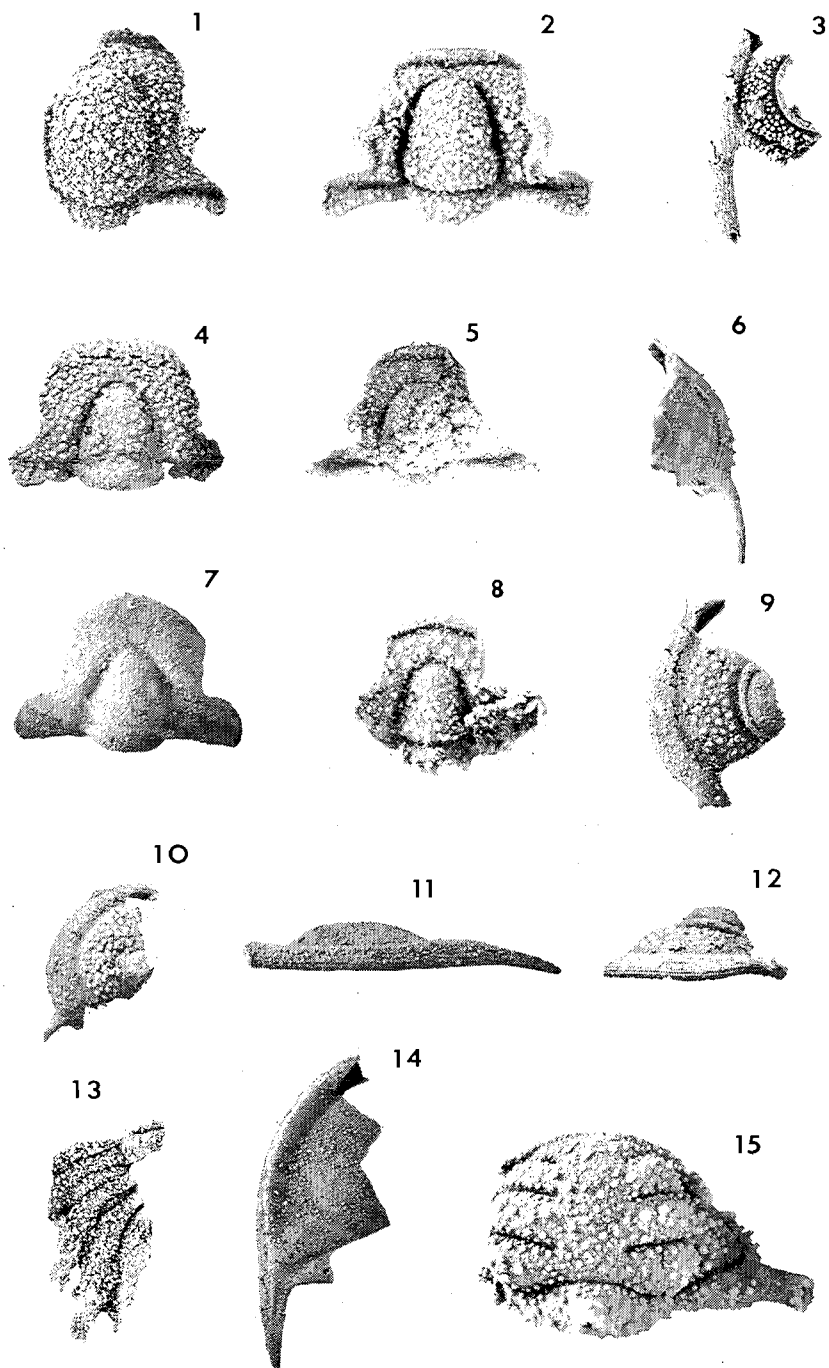


PLATE 4

## PARAHYSTRICURUS (?) sp.

Plate 5, fig. 6

*Discussion*.—Librigena of this form are rare in sections studied. It appears to have some similarity to the genus *Parahystricurus*, but can be assigned only tentatively.

*Occurrence*.—Zone "E", section EE, Lower Fillmore Formation, Utah.

*Repository*.—Figured specimen is BYU 1663.

Genus PILEKIA Barton, 1915  
PILEKIA (?) TRIO Hintze, 1952  
Plate 5, fig. 15

*Pilekia (?)trio* Hintze, 1952, p. 205, Pl. 21, fig. 1.

*Discussion*.—This rather rare form is known in the studied sections from only one relatively well preserved specimen of the cranidia. Other poorly preserved specimens of perhaps the same genus occur in the same horizon. This genus is not found in section EE. The reader is referred to the discussion by Hintze (1952) on the appropriateness of the assignment of this form to the genus *Pilekia*.

*Occurrence*.—Zone "E", subzone "E<sub>2</sub>", section AA, Lower Fillmore Formation, Utah.

*Repository*.—Figured specimen is BYU 1657.

## EXPLANATION OF PLATE 5

PSEUDOHYSTRICURUS, PAENEBELTELLA, PARAHYSTRICURUS,  
HYSTRICURUS, AND UNASSIGNED FRAGMENTS

- FIG. 1.—Cranidium, dorsal view, *Pseudohystricurus obesus* Ross, 1951, x8, BYU 1658, zone "E".
- FIG. 2.—Cranidium, dorsal view, *Paenebeltella vultulata* Ross, 1951, x10, BYU 1659, zones "D" and "E".
- FIG. 3.—Librigena, dorsal view, *Paenebeltella vultulata* Ross, 1951, x3, BYU 1660, zones "D" and "E".
- FIG. 4.—Librigena, dorsal view, *Parahystricurus* sp., x3, BYU 1661, zone "E".
- FIG. 5.—Librigena, dorsal view, *Parahystricurus* cf. *bispicatus* Hintze, 1952, x5, BYU 1662, zone "E".
- FIG. 6.—Librigena, dorsal view, *Parahystricurus* (?) sp., x5, BYU 1663, zone "E".
- FIG. 7.—Librigena, dorsal view, *Hystricurus* (?) sp., x9, BYU 1664, zone "E".
- FIG. 8.—Librigena, dorsal view, *Hystricurus* (?) sp., x9, BYU 1665, zone "E".
- FIG. 9.—Librigena, dorsal view, unassigned, x5, BYU 1666, zone "E".
- FIG. 10.—Pygidium, dorsal view, unassigned, possibly referable to *Hystricurus*, x11, BYU 1667, zone "E".
- FIG. 11.—Librigena, dorsal view, unassigned, x3, BYU 1668, zone "E", possibly referable to *Hystricurus* (?) sp. on Plate 2, fig. 8.
- FIG. 12.—Pygidium, posterior lateral view, unassigned, x7, BYU 1669, zone "E".
- FIG. 13.—Pygidium, dorsal view, unassigned, x7, BYU, 1669, zone "E".
- FIG. 14.—Pygidium, dorsal view, unassigned, x10, BYU 1671, zone "E".
- FIG. 15.—Librigena, lateral view, unassigned, x6, BYU 1668, zone "E".
- FIG. 16.—Pygidium, dorsal view, unassigned, x10, BYU 1672, zone "E".

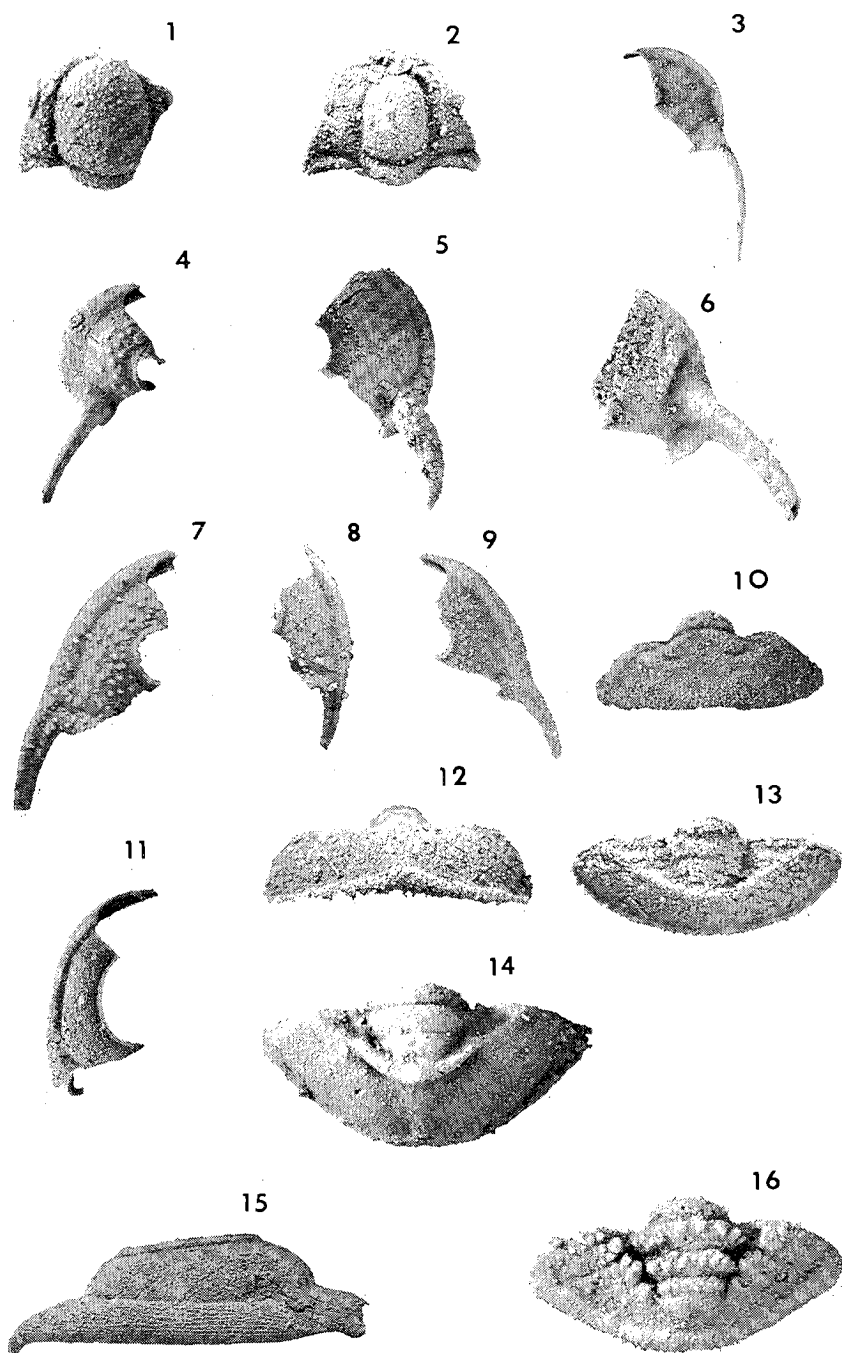


PLATE 5

## PILEKIA (?) sp.

Plate 6, fig. 16

*Discussion*.—Following the suggestion of Hintze (1952, p. 209) designation of species for these forms is postponed until further research demonstrates the relationship between found pygidia and unknown cranidia.

*Occurrence*.—Zone "E", sections AA and EE, Lower Fillmore Formation, Utah.

*Repository*.—Figured specimen is BYU 1689.

## PILEKIA LOELLA Demeter, 1973

Plate 6, figs. 12 and 15

*Discussion*.—Relatively common in the sections studied, though seldom as well preserved as the specimen in figure 15. This form has only three pairs of pygidial pleura.

*Occurrence*.—Zone "E", sections AA and EE, Lower Fillmore Formation, Utah.

*Repository*.—Figured specimens are BYU 1685, and 1688.

## Genus ROSSASPIS Harrington, 1957

## ROSSASPIS SUPERCILIOSA (?) (Ross, 1951)

Plate 6, fig. 13

*Protopliomerops superciliosa* Ross, 1951, p. 133, Pl. 31, figs. 16-26; Pl. 32, figs. 1-16; Pl. 34, figs. 5-8, 19.

*Rossaspis superciliosa* Harrington, 1957, p. 812.

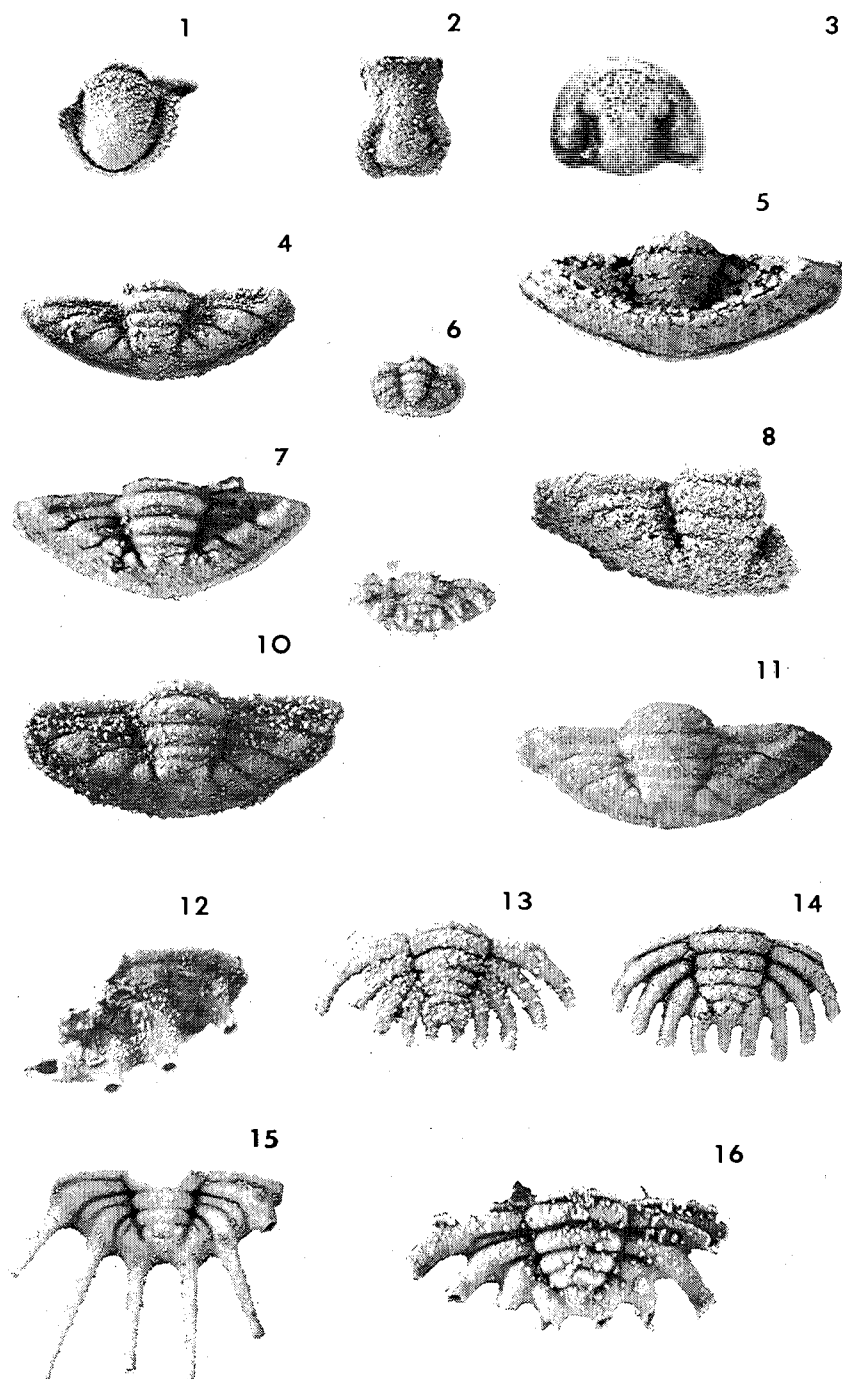
*Discussion*.—Well-preserved specimens of this genus are rare in the studied sections. Only fragmental cranidia were recovered. This pygidium is unusually coarsely pustulose.

## EXPLANATION OF PLATE 6

## SHUMARDIA, PILEKIA, ROSSASPIS, AND PROTOPLIOMEROPS

- FIG. 1.—Hypostome, ventral view, unassigned, x11, BYU 1673, zone "D".  
 FIG. 2.—Hypostome, ventral view, unassigned, x11, BYU 1674, zone "E".  
 FIG. 3.—Cranidium, dorsal view, *Shumardia* sp., x11, BYU 1621, zones "D" and "E".  
 FIGS. 4, 5, 7, 8, 10, and 11.—Pygidia, dorsal view, unassigned, BYU 1676, 1678, 1680, 1681, 1682, 1683, and 1684, respectively, zone "E".  
 FIG. 6.—Pygidium, dorsal view, *Shumardia* sp., x11, BYU 1679, zones "D" and "E".  
 FIG. 12.—Pygidium, dorsal view, *Pilekia loella* (?) Demeter, 1973, x10, BYU 1685, zone "E".  
 FIG. 13.—Pygidium, dorsal view, *Rossaspis superciliosa* (?) (Ross, 1951), x10, BYU 1686, zone "E".  
 FIG. 14.—Pygidium, dorsal view, *Protopliomerops* sp. 5 of Hintze, 1952, x6, BYU 1687, zone "E".  
 FIG. 15.—Pygidium, dorsal view, *Pilekia loella* (?) Demeter, 1973, x4, BYU 1688, zone "E".  
 FIG. 16.—Pygidium, dorsal view, *Protopliomerops* sp. 7, x4, BYU 1689, zone "E".





*Occurrence*.—Zone "E", sections AA and EE, Lower Fillmore Formation, Utah.

*Repository*.—Figured specimen is BYU 1686.

Genus PROTOPLIOMEROPS Kobayashi, 1934

PROTOPLIOMEROPS sp. 5 of Hintze, 1952

Plate 6, fig. 14

*Protopliomerops* sp. 5 of Hintze, 1952, p. 210, Pl. 21, fig. 5.

*Discussion*.—An unnamed species of *Protopliomerops* referred to as *P.* sp. 5 by Hintze (1952) is relatively common in the sections. No cranidium is as yet assignable. Previously noted only from zone "F". It is similar to *Rossaspis pliomeris* Demeter except for terminal spine.

*Occurrence*.—Zone "E", sections AA and EE, Lower Fillmore Formation, Utah.

*Repository*.—Figured specimen is BYU 1687.

Genus PSEUDOCLELANDIA Ross, 1951

PSEUDOCLELANDIA FLUXAFISSURA Ross, 1951

Plate 4, figs. 4 and 7

*Pseudoclelandia fluxafissura* Ross, 1951, p. 119, Pl. 29, figs. 14, 17, 18.

*Discussion*.—This relatively common form as originally described (Ross, 1951) occurred only in the "F" zone. Later, Hintze (1952) extended its occurrence, tentatively, to the "E" zone. This extension of its range is verified in the present study and is again tentatively extended to include at least the upper portion of the "D" zone. Form is known in this study only from cranidia.

Plate 4, figure 4, shows a specimen somewhat more coarsely pustulose than usual and with more distinct border furrows both anteriorly and posteriorly. This may represent another species of this genus, but too few specimens are available for separation.

*Occurrence*.—Zones "D" through "E", section AA; zone "E", section EE, Lower Fillmore Formation, Utah.

*Repository*.—Figured specimens are BYU 1648, and 1651.

Genus PSEUDOHYSTRICURUS Ross, 1951

PSEUDOHYSTRICURUS OBESUS Ross, 1951

Plate 5, fig. 1

*Pseudohystricurus obesus* Ross, 1951, p. 74, Pl. 16, figs. 25, 30, 34.

*Discussion*.—This form occurs only once in section EE, at the highest point collected (425 feet above the base of the Fillmore Formation), which may represent the beginning of the "F" zone. This cannot be verified until further collecting is done. If this is still in the "E" zone, then this represents an extension of the known occurrence of *Pseudohystricurus obesus* Ross.

*Occurrence*.—Zone "E" (?), section EE, Lower Fillmore Formation, Utah.

*Repository*.—Figured specimen is BYU 1658.

PSEUDOHYSTRICURUS sp. (?) of Ross, 1951

Plate 2, fig. 2

*Pseudohystericurus* sp. of Ross, 1951, p. 75, Pl. 16, figs. 26, 27, 31.

*Discussion*.—A form similar to the unnamed form described by Ross (1951) as *Pseudohystericurus* sp. occurs in the "E", and possibly in the "D" zones.

*Occurrence*.—Zones "E" and "D" (?), sections AA and EE, Lower Fillmore Formation, Utah.

*Repository*.—Figured specimen is BYU 1616.

Genus PSEUDOKAINELLA Harrington, 1938

PSEUDOKAINELLA sp. A (?) Hintze, 1952

Plate 4, fig. 3

*Pseudokainella* sp. A Hintze, 1952, p. 219, Pl. 5, figs. 6-9.

*Discussion*.—Although rare in the sections studied, and although recognized on the basis of only a few librigena and one poorly preserved pygidium (not figured), this occurrence is significant because it extends the known range of this form from the "B" zone into the "D" zone.

*Occurrence*.—Zone "D", section EE, Lower Fillmore Formation, Utah.

*Repository*.—Figured specimen is BYU 1647.

Genus SHUMARDIA Billings, 1862

SHUMARDIA sp.

Plate 6, figs. 2, 6

*Discussion*.—This form is common throughout both sections as disarticulated pygidia, cranidia, thoracic segments, and macropleural fourth (?) thoracic segments. Genus not previously recognized in these strata of the Great Basin possibly because of its minute size. Because this form ranges throughout the entirety of both sections, it is not useful for local correlation but aids in correlation with the European Ordovician where it occurs in the Tremadocian.

*Occurrence*.—Zones "D" and "E", sections AA and EE, Lower Fillmore Formation, Utah.

*Repository*.—Figured specimens are BYU 1621, and 1679.

Genus TESSELACAUDA Ross, 1951

TESSELACAUDA DEPRESSA Ross, 1951

Plate 2, figs. 6, 9, and 13

*Tesselacauda depressa* Ross, 1951, p. 130, Pl. 31, figs. 27-31; Pl. 34, figs. 1-4, 18.

*Discussion*.—This form is common in both sections studied and is commonly well preserved. Its range extends into the "D" zone in section AA, somewhat lower than previously described.

*Occurrence*.—Zones "D" and "E", section AA; zone "E", section EE, Lower Fillmore Formation, Utah.

*Repository*.—Figured specimens are BYU 1619, 1622, and 1626.

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