Leperditicopid Ostracodes from Ordovician Rocks of Kentucky and Nearby States and Characteristic Features of the Order Leperditicopida

GEOLOGICAL SURVEY PROFESSIONAL PAPER 1066-J

Prepared in cooperation with the
Commonwealth of Kentucky,
University of Kentucky,
Kentucky Geological Survey

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By JEAN M. BERDAN

CONTRIBUTIONS TO THE ORDOVICIAN PALEONTOLOGY OF KENTUCKY AND NEARBY STATES

Edited by JOHN POJETA, JR.

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Descriptions and illustrations of 16 ostracode taxa, including 2 new genera, 3 new species, and 1 new subspecies, with discussions of their paleoecologic and stratigraphic significance

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SYSTEM OF MEASUREMENT UNITS

The investigations underlying this series of reports were made over a period of years, and distances and stratigraphic measurements appear fairly uniformly in English units. Measurements of fossil specimens, on the other hand, follow the longstanding convention of appearing in metric units. Because of the dates of the investigations and the amount of resulting data, the English measurements have been retained. Conversions to metric units may be made by using the following conversion table:

To convert English unit:	To metric unit:	Multiple by:
Mile (mi)	Kilometer (km)	1.61
Foot (ft)	Meter (m)	.305
Inch (in.)	Centimeter (cm)	.394

CONTRIBUTIONS TO THE ORDOVICIAN PALEONTOLOGY OF KENTUCKY AND NEARBY STATES

LEPERDITICOPID OSTRACODES FROM ORDOVICIAN ROCKS OF KENTUCKY AND NEARBY STATES AND CHARACTERISTIC FEATURES OF THE ORDER LEPERDITICOPIDA

By JEAN M. BERDAN

ABSTRACT

Leperditicopid ostracodes from the Ordovician formations of Kentucky occur in micritic to fine-grained carbonate rocks believed to represent shallow-water facies. They are found at widely separated horizons in the Middle Ordovician High Bridge Group, the Middle and Upper Ordovician Lexington Limestone, and the Upper Ordovician Ashlock, Bull Fork, and Drakes Formations. In this sequence, the leperditicopes are represented by two genera of leperditiids, *Eoleperditia* Swartz, 1949 and *Bivia* Berdan, 1976, and six isochilinid genera, *Isochilina* Jones, 1858, *Teichochilina* Swartz, 1949, *Ceratoleperditia* Harris, 1960, *Parabriartina* n. gen., *Kenodontochilina* n. gen., and *Saffordellina* Bassler and Kellett, 1934; the type species of the hitherto poorly known genus *Saffordellina, S. muralis* (Ulrich and Bassler, 1923), is redescribed and refigured. In all, 18 taxa, of which 2 are in open nomenclature, are described and illustrated. In addition, the family Isochilinidae Swartz, 1949 is redefined to include genera without marginal brims and with straight ventral contact margins. The morphological characteristics of leperditicopid genera are discussed, and a table listing described genera and their diagnostic features is included.

INTRODUCTION

This paper is one of a series describing various elements of the Ordovician fauna of Kentucky, based upon collections made during the course of a program to map the geology of the State conducted by the U.S. Geological Survey in cooperation with the Kentucky Geological Survey. A previous paper (Warshauer and Berdan, 1982) dealt with the palaeocopid and podocopid ostracodes of the Lexington Limestone and lower Clays Ferry Formation, which are Middle and early Late Ordovician in age. This paper contains descriptions and discussions of leperditicopid ostracodes from the High Bridge Group (Middle Ordovician), the Lexington Limestone (Middle and Upper Ordovician), and the Ashlock, Bull Fork, and Drakes Formations (Upper Ordovician). The collections from which ostracodes were obtained were made for megafossils such as brachiopods and pelecypods rather than for ostracodes; however, the large size of most leperditicopids makes them easy to see in the field, and it is probable that most if not all of the beds in which leperditicopids are abundant are represented in the collections. In all, 32 collections were made from 18 localities in 12 mapped 7.5-minute quadrangles, which are shown on figure 1. In addition to these recent collections by members of the U.S. Geological Survey, older collections in the U.S. National Museum of Natural History have been examined, and, where possible, the types of older genera and species have been refigured because many of the original illustrations are drawings that do not represent the characters of the described taxon adequately.

Of the 32 collections containing leperditicopid ostracodes, 8, or one-fourth of the total number, yielded silicified specimens. Of these, all but one are from the Lexington Limestone, the one exception is from the Ashlock Formation. Some of the silicified specimens show well-preserved muscle scars and details of the marginal structures, but in many the margins and especially the cardinal angles, which are used to determine species, are broken. Where possible, study and illustration of the silicified material have been supplemented by study of calcitic specimens from the same collection. The calcitic specimens were prepared by heating, quenching the rock in cold water, and cleaning the specimens with a vibratool and needle. The matrix in which the leperditicopes occur is generally very fine grained and does not separate easily from the shell; when broken or crushed, the rock tends to break

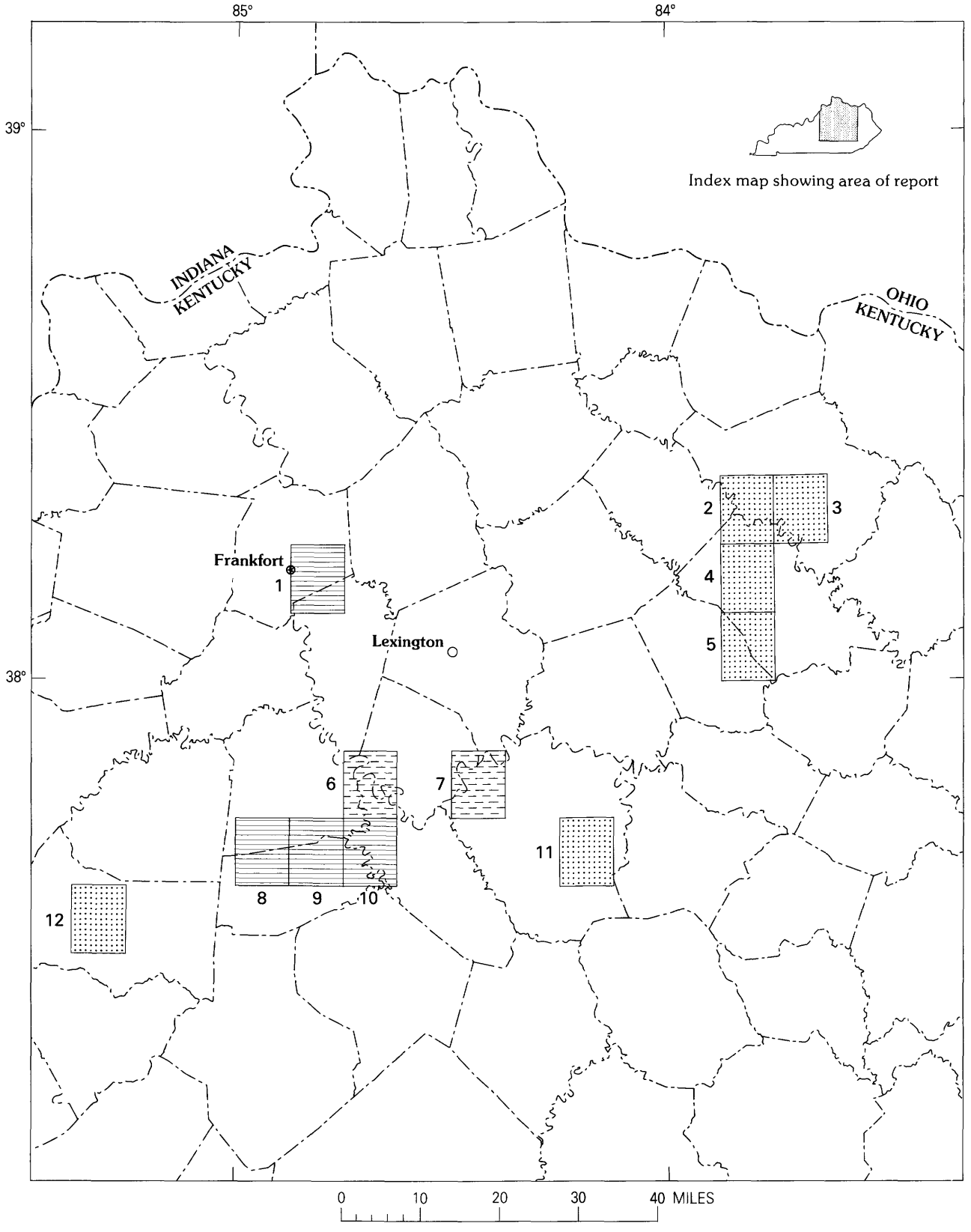

FIGURE 1.—Quadrangles in Kentucky from which collections of leperditicopes were made. Dashed lines represent quadrangles with outcrops of the High Bridge Group, solid lines those with outcrops of the Lexington Limestone, and the dotted pattern those with outcrops of Upper Ordovician formations. **1**, Frankfort East; **2**, Sherburne; **3**; Hillsboro; **4**, Owingsville; **5**, Preston; **6**, Wilmore; **7**, Valley View; **8**, Perryville; **9**, Danville; **10**, Bryantsville; **11**, Moberly; **12**, Lebanon West. Index map shows location of study area (shaded).

through rather than around the fossils. Consequently, preparation of specimens to show diagnostic features necessary for classification is a tedious and time-consuming process, and the number of specimens recorded for any species does not necessarily reflect the actual number of individuals in the collection. In addition, many specimens have been broken diagenetically in the matrix. Because of these limitations, no attempt has been made to carry out statistical studies, and for some taxa it has not even been possible to determine an ontogenetic series. Carapaces with both valves together in a natural position, neither sheared nor crushed, are extremely rare; this has impeded study of the amount and character of overlap in some taxa.

In spite of problems with the preservation of some of the collections from Kentucky, enough material is available to redescribe and evaluate the older taxa and distinguish two new genera, three new species, and one new subspecies. In addition, one formerly poorly known genus and species from Tennessee has been described and refigured for comparison with one of the new species from Kentucky. An extended section on the classification and morphology of the Order Leperditicopida has been included because much of the literature on this group is scattered and not readily available in English.

The type specimens of all new taxa are deposited in the United States National Museum of Natural History (USNM). In addition to other USNM material, specimens were borrowed from the Geological Survey of Canada (GSC) and one holotype was borrowed from the Walker Museum collections, formerly at the University of Chicago (UC) but now at the Field Museum of Natural History, Chicago, Ill.

ACKNOWLEDGMENTS

I am most grateful to F. J. Collier of the U.S. National Museum of Natural History and Murray J. Copeland of the Geological Survey of Canada for making types of leperditicopes in their respective institutions available to me. Especial thanks are due to John Pojeta, Jr., who, as editor of this series of publications on the Ordovician paleontology of Kentucky and nearby States, has provided invaluable assistance as well as most of the collections.

CLASSIFICATION AND MORPHOLOGY

The order Leperditicopida Scott, 1961 comprises large, generally smooth ostracodes which range from the Late Cambrian(?) (Frederickson, 1946, p. 578, text-figs. 1–3; Palmer, 1954, p. 774, pl. 91, figs. 14, 15, 17) through the Late Devonian (Abushik, 1964, 1979; Schevtsov, 1971). Although leperditicopes have been reported from rocks as old as Middle Cambrian (Abushik, 1960a), these have since been reclassified as belonging in the order Bradoriida by Jones and McKenzie (1980, p. 207). Abushik (1979, p. 31) stated that no reliable data confirm the presence of leperditicopes in the Cambrian or in the Carboniferous. Because of their large size and abundance in certain beds, leperditicopes came early to the attention of paleontologists, and an extensive descriptive literature was developed throughout the 19th and 20th centuries. Detailed morphologic studies were not begun until the latter half of the 20th century, initiated by Swartz (1949) and signally extended by Abushik (1960b). However, because much of the literature is scattered, not readily available, or not in English, it seems desirable to present a brief review of the order here.

Most leperditicopes were identified as *Cytherina* until the middle of the 19th century. An abbreviated chronological account of the development of the suprageneric classification of leperditicopes follows below.

1851. Rouault proposed the genus *Leperditia* with *Leperditia brittanica* as the type species.
1856. Jones proposed the family Leperditidae which he put questionably under the Phyllopoda, and described five species.
1858. Jones suggested *Isochilina* as a subgenus of *Leperditia*, with *Isochilina ottawa* as the type species.
1923. Ulrich and Bassler restricted the family Leperditiidae Jones to three genera, *Leperditia* Rouault, *Isochilina* Jones, and *Saffordella* (sic) Ulrich and Bassler.
1934. Bassler and Kellett introduced the superfamily Leperditacea to include the families Leperditiidae and Leperditellidae and corrected the junior homonym *Saffordella* to *Saffordellina*.
1949. Swartz proposed that the Isochilininae be separated as a subfamily from the Leperditiinae in the family Leperditiidae.
1953. Henningsmoen considered that the superfamily Leperditacea included the Leperditiidae but questioned the inclusion of the Leperditellidae.
1953. Pokorný introduced the suborder Leperditiida because he considered the character of the muscle scars and the presumed presence of a heart to be primitive characters.
1958. Pokorný raised the Leperditiida to an order which included only the family Leperditiidae with the subfamilies Leperditiniinae and Isochilininae.
1960. Ivanova proposed the subclass Ostracodoidea to contain the three orders Bradoriida Raymond, 1935, Leperditiida Pokorný, 1953 and Ostracoda Latreille, 1804.
1960. Abushik, Zanina, and Polenova considered the Leperditiida as a suborder of the order Palaeocopida Henningsmoen, 1953 which included the families Leperditiidae (with subfamilies Leperditiinae and Hermanninae Abushik, 1960), and Isochilinidae, but they also included the superfamily Aparchitacea in the suborder Leperditiida.
1961. Scott introduced the term Leperditicopida as an order, to include only the families Leperditiidae and Isochilinidae. As thus constituted, the order Leperditicopida Scott, 1961 is an exact equivalent of the order Leperditiida Pokorný, 1953. Scott's nomenclature is used here because in vernacular use

the term "leperditiid" could apply to either the order or the family and thus become a source of confusion.

The order Leperditicopida, as currently understood, consists of a group of about 35 genera. These have in common the ordinal characters of large size, large adductor muscle scars composed of many individual muscle stigmata (Scott, 1961; Gramm, 1982, p. 201–202; see pl. 4, fig. 1; pl. 9, figs. 8, 9), and an overlap of the right valve over the left (pl. 2, fig. 3). Leperditicopes tend to be postplete in lateral outline and to have the greatest width in the anterior half of the carapace (pl. 2, fig. 3); they also tend to develop tubercles (pl. 4, figs. 3, 5) on the anterodorsal part of each valve which are generally considered to represent the sites of eyes (Abushik, 1964, p. 217; 1966). The family Leperditiidae contains genera with markedly unequal valves that have a distinct overlap and a sinuous commissure in ventral view (pl. 3, fig. 6). The left valve commonly has a narrow stop ridge against which the ventral edge of the right valve fits (pl. 4, fig. 4). The family Isochilinidae, in contrast, contains genera with nearly equal valves that have little ventral overlap (pl. 8, fig. 4), and was defined by Swartz (1949, p. 310–311) as having a complete brim (pl. 9, fig. 3) around the free margins of both valves. Swartz (1949, p. 321) noted that some species then assigned to *Isochilina* have valves virtually equal, have a plane commissure in ventral view, but lack marginal brims (pl. 7, figs. 10–21). Such taxa are here considered to belong with the isochilinids rather than the leperditiids, and the family Isochilinidae Swartz, 1949 is redefined to include leperditicopes in which the ventral commissure is plane and there is no conspicuous overlap, although a marginal brim may be lacking. This results in classifying genera such as *Ceratoleperditia, Pteroleperditia, Kiaeria,* and *Parabriartina* with the isochilinids rather than the leperditiids.

In addition to the plane commissure and subequal valves of the isochilinids, they also tend to have more extreme lobation than the leperditiids; the muscle scar may be elevated on a boss, eye tubercles are more prominent, and additional lobation may be developed. The isochilinid genera also tend to have more diffuse and less well defined subocular scars than the leperditiids.

Features that have been used to differentiate leperditicopid genera include the lateral outline, the presence or absence of a posterodorsal swelling on the left valve or on both valves, the development of nodes or sulci, the character of the marginal structures, the type of muscle scars, and the type of hingement. These characters, and the terminology used for them in this paper, are shown diagrammatically in figure 2. The sketches are composite and do not represent any single genus. In the interests of simplicity, a few features mentioned in the text have been omitted, such as the trailing chevron scar of genera like *Gibberella* (see Abushik, 1960b, fig. 22) and *Dihogmochilina* (see Copeland, 1970, pl. 2, fig. 19) and the ventral alar projection of genera like *Ceratoleperditia* (pl. 7, figs. 18–21). It should be noted that the cross section of a leperditiid is based on actual specimens of *Eoleperditia* (pl. 1, figs. 1, 2), whereas that of the isochilinid is largely deduced from nonarticulated specimens.

The left valve of the leperditiids has a ventral overlap platform (fig. 2; pl. 1, fig. 6; pl. 4, fig. 4) which is usually bounded by a stop ridge that receives the edge of the ventral lappet of the right valve. This overlap platform is always developed to a greater or lesser degree in leperditiids; it may be present in isochilinids, but where present it is very narrow (pl. 8, fig. 4). In addition to the stop ridge, the overlap platform may have a very fine ridge parallel to the contact margin (pl. 1, fig. 6; pl. 6, fig. 14), here termed the selvage (not shown on fig. 2).

Table 1 lists described leperditicopid genera arranged in approximate stratigraphic order, and the characters that have been used to define them. This table is based as much as possible on the original descriptions of the type species of each genus, but has been supplemented by later studies, especially those of Abushik (1960b, 1964) and Copeland (1962, 1970). No attempt has been made to indicate relationships below the family level or to suggest possible synonymy. Some of the characters listed are of ordinal or familial rank, but were included because either they were mentioned in the original description or they can be determined from illustrations; they provide information on the taxonomic position of the genus. Names in parentheses below the generic names are those of the type species. Although the genera in table 1 are divided into the families Leperditiidae and Isochilinidae, further study may show that some of them should be reassigned because of the revised family diagnoses. The genus *Briartina* Kegel, 1933 is here classified with the leperditiids because the type species, *B. quenstedti* Gümbel, 1874 is figured by Kegel (1933, p. 925, fig. 12) with an overlap platform, although the new genus *Parabriartina* is considered an isochilinid because of its narrow platform and straight ventral margin. Although *Moelleritia* Abushik, 1968 and *Paramoelleritia* Wang, 1976 may have straight ventral margins, they are here left under the Leperditiidae because Copeland (1962, p. 4, fig. 1) shows a wide overlap platform on *M. canadensis.* Further study of the ventral margins of these genera would be desirable.

One of the problems with leperditicopid classification at the generic level is that many of the features used to

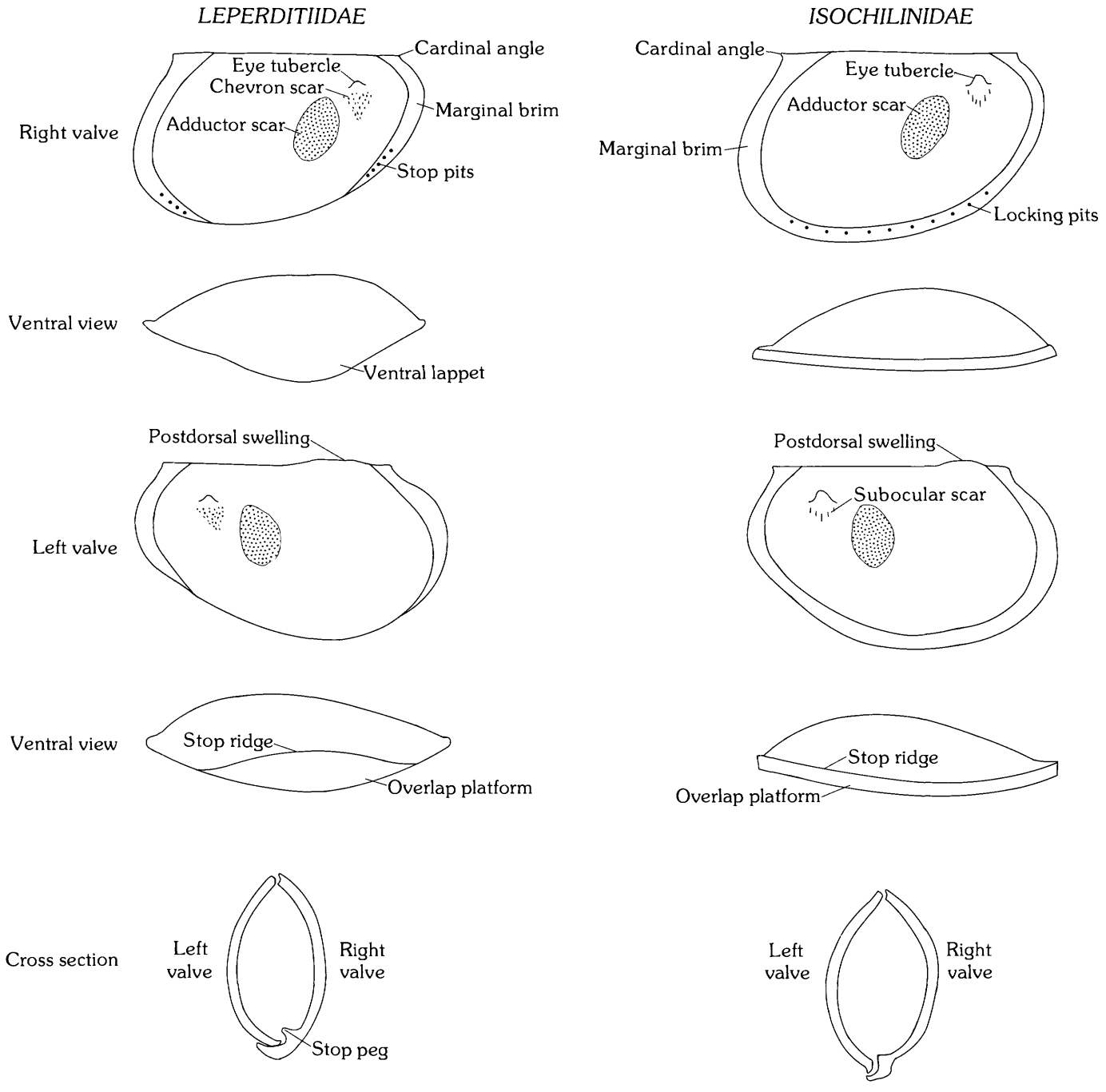

Figure 2.—Generalized diagram showing characters of leperditicopes and the terminology used for them in this report.

define genera are visible only on well-preserved specimens. Kegel (*in* Paeckelmann, 1922, p. 16) and Swartz (1949, p. 308) considered the presence or absence of a taxodont hinge as a generic character, but, as may be seen from table 1, this feature is not certainly known for most genera because of the difficulties in preparing specimens so that the hinge may be studied. In general, taxodont hingement has not been found in Ordovician genera, and the tongue-and-groove hingement characteristic of Ordovician forms may persist into the Devonian, as shown by *Chevroleperditia* Swartz, 1949, now known to be a Devonian genus (Pojeta, Kříž, and Berdan, 1976, p. 8). Further study of the hingement of most leperditicopid genera is needed.

Other structures which may be difficult to determine and which have been used to differentiate leperditiid

TABLE 1.—*Genera of leperditicopid ostracodes and their distinguishing characters arranged in stratigraphic order and by family*

[o.p., overlap platform; RV, right valve; LV, left valve. Characters not mentioned in the original description are indicated by dashes]

Genus	Outline	Overlap	Marginal structures	Hinge	Muscle scars	Other features	Age
LEPERDITIIDAE							
Bivia Berdan, 1976 (*Leperditia bivia* White, 1874)	Amplete	RV/LV, ends flattened.	2–3 stops on RV.	Tongue and groove.	Adductor, subocular scar may be present.	Eye tubercle small or lacking, o.p. on LV	Middle to Late Ordovician.
Eoleperditia Swartz, 1949 (*Cytherina fabulites* Conrad, 1843)	Postplete	RV/LV, no brim.	8–10 stops on RV.	Tongue and groove.	Adductor only.	More or less distinct eye tubercle	Middle to Late Ordovician.
Anisochilina Teichert, 1937 (*A. punctulifera* Teichert, 1937)	Slightly postplete.	RV/LV very slight.	Stop ridge on LV.		Adductor only.	Eye tubercle low and obscure, greatest gibbosity ventral.	Ordovician.
Heterochilina Poulsen, 1937 (*H. obliqua* Poulsen, 1937)	Slightly postplete.	RV/LV	Stops on inner edge of RV, "long row" of papillae.			Eye tubercle, anteroventral ridge parallel to free margin on RV only, thickening along dorsal margin of LV. Undefined sulcus behind eye tubercle on both valves.	Ordovician.
Paraeoleperditia Adachi & Igo, 1980 (*P. fukujiensis* Adachi & Igo, 1980)	Postplete	RV/LV slight on ventral margin, brims on ends.		Taxodont	Adductor large, trailing chevron.	Eye tubercle large, "venose lines" radiate from adductor.	Ordovician.
Sibiritia Abushik, 1958 (*Leperditia wiluiensis* F. Schmidt 1873).	Postplete	RV/LV strong anteroventral.	4–10 stops		Adductor and small chevron.	Eye tubercle distinct, postdorsal swelling on LV.	Early to Middle Silurian.
Tollitia Abushik, 1960 (*T. bitorosa* Abushik, 1960)	Postplete	RV/LV?, gape anteroventral.	Off-center stop ridge and ventral lappet.		Adductor and good chevron.	Eye tubercle small, postdorsal swelling on LV, also anteroventral and postventral swellings inside end margins.	Silurian.
Bispinitia Abushik, 1962 (*B. uralica* Abushik, 1962)	Nearly amplete.	RV/LV, brim on RV dorsal only, brim on LV extends ventrally.			Adductor and chevron.	Eye tubercle indistinct. Ends of RV drawn out into spines, ends of LV sharply angular. No postdorsal swelling on LV.	Late Silurian.
Schrenckia Glebowskaya, 1949 (*Cypridina grandis* Schrenk, 1854; see Bassler and Kellett, 1934, p. 386)	Postplete	RV/LV slight, ends flattened.	2 large serrated stops.		Adductor and irregular chevron.	Eye tubercle usually prominent, adductor often raised, postdorsal swelling on both valves of some species.	Late Silurian.

TABLE 1.—*Genera of leperditicopid ostracodes and their distinguishing characters arranged in stratigraphic order and by family*—Continued

Genus	Outline	Overlap	Marginal structures	Hinge	Muscle scars	Other features	Age
LEPERDITIIDAE							
Yukopsis Copeland, 1966 (*Y. jobi* Copeland, 1966)	Postplete	RV with lappet, brims on ends.	No stops	----------	Adductor in sulcus.	Node in position of eye tubercle, low postdorsal nodes extending to or above dorsal margin, ventromedian boss or spine. Dorsal and free margins spinose or tuberculate, surface pustulose.	Late Silurian.
Leperditia Rouault, 1851 (*L. brittanica* Rouault, 1851)	Postplete	RV/LV strong-	Stop ridge on LV, o.p.	Taxodont	Adductor and chevron.	Eye tubercle may or may not be present, postdorsal swelling on LV only.	Silurian to Devonian.
Herrmannina Kegel, 1933 (*Herrmannella waldschmidti* Paeckelmann, 1922)	Postplete	RV/LV	Stop ridge on LV, o.p.	Taxodont	Adductor and chevron.	Eye tubercle may or may not be present, postdorsal swelling lacking.	Silurian to Devonian.
Paenaequina Solle, 1935 (*P. pentagonalis* Solle, 1935)	Amplete	RV/LV slight, marginal brim nearly complete.	4–6 stops on RV at ends of brim.	----------	----------	Eye tubercle well developed, type sp. with distinct ventral bulge.	Late Silurian to Middle Devonian.
Chevroleperditia Swartz, 1949 (*C. chevronalis* Swartz, 1949)	Postplete	RV/LV	Stop ridge on LV?	Tongue and groove.	Adductor and small chevron.	Eye tubercle distinct, no postdorsal swelling.	Devonian.
Paraleperditia Sun, 1978 (*P. zhongquoensis* Sun, 1978)	Postplete	RV/LV large-	Stop ridge on LV.	----------	----------	Eye tubercle distinct. Postdorsal swelling on both valves, hinge line incised. Very large.	Early Devonian.
Eomoelleritia Abushik, 1972- (*E. kondiaini* Abushik, 1972)	Postplete	RV/LV, ends flattened.	Stop ridge and o.p. on LV.	----------	Adductor and chevron.	Eye tubercle present, more or less distinct, no dorsal inflation.	Early Devonian.
Moelleritia Abushik, 1958 (*Leperditia moelleri* F. Schmidt, 1883)	Postplete	RV/LV slight, ends flattened.	Stop ridge and small o.p. on LV.	Finely taxodont.	Adductor and chevron.	Eye tubercle large, prominent dorsal swellings on both valves.	Early to Middle Devonian.
Paramoelleritia Wang, 1976- (*P. xiangzhouensis* Wang, 1976)	Slightly postplete.	RV/LV large? brims on ends.	----------	----------	Adductor and trailing chevron.	Eye tubercle large, valves inflated dorsally behind eye tubercle.	Middle Devonian.
Briartina Kegel, 1933 (*Leperditia quenstedti* Gümbel, 1874)	Amplete	RV/LV	Small o.p.	----------	Adductor and chevron.	Supposedly like *Leperditia* except for outline.	Devonian.

TABLE 1.—*Genera of leperditicopid ostracodes and their distinguishing characters arranged in stratigraphic order and by family*—Continued

Genus	Outline	Overlap	Marginal structures	Hinge	Muscle scars	Other features	Age
ISOCHILINIDAE							
Tirisochilina Berdan, 1976— (*T. juabaria* Berdan, 1976)	Postplete	RV/LV slight-	No stops, narrow o.p.		Adductor only-	Eye tubercle small, no postdorsal swellings, most species punctate.	Early to Middle Ordovician.
Isochilina Jones, 1858 (*I. ottawa* Jones, 1858)	Almost amplete.	Complete brim, overlap not apparent.	Many stops on RV.		Adductor and subocular scar.	Eye tubercle distinct, weak sulcus above adductor and behind eye. In some species, node posterior to postocular sulcus.	Ordovician.
Teichochilina Swartz, 1949 – (*Isochilina jonesi* Wetherby, 1881)	Postplete	Complete brim, narrow on LV.	2–3 stops on RV.	Adont	Adductor and subocular scar.	Eye tubercle distinct, may be inconspicuous depression behind it.	Ordovician.
Parabriartina n. gen. (*Briartina modesta* Ulrich & Swain, 1957)	Amplete	No brim, RV/LV slight.	Several small stops?		Adductor only.	Eye tubercle very low	Middle Ordovician.
Ceratoleperditia Harris, 1960– (*C. arbucklensis* Harris, 1960)	Postplete	RV/LV slight-	No stops		Adductor only-	Eye tubercle low or absent, subcentral alar projection on both valves, postdorsal swelling on LV.	Middle Ordovician.
Kenodontochilina n. gen. (*K. pustulosa* n. sp.)	Amplete	Complete wide brim.	No stops	Adont	Adductor only-	Eye tubercle large, adductor scar raised above valve surface and bounded by sulci, dorsal node postdorsal of adductor.	Middle to Late Ordovician.
Saffordellina Bassler and Kellett, 1934 (*Saffordella muralis* Ulrich and Bassler, 1923)	Amplete to slightly postplete.	Nearly equivalved, wide brim.	No stops		Adductor only-	Eye tubercle prominent, adductor scar raised on prominent node, dorsocentral node postdorsal of adductor, other nodes may be present. Distinct ridge roughly parallel to free margins.	Middle to Late Ordovician.
Dihogmochilina Teichert, 1937 (*Isochilina grandis latimarginata* Jones, 1891)	Slightly postplete.	Complete brim.	No stops		Adductor and trailing chevron parallel to adductor.	Eye tubercle distinct, sulcus behind it forks to go on either side of adductor.	Ordovician to Silurian.
Gibberella Abushik, 1958 (*Leperditia chmielewskii* F. Schmidt, 1900)	Nearly amplete.	RV/LV slight to distinct.	No stops?		Adductor and indistinct chevron.	Eye tubercle prominent; short, distinct triangular sulcus behind it. Large swelling on middorsum of both valves. Very large.	Early to Middle Silurian.
Pteroleperditia Hamada, 1959 (*Herrmannina ehlersi* Kesling, 1958)	Slightly postplete.	RV/LV, ends flattened.		Finely taxodont.	Adductor and chevron.	Eye tubercle distinct, postdorsal swellings on both valves, anteroventral alar projection.	Early to Middle Silurian.

TABLE 1.—*Genera of leperditicopid ostracodes and their distinguishing characters arranged in stratigraphic order and by family*—Continued

Genus	Outline	Overlap	Marginal structures	Hinge	Muscle scars	Other features	Age
ISOCHILINIDAE							
Kiaeria Glebowskaya, 1949 – (*Leperditia kiaeri* Glebowskaya, 1949)	Postplete ----	RV/LV slight–	2 stops ------	----------	Adductor and small chevron.	Eye tubercle prominent, postdorsal swelling on both valves, midventral alar projection.	Late Silurian.
Sollenella Abushik, 1960 --- (*S. subquadrata* Abushik, 1960)	Amplete to slightly postplete.	Nearly equivalved, complete brim.	Stop pits on margin.	----------	Adductor large, and trailing chevron.	Eye tubercle small to inflated, no postocular sulcus. Post-Llandovery spp. with swelling over adductor.	Early Silurian to Middle Devonian.
Swartzochilina Scott, 1956 -- (*Dihogmochilina straitcreekensis* Swartz, 1949)	Strongly postplete.	Nearly equivalved, complete brim.	No stops-----	----------	Adductor small, cut by furrow, large chevron.	Eye tubercle prominent, 4 distinct pits anterior to it. Large subtriangular postocular sulcus.	Late Silurian.
Hogmochilina Solle, 1935--- (*Isochilina (H.) elliptica* Solle, 1935)	Amplete to slightly postplete.	Nearly equivalved, complete brim.	----------	----------	Adductor and trailing chevron (Abushik, 1960).	Eye tubercle distinct, sulcus curves anteriorly around it; larger sulcus between eye tubercle and adductor.	Silurian to Devonian.
Holtedahlites Solle, 1936 --- (*Holtedahlina teres* Solle, 1935)	Amplete-----	RV/LV, brim complete on RV, narrow or lacking on LV.	Row of stops—	----------	Adductor large, chevron?.	Eye tubercle distinct, no sulcus behind it —	Early Devonian.
?*Dalelina* Sun, 1978 ------- (*D. quangxiensis* Sun, 1978)	Postplete ----	Complete brim very narrow ventrally.	----------	----------	Adductor and trailing chevron.	Eye tubercle large, sulcus behind it divides to go on either side of adductor.	Early Devonian.

genera since Swartz (1949, p. 308–309) called attention to their value are those along the free margins of both valves. These structures include prongs or pegs in the right valve that may or may not be reflected as pits on the exterior of the valve. These pegs presumably served as stops for the edge of the left valve (Ulrich, 1891, p. 174; 1894, p. 633, 635) as shown on plate 1, figures 1, 2. However, in some species the internal pegs may not be reflected externally by pits; on some specimens when wetted the pegs may be seen as dark spots. Swartz (1949, p. 309) thought that post-Ordovician leperditiids lacked marginal stop pegs in the right valve; however, several Silurian and Devonian genera have been described that have these structures, as shown in table 1.

Abushik (1960b, p. 11) called attention to a series of smaller pits and pegs on the ends of the right valve on the flattened margins of the Silurian leperditiid genus *Sibiritia* Abushik, 1958; she differentiated these from the stop pits and considered them "locking pits." She compared them with pits on the right valve of *Isochilina ottawa* Jones, 1858 as figured by Swartz (1949, pl. 67), and also shown on the paratype (GSC 1077a; pl. 8, fig. 2), and concluded that the "locking" pegs represented by the pits might have fitted into sockets on the interior of the left valve, and thus a tight seal was provided. The marginal structures of the isochilinids are less well known than those of the leperditiids; locking pegs may or may not be present, but as yet I have seen no indication of sockets into which they might fit.

One feature that has been used to distinguish genera is a posterodorsal swelling of the left or of both valves. The posterodorsal swelling of the left valve in the genus *Leperditia* Rouault, 1851, redescribed by Grekoff (1967), is the only character that separates *Leperditia* from *Herrmannina* Kegel, 1933. Abushik (1960, *in* Abushik, Zanina, and Polenova) proposed the subfamilies Leperditiinae and Herrmannininae in the family Leperditiidae on the basis of the presence or absence of posterodorsal swellings. However, although maintaining the subfamilies, Abushik (1964, p. 217) noted that the posterodorsal swelling of the left valve could be present or absent in specimens of *Schrenckia grandis* (Schrenk, 1852) from the same sample; later, Abushik (1979, p. 31) did not mention the subfamilies. In addition to *Leperditia*, leperditiid genera that have left-valve posterodorsal swellings are *Sibiritia* Abushik, 1958, *Tollitia* Abushik, 1960, *Schrenckia* Glebowskaya, 1949, *Bivia* Berdan, 1976, *Paraleperditia* Sun, 1978 and *Yukopsis* Copeland, 1966. Other genera, such as *Moelleritia* Abushik, 1978 and *Paramoellerita* Wang, 1976, have posterodorsal swellings in both valves, as does the isochilinid genus *Gibberella* Abushik, 1958. Three additional isochilinid genera that have posterodorsal inflation are *Ceratoleperditia* Harris, 1960, *Pteroleperditia* Hamada, 1959 and *Kiaeria* Glebowskaya, 1949; these genera also differ from other leperditicopes in having ventral alar projections and may form a phylogenetic series as suggested by Abushik (1979, pl. 1, p. 34).

Abushik (1964, p. 217) considered the presence of eye tubercles (pl. 3, figs. 5, 8) to be an ordinal character, although in some taxa these structures may not be visible on the exterior. However, their position is commonly marked by a thinning of the shell that is reflected as a node on steinkerns or as a translucent spot on wetted specimens. Langer (1973, p. 45) noted that as long ago as 1873 Fr. Schmidt commented on the thinning of the shell at these tubercles and suggested that they marked the position of eyes. According to Langer (1973, p. 45, pl. 12, fig. 5), the structure of the shell wall does not change at the eye tubercle, but, although there is no indication of a lens, he considered the tubercle as probably translucent during the lifetime of the animal and as the site of a light sensitive organ.

Grooves, furrows, or sulci have been used as distinctive characters for some leperditicopid genera. These grooves or sulci appear to be due to the relative elevation of the eye tubercle, adductor scar, or other features above the surface of the valve, and thus differ from palaeocopid sulci, which are generally well-defined depressions below the valve surface. These features are more characteristic of isochilinid genera such as *Isochilina* Jones, 1858, *Teichochilina* Swartz, 1949, *Dihogmochilina* Teichert, 1937, *Gibberella* Abushik, 1958, *Swartzochilina* Scott, 1956, *Hogmochilina* Solle, 1935 and *Dalelina* Sun, 1978, although the little known leperditiid genus *Heterochilina* Poulson, 1937 is reported to have a poorly defined sulcus behind the eye tubercle (Poulson, 1937, p. 60). An extreme development of the elevation of eye tubercles and muscle scars is seen in the aberrant Ordovician isochilinid *Saffordellina* Bassler and Kellett, 1934 (pl. 11, figs. 1–4) in which the eye tubercle is a prominent node and the adductor is raised on a distinct subcircular anterocentral boss; in addition, other nodes and ridges are developed. An apparent exception to the tendency for the adductor muscle scar to become elevated is seen in the Late Silurian leperditiid genus *Yukopsis* Copeland, 1966, which Copeland (1966, p. 49) described as having the adductor scar located within the ventral end of a poorly defined sulcus. In general, adductor scars are more apt to be depressed in leperditiids, even if only slightly; in isochilinids they are nearly always raised to a greater or lesser degree.

One of the more important characters used to discriminate genera among the leperditicopid ostracodes

is the character of the muscle scars. In general, all leperditicopes have a large oval adductor field in the anterocentral part of the valve (pl. 6, figs. 11, 13, 16), which in post-Ordovician genera is supplemented by a V-shaped or chevron-shaped field beneath the eye tubercle. A complex chevron scar is lacking in Ordovician leperditicopes, but both leperditiids (pl. 4, fig. 1) and isochilinids (pl. 9, figs. 8, 9) may have vertically elongated subocular muscle stigmata in the same position as the chevron scar. Abushik (1960b, p. 16–29) studied the adductor and chevron muscle scars of Silurian genera in detail and investigated the shapes and number of individual stigmata in both. She observed that the stigmata tend to be subdivided in some leperditiid genera and suggested the use of the terms "primary" and "secondary" to distinguish the undivided stigmata from those that are divided (Abushik, 1960b, p. 18). According to Abushik (1960b, p. 18), secondary stigmata are not present in the isochilinids and in Ordovician leperditiids, may be present in Silurian leperditiids, and are always present in Devonian leperditiids; she suggested that the splitting of the stigmata is related to an increase in carapace size and consequent need for more muscle fibers by the animal, although equally large isochilinids do not show this division. Abushik (1960b, figs. 7–22) illustrated the chevron scars of Silurian species of the leperditiid genera *Sibiritia, Leperditia, Schrenckia, Herrmannina, Tollitia,* and Devonian *Moelleritia,* and Silurian species of the isochilinid genera *Hogmochilina* and *Gibberella.* She concluded (Abushik, 1960b, p. 29) that the characters of the chevron scars may be useful for distinguishing genera in the Leperditicopida.

The function of the muscles that formed the chevron scar has not yet been determined, although several suggestions have been made. Triebel (1941, p. 332) referred to the figure of the Silurian species *Leperditia hisingeri* Schmidt, 1873 published by Chmielewski (1900, pl. 2, fig. 55), which shows the stigmata of the chevron encircling the eye tubercle, and proposed that the muscles were connected to the eyes. Swartz (1949, p. 307) considered that the chevron might have been made by muscles connected to the mouth parts. Pokorný (1958, p. 124, 126), following Scott (1951, p. 324, pl. 51, fig. 2) attributed this scar to the antennal muscles. Abushik (1960b, p. 27) suggested that the chevron was caused by mandibular muscles, although she noted that a distinct chevron is lacking in the Ordovician genus *Eoleperditia* and that it is highly unlikely that *Eoleperditia* did not have these muscles. Possibly the chevron scar represents the point of attachment of an additional adductor muscle, as demonstrated by Anderson (1974, p. 83–85) for the living marine ostracode *Cytheridea papillosa* (Bosquet, 1851). However, it seems most probable to me that the chevron and other subocular scars (pl. 4, fig. 1; pl. 9, figs. 8, 9) were made by antennal muscles. Regardless of the function of the muscles attached to the chevron and other subocular scars, the increase in size and complexity of these scars from the Ordovician through the Devonian suggests a progressive change in the living habits of the Leperditicopida.

In addition to the adductor and subocular scars, two other groups of smaller scars have been recognized in the leperditiids (Abushik, 1960b, p. 16–17, fig. 6)—the anterior pre-ocular group and the anterodorsal group. The individual stigmata composing these scars are so small that they are difficult to determine on most specimens where the scars can be seen, and consequently they have not been used for classification. Swartz (1949, p. 307, pl. 65, figs. 9, 15; pl. 66, fig. 4), Scott (1951, p. 322–323, pl. 51, figs. 2, 4) and Abushik (1960b, p. 17, fig. 6) illustrated these scars. Swartz (1949, p. 307) suggested that they represented muscles attached to the foregut, but did not rule out the possibility that some were connected to the appendages. Scott (1951, p. 324, pl. 51, fig. 4), working with well-preserved material of the Ordovician species *Eoleperditia fabulites,* designated the scars by letters and considered that the anterior pre-ocular group, his scars a, a′ and b as well as the subocular b′, were made by muscles attached to the antennules and antennae, and that the anterodorsal group, his scars c–f, were possible endoskeleton scars or of unknown origin, except for c and c′, which he believed were mandibular. Abushik (1960b, p. 27–29) rejected Scott's placement of the mandibular scars in the anterodorsal group because of their position above the adductor scar, and suggested that some of the scars anterior to the eye tubercle figured by Swartz and Scott might have had the same function as the chevron scar, by her inference, mandibular. Abushik (1960b, p. 29) also noted that the scars of the anterior pre-ocular and anterodorsal groups are fairly stable through time and cannot be used for classification. These scars are difficult to see and have not yet been found in the isochilinids, although presumably they are present. Neither group of scars can be readily recognized on any of the specimens from Kentucky.

A feature of the interior of the leperditicopid valve that has apparently not been reported by previous workers is the presence in the anterior and anteroventral part of scattered low tubercles (pl. 4, fig. 1; pl. 8, fig. 5; pl. 9, figs. 8, 9). These have been found in silicified specimens of *Teichochilina jonesi* (Wetherby, 1881) and as impressions on a steinkern of *Bivia tumidula* (Ulrich, 1891); their significance is not known. They do not appear to be related to the tubercles composing the muscle scars; possibly they

represent some sort of attachment of the shell to the inner lamella. They are in the same position as the "venose lines" illustrated by Scott (1951, pl. 51, fig. 2) for *Eoleperditia fabulites*, and may be comparable to them, but the features on Scott's specimen and *T. jonesi* and *B. tumidula* are disjunct, unlike true "vascular markings" (pl. 8, fig. 5) which are also posteroventral rather than anteroventral.

The wall structure of the leperditicopes was studied by Scott (1951, p. 323), Levinson (1951, p. 554, pl. 77, figs. 5a, b), Abushik (1960b, p. 12–13, pl. 1, figs. 1–4), Adamczak (1961, p. 63–67), and Langer (1971, p. 184–186; 1973, p. 38–45, pl. 11–15), among others. As noted by Adamczak (1961, p. 63) and Langer (1973, p. 38), the prismatic character of the leperditicopid shell has been recognized since the middle of the 19th century. The calcite prisms are oriented perpendicular to the surface of the shell, as shown by Langer (1973, pls. 13, 15) and Majewske (1969, pls. 17, 18). Scott (1951, p. 323) considered that the shell was composed of three layers, an inner and an outer dark layer and a light middle layer; Levinson (1951, p. 554) found two layers, a third layer being present on only one specimen. Abushik (1960b, p. 12) believed that there were four layers, an inner and an outer chitinous layer and between these an inner and an outer calcareous layer, the inner calcareous layer being yellowish in thin section and the outer calcareous layer being colorless and prismatic. Adamczak (1961, p. 63–64) recognized three layers, an outer dark layer, a median thick prismatic layer, and an inner dark layer. The most recent and most extensive study of leperditicopid wall structure was done by Langer (1973, p. 38–41); he concluded that there were two principal layers, the inner tabulatum fibrosum (= dark layer of this paper) and the outer tabulatum graviprismaticum (= prismatic layer of this paper). He considered an outermost layer of micritic structure to be due to diagenesis of the prismatic layer.

Some steinkerns of leperditicopid specimens show a pattern of raised ridges radiating from the adductor muscle scar; according to Triebel (1941, p. 331), these were observed as early as 1873 by F. Schmidt, who called them "Gefässe," or vessels. Triebel (1941, p. 331) described them as occurring on steinkerns of leperditiids and considered them to be marks of true blood vessels, with the consequent implication that the leperditiids possessed a heart. Pokorný (1953, p. 229–232; 1958, p. 124; 1965, p. 130–131) accepted this conclusion, as did most subsequent authors, and based his Order Leperditiida in part upon the presumed presence of a heart in this group. Adamczak and Weyant (1973, p. 524–526) discovered similar markings in the Devonian non-leperditicope genus *Rishona* Sohn, 1961 which they also considered as part of a vascular system. However, Sohn (1974, p. 725) questioned the interpretation of these structures as blood vessels because they appear to be within the calcified shell walls. Langer (1973, p. 45) noted that, in species of *Herrmannina*, these markings appear weakly after the upper surface of the valve is strongly etched but stated that their relationship to the shell structure was not known.

Some silicified specimens of *Teichochilina jonesi* (Wetherby, 1881) from the Devils Hollow Member of the Lexington Limestone (USGS colln. 5095–CO and 5087–CO, pl. 8, figs. 3, 5) show these radiating markings both on the inside and the outside of the valves. However, in these specimens the external markings on a partly corroded valve are finer and do not appear to correspond to the anastomosing channels seen on the interior. These external markings are almost certainly part of the valve structure. Langer (1973, p. 39–40, pl. 13, figs. 1, 2) showed that the calcite prisms of the prismatic layer are composed of transverse platelike elements (internodia), which interlock with those of adjoining prisms to strengthen the shell. Possibly the radiating ridges seen on the exterior of corroded specimens are sites where the internodia are denser or interlock more closely, and the ridges are devices to strengthen the valve against the pull of the adductor muscle. The radiating external ornamentation of *Saffordellina* (pl. 11, figs. 1–4) appears to be an extreme sample of this structure. This explanation does not apply to the radiating channels seen on the interior of the valves, which may well be the impressions of some sort of vascular structure.

Although leperditicopids have been generally considered to have thick or relatively thick shells (Swartz, 1949, p. 311; Scott, 1961, p. Q103; Abushik, 1964, p. 214; and others), their shells may be no thicker than those of many other ostracodes in proportion to the size of the leperditicopid carapace. This may be readily seen by comparing illustrations of thin sections of leperditiids with those of other ostracodes magnified to the same size. In addition, in many collections the leperditicopid valves after preparation prove to be diagenetically broken in the rock, which suggests that the shell structure was not particularly strong. Adamczak (1961, p. 63) and Rosenfeld (1979, fig. 3A) noted that several podocopid genera also have prismatic wall structure, although the prisms are smaller than those of the leperditicopid shell. However, as with the shell thickness, the relative size of the prisms is comparable in both groups.

The ontogeny of leperditiid ostracodes has been studied by Scott (1951) for the Ordovician species *Eoleperditia fabulites* (Conrad, 1843) and by Belak (1977) for the Lower Devonian species *Herrmannina*

alta (Conrad, 1841). Scott (1951, p. 323–325) considered that he had eight instars of *Eoleperditia fabulites* represented in his material, although he thought that nine might be present. Belak (1977, p. 945–951) found nine molt stages in *Herrmannina alta* and stated that Scott probably also had nine. Both authors found a certain amount of overlap in length and height measurements between molt stages. Belak (1977, p. 945) considered the growth of *H. alta* to be virtually isometric, although he noted that in *E. fabulites* the hinge length decreased significantly with respect to shell length throughout ontogeny. As yet no comparable studies have been done on isochilinids owing to lack of adequate material. However, although a complete series of instars is not available, juvenile specimens of *Ceratoleperditia kentuckyensis* (Ulrich, 1891) have less pronounced alar processes than presumed adults (pl. 7, figs. 16–20); allometry may be shown in the spine, which appears to have increased in relative size during ontogeny.

The question of possible sexual dimorphism in leperditicopid ostracodes has been raised by Abushik (1964) and Heidrich (1977). Abushik (1964, p. 217) suggested that the posterodorsal swelling of the left valve might be a dimorphic character, because it could be present or absent in specimens of the Silurian species *Schrenckia grandis* (Schrenk, 1854) from the same sample; she noted that if this proved to be true of other species, the distinction between the Silurian-Devonian genera *Leperditia* and *Herrmannina* and therefore the Leperditiinae and Herrmannininae would be invalid. Heidrich (1977, p. 7) assumed that dimorphism was shown by the degree of curvature of valves, swellings on dorsal or ventral margins, the position of greatest convexity, the width of the marginal brim anteriorly and posteriorly, and other features, including the stop pits on the right valve of *Schrenckia*. Schallreuter (1978, p. 6–7) discussed Heidrich's criteria and concluded that, although some of the features mentioned could be dimorphic, Heidrich's conclusion that the alar processes on the Silurian *Leperditia obesa* Kummerow, 1924 were developed to hold spermatozooids is unjustified because alar processes have been found on many species in immature instars, as in *Ceratoleperditia kentuckyensis*, whereas normally in ostracodes dimorphism cannot be determined before the A-3 growth stage. The same argument can be used against the suggestion by Abushik (1964, p. 217) that the posterodorsal swelling on several leperditiid genera is dimorphic, as it occurs in juvenile instars of *Bivia tumidula* (pl. 3, fig. 2). Whereas the probability is great that leperditicopids were sexually dimorphic rather than parthenogenetic, as noted by Schallreuter (1978, p. 6), dimorphism is not necessarily expressed in the carapace. As yet there is no unequivocal evidence of dimorphism in the leperditicopids.

Swartz (1949, p. 311) and some other authors suggested that the leperditicopes might not be ostracodes, and most recently Heidrich (1977) argued that they should be classed with the Entomostraca under the order Phyllopoda. Heidrich (1977, p. 2–3, fig. 1) based this changed classification in part on a specimen that he considered to show the body of a phyllopod in a valve of the Silurian *Leperditia baltica* (Hisinger, 1831). According to Schallreuter (1978, p. 2), the specimen described by Heidrich is now lost, but it was seen by Krömmelbein, who did not consider that the body and appendages shown by Heidrich belonged with the leperditiid valve, but were instead part of the spiralia of a brachiopod. This matter must remain unresolved until Heidrich's specimen, or others with appendages, are found, but, as noted by Schallreuter (1978, p. 2), even if the leperditicopid body were as indicated by Heidrich, this would not justify an assignment of the Leperditicopida to the Entomostraca. Schallreuter (1978, p. 2) cited the calcareous carapace, complete molting of entire carapace, and discrete valves not joined at dorsum as evidence of the ostracode affinites of leperditicopes, as none of these features is typical of entomostracans. Although the leperditicopes differ in many respects from other ostracodes, they are closer to ostracodes than to any other group of Crustacea and are here classified accordingly.

Criteria used to distinguish leperditicopid species are usually those of degree rather than kind, such as the relative width of the marginal brim, relative tumidity, degree of acuteness of the cardinal angles, lateral outline, ventral or end outline, surface ornamentation and similar features. Unfortunately, many of these characters, especially the form of the cardinal angles, are obscured or altered by poor preservation, and careful preparation of a number of specimens is usually necessary to determine which species of a genus is present.

PALEOECOLOGY

In order to provide a basis for comparison of the paleoenvironments inhabited by the Ordovician leperditicopes of Kentucky, I have here summarized some of the information on leperditicopes of other ages and areas. More information is available on the field occurrence and paleoecology of leperditiid ostracodes than of isochilinids, so most of the following comments, both published and unpublished, refer to leperditiids, although both families occur together in the Ordovician of Kentucky. Leperditiids tend to occur in large numbers, as dissociated valves representing several

molt stages, on bedding planes of fine-grained sedimentary rocks. Usually these are limestones or dolomites, but they may also be shales and siltstones. Some of the North American concentrations of leperditiids in carbonate rocks are found in the Lehman Formation (lower Middle Ordovician) of western Utah, the Leigh Dolomite Member of the Bighorn Dolomite (Upper Ordovician) of Wyoming, many horizons in carbonates of the midcontinent region of the United States and Canada (Middle Ordovician through Silurian), the Black River Group (Middle Ordovician) of New York, the Tonoloway Limestone (Upper Silurian) of Maryland, and the Manlius Limestone (Lower Devonian) of New York; many other formations could be cited. However, similar concentrations of leperditiids also occur in clastic rocks, such as the red shales and siltstones of the Grimsby Formation (Lower Silurian) as used by Fisher and others (1961) of New York and the gray shales and siltstones of the Eastport Formation (Lower Devonian) of Maine.

Walker and Laporte (1970, p. 934–936, 938–939), in comparing the paleoenvironments of the Manlius Limestone and the Black River Group, included leperditiid ostracodes in their supratidal and intertidal communities and interpreted them as benthonic surface-deposit feeders or scavengers. Belak (1977, p. 951) considered the leperditiids in the Manlius Limestone to have lived in an intertidal to very shallow subtidal environment and to have been poor swimmers, living on and within algal mats. Warshauer and Smosna (1977, p. 478), discussing leperditiids from the Tonoloway Limestone, also noted the relationship of these ostracodes to algal stromatolites and suggested that the leperditiids cropped the blue-green algae that formed the stromatolites; they considered that the sediments containing leperditiids were characteristic of a carbonate tidal flat. Johnson and Campbell (1980, p. 1045–1046), studying the Byron, Hendricks and Schoolcraft Dolomites of Ehlers and Kesling (1957) (Lower Silurian) of northern Michigan, proposed a fucoid-ostracode community (the ostracodes being leperditicopid genera), which they considered to be indicative of very shallow water of high salinity, where the environment at times bordered on that of an evaporite flat. They considered the fucoids to be trace fossils, unlike the interpretation of Scott (1951, p. 325), who reported a similar association of leperditiids with fucoids in the Platteville Limestone (Middle Ordovician) of Illinois but considered the fucoids to be algal remains.

Less information is available on the paleoenvironments inhabited by leperditiids found in clastic rocks. Fisher (1966, p. 6) considered the Grimsby Formation as used by Fisher and others (1961) to be a beach deposit where the leperditiids lived on intertidal flats and in lagoons behind sandbars. The leperditiid-bearing shales and siltstones of the Eastport Formation also contain beds that have several kinds of trace fossils, ripple marks, and mud cracks, which indicate a tidal-flat environment. The physical characteristics of the rocks containing North American leperditicopes strongly suggest that most of them lived in an intertidal to very shallow subtidal environment.

Few papers are available that specifically discuss the types of rock in which Eurasian leperditicopes are found or their paleoecological significance. Chmielewski (1900, p. 32–35) described the lithology and associated fauna for his leperditiids from the Baltic area; it is difficult to interpret the environment of deposition from his descriptions of hand specimens, but his reports of crystalline limestone as matrix for some species and the occurrence of graptolites with other species suggest a higher energy environment for some, and a deeper water environment for others than that postulated for the North American leperditicopes. Solle (1935, p. 54–58) listed the lithologies for the leperditicopes, mostly Devonian, that he described from Spitzbergen; many of these were found in sandstones and shales. Glebowskaya (1936, p. 9) briefly discussed the paleoecology of ostracodes in general, but because her paper is predominantly about leperditicopes, it seems likely that she was referring to this group when she noted that large numbers of ostracodes occurred in thin, laminated sandy or clay shale associated with rare and thin-shelled gastropods and pelecypods, and she suggested a lagoonal environment. Rein (1936, p. 77) gave the lithology of his samples and listed the associated fauna with the leperditicopes he described from Novaya Zemlya. In the Upper Silurian and Lower Devonian formations of Podolia, leperditiids are abundant and form bands of coquina in the Ivane horizon (Nikiforova and Predtechenskij, 1968, p. 33); although the ostracode coquinas are limestone bands, much of the Ivane horizon consists of green and red shales and siltstones, and probably represents a nearshore environment.

In discussing leperditicopes from the Silurian of the Baltic area, Heidrich (1977, p. 8) stated that they occur in reef limestone or reef flank deposits. Jaanusson (1979, p. 281), in a summary of the detailed analysis of the biota of the Wenlockian beds in the Vattenfallet section on Gotland, commented on the association of leperditiids with calcareous algae in Högklint *c* in the upper part of the section as resembling North American shallow-water occurrences, but noted that the Lower Visby Marl, in the lower part of the section, also contained leperditiids but on other grounds seemed to represent a low-energy, deeper water environment. He

concluded that on Gotland leperditiids are represented in, but not restricted to, shallow-water environments. The depth range for Eurasian leperditicopes thus appears to be somewhat greater than that postulated for most North American occurrences of this group.

Concerning the mode of life of the individual leperditicopid animal, some speculations have been made that are based on the shell morphology of leperditiids; isochilinids have not been discussed in this context. Scott (1951, p. 325–326), discussing the Ordovician species *Eoleperditia fabulites*, concluded that the "exceptionally strong appendage muscles" indicated an animal that was a capable swimmer, and, because he considered the associated fucoids to be algae, he suggested that these ostracodes were free-swimming vegetarians living in warm water from the surface to a depth not greater than that in which algae lived. Berdan (1969), working with Silurian and Devonian leperditiids, interpreted the chevron scars as indicating strong appendages capable of digging, and proposed that the large adductors, smooth shell, and marginal structures might represent an adaptation to temporary exposure to air, as in a tidal-flat environment. She suggested that the animals might have burrowed just below the surface of the mud when the tide went out, in the manner of modern intertidal arthropods. Langer (1973, p. 46) also considered the possibility that leperditiids might have burrowed in the mud. The Ordovician leperditiids, which lack prominent, well-developed subocular muscle scars, may not have been so well adapted to this mode of life. The Ordovician isochilinids, especially alate forms such as *Ceratoleperditia*, were almost certainly not burrowers. Their small subocular scars may have been related to appendages used to pump currents of water between the valves.

In the Ordovician rocks of Kentucky, leperditicopid ostracodes occur at horizons that are widely separated stratigraphically but are, with the exception of some of the Upper Ordovician formations, of very similar lithology. The oldest collections containing leperditicopes are from the Camp Nelson Limestone (Middle Ordovician) of the High Bridge Group, which Cressman and Noger (1976) and Cressman (written commun., 1982) interpreted as representing a shallow subtidal to tidal-flat environment. Two taxa of leperditicopes have been found in the Camp Nelson, the isochilinid *Parabriartina modesta* (Ulrich and Swain, 1957) and the leperditiid *Eoleperditia* sp. aff. *E. pauquettiana* (Jones, 1858). The collection (USGS colln. 7861–CO) from which *P. modesta* has been extracted is composed of dove-gray (light brownish gray, 5 YR 6/1 on the rock color chart; Goddard and others, 1948) micrite with irregular argillaceous yellowish mottling; other fossils in the collections are small pelecypods, gastropods, rare brachiopods, trilobites, and a few bits of echinoderm debris, indicating a shallow subtidal environment. The collections (USGS collns. D1144–CO, D1147–CO and D1358–CO) containing *Eoleperditia* sp. aff. *E. pauquettiana* are also generally dove gray, but only one (USGS colln. D1358–CO) is micritic; the other two are finely crystalline and contain brachiopods and small ostracodes such as schmidtellids and leperditellids. These collections also appear to represent a subtidal environment, on the basis of the number of brachiopods. *Parabriartina modesta* occurs at the bottom of the gorge at High Bridge, Wilmore quadrangle, and *Eoleperditia* sp. aff. *E. pauquettiana* has been found in the West Marble Creek section, Valley View quadrangle; the two taxa have not yet been found together.

The Tyrone Limestone, in the upper part of the High Bridge Group, contains the leperditiid *Eoleperditia fabulites* (Conrad, 1843) and the isochilinid *Ceratoleperditia kentuckyensis* (Ulrich, 1891). These species occur together in USGS collns. D1137–CO, D1138–CO, and D1141–CO from the West Marble Creek section, Valley View quadrangle. The matrix of these collections is dove-gray micrite, like that of the Camp Nelson Limestone, mottled with grayish-orange (approximately 10 YR 7/4) dolomite, which appears to be filling burrows. Some bedding planes (USGS colln. D1138–CO) are covered with single valves of *E. fabulites* that have random orientation and at least two or three instars represented. Other fossils associated with the ostracodes are infrequent strophomenoid brachiopods, pelecypods, and gastropods; some fragments of the coral *Tetradium* are present. The burrows are oriented horizontally along bedding planes, rather than being vertical; this suggests the subtidal environment described for the Tyrone by Cressman and Noger (1976, p. 7–8). The fine-grained matrix and the random orientation and size range of the leperditiid valves indicate a low-energy, possibly lagoonal, environment, but the salinity was apparently normal marine (Cressman and Noger, 1976, p. 10).

Most of the leperditicopes in our collections from the Lexington Limestone are from two horizons, the Faulconer and Salvisa Beds of the Perryville Limestone Member and the Devils Hollow Member. Cressman (1973, p. 24–25) described the Faulconer as a brownish-gray calcilutite and the Salvisa as interbedded light-gray to light-olive-gray calcilutite, like much of the limestone in the Tyrone Limestone, and brownish-gray calcilutite, like that of the Faulconer. Both lithologies contain *Bivia tumidula* (Ulrich, 1891) and *B. linneyi* (Ulrich, 1891); *Teichochilina jonesi* (Wetherby, 1881) appears to be restricted to the brownish-gray calcilutite. All the leperditicope species are represented by single valves, many of which were apparently broken during

early diagenesis; no carapaces have been found. The valves are oriented at random with respect to one another, and although generally parallel to the bedding surfaces, may also be at various angles in the matrix. There is no apparent size sorting, and several instars are present in most collections. Cressman (1973, p. 24–25) noted that whereas the Faulconer was fossiliferous, very few fossils were in the Salvisa. A collection (USGS colln. 7853–CO) from the upper unit of the Faulconer 1 foot below the Salvisa contains *Bivia tumidula* and *Teichochilina jonesi* associated with *Tetradium*, mollusks, inarticulate brachiopods, and small, smooth palaeocope and podocope ostracodes. Collections from the Salvisa contain trilobite and brachiopod fragments and small ostracodes, including the palaeocopid ostracodes *Ceratopsis intermedia* Ulrich, 1894, *C. asymmetrica* Warshauer and Berdan, 1982 and *Bolbopisthia sculptilis* (Ulrich, 1890) and the podocopid *Phelobythocypris cylindrica* (Hall, 1871).

The lack of complete carapaces in either the Faulconer or Salvisa suggests that many of the leperditicopes in these units may represent cast molts rather than dead animals. The lack of size sorting and the random orientation, together with the fine-grained matrix, indicate quiet water and little wave or current action. Cressman (1973, p. 29) considered that the Faulconer and Salvisa were separated from more normal marine waters to the north by a zone of calcarenite bars and were deposited in shallow, quiet water—the Faulconer in water of normal marine salinity, but the Salvisa in water of higher salinity.

Cressman (1973, p. 40–41) described the Devils Hollow Member of the Lexington Limestone as being composed of two intertonguing phases, a coquina of gastropod or brachiopod shells and a calcilutite similar to that of the Tyrone Limestone consisting of two closely related rock types, one light greenish gray or light gray and one brownish gray. The leperditicopes *Bivia frankfortensis* (Ulrich, 1891) and *Teichochilina jonesi* (Wetherby, 1881) are in the calcilutite; *B. frankfortensis* is in both rock types, but *T. jonesi* appears to be most abundant in the brownish-gray rock, as it was in the Salvisa. Cressman (1973, p. 41) noted that some of the light-gray calcilutite was laminated, which might indicate the presence of an algal mat, and interpreted the light calcilutite as forming just below water level and the dark calcilutite in water a few meters deep, both being deposited in quiet protected waters of relatively high salinity. The leperditicopids are oriented at random in the rock, and the presence of several instars indicates the lack of size sorting. The associated fossils are gastropods with whorls as large as 1.5 cm in diameter, fragments of inarticulate brachiopods, and the small ostracodes *Phelobythocypris cylindrica* (Hall, 1871) and *Uninodobolba franklinensis* Warshauer and Berdan, 1982.

Leperditicopes in our collections from the Upper Ordovician Ashlock and Bull Fork Formations are isochilinids belonging to three genera: *Isochilina, Saffordellina,* and *Kenodontochilina.* Most specimens are from the Sunset Member of the Ashlock and Bull Fork Formations, although some also occur in similar lithologies in the Gilbert and Grant Lake Members of the Ashlock Formation. The Sunset Member has been described by Weir, Peterson, and Swadley (in press) as pale-olive, greenish-gray and medium-gray micrograined to fine-grained limestone and light greenish-gray muddy limestone containing minor amounts of shale. Megafossils are few; Outerbridge (1970), Mytton and McDowell (1970), and Weir and McDowell (1976) reported a few irregularly shaped stromatoporoids, large brachiopods of the genera *Hebertella* and *Platystrophia,* and abraded gastropods and cephalopods. Smaller ostracodes found with the leperditicopes include the palaeocopes *Bolbopisthia* sp. and *Laccoprimitia* sp. and undetermined podocopes. In addition, in three collections (USGS 4318–CO, 9420–CO, and 9421–CO) from the Hillsboro and Sherburne quadrangles, the leperditicopes are associated with numerous plant remains, which have been interpreted by F. M. Hueber, U.S. National Museum of Natural History (written commun., 11/6/1963) as probable algae. The leperditicopes are represented by single valves; no carapaces have been found. More than one instar is represented, and the valves are usually approximately parallel to the bedding surfaces. Weir and Peck (1968, p. D168) interpreted the micrograined limestone lithofacies, which represents the Sunset and Gilbert Members (Weir, Peterson, and Swadley, 1979), as a very shallow quiet-water deposit, probably laid down in tide-level lagoons.

In summary, leperditicopes in the High Bridge Group and the Lexington Limestone occur in a micritic lithofacies and, especially in the Lexington, leperditiids and isochilinids occur together. In the Ashlock and Bull Fork Formations, the leperditicopes are found in muddier, micrograined limestones, and only isochilinids are represented. The lithostratigraphic evidence suggests that both facies were deposited in shallow to very shallow water, but there is no clear indication that the leperditicope-bearing beds were intertidal. That the isochilinids may have preferred slightly deeper water than the leperditiids is indicated by the presence of *Teichochilina jonesi* in the brownish-gray calcilutite of the Faulconer and Salvisa Beds of the Perryville Limestone Member of the Lexington Limestone, which Cressman (1973, p. 30) considered to have been deposited in somewhat deeper water than the light-

colored calcilutite. Possibly the isochilinids were filter feeders, as suggested by Adamczak (1969) for ostracodes with straight, symmetrical margins, whereas the leperditiids were deposit feeders or scavengers. A difference in feeding strategy might explain the occurrence of the two otherwise similar groups together in a very restricted habitat. Leperditicopids in general appear to have been euryhaline and to have lived mostly in an intertidal to shallow subtidal environment not deeper than the photic zone.

STRATIGRAPHIC OCCURRENCE

The restriction of leperditicopes to micritic or micrograined limestones means that they are found in widely separated stratigraphic horizons. As might be expected, each of the five leperditicope-bearing horizons has a different association of genera and species, which can be readily discriminated. The oldest of these is in the lower part of the Camp Nelson Limestone of the High Bridge Group, which contains *Parabriartina modesta* (Ulrich and Swain, 1957) and *Eoleperditia* sp. aff. *E. pauquettiana* (Jones, 1858). In the upper part of the High Bridge, in the Tyrone Limestone, *Ceratoleperditia kentuckyensis* (Ulrich, 1891) is associated with *Eoleperditia fabulites* (Conrad, 1843). The High Bridge Group is separated by a disconformity from the younger Lexington Limestone (Cressman, 1973, p. 10). In the Lexington, the leperditicope-bearing horizons are the Faulconer and Salvisa Beds of the Perryville Limestone Member and the somewhat younger Devils Hollow Member. The Salvisa is characteristized by *Bivia tumidula* (Ulrich, 1891), associated with *Teichochilina jonesi* (Wetherby, 1881), whereas although *T. jonesi* also ranges up into the Devils Hollow, *Bivia frankfortensis* (Ulrich, 1891) replaces *B. tumidula* in that member. The Lexington horizons are separated by a considerable thickness of limy shale and shaly limestone from the youngest horizons, principally the Sunset Member of the Bull Fork and Ashlock Formations, which contain *Isochilina copelandi* n. sp., *Kenodontochilina subnodosa glabra* n. subsp., *K. pustulosa* n. sp. and *Saffordellina striatella* n. sp. A possibly even younger sixth horizon may be represented by *Eoleperditia caecigena* (Miller, 1881), but this species was described from Indiana and has not been found in our collections from Kentucky.

The relative stratigraphic positions of leperditicope-bearing horizons are shown schematically on figure 3. No attempt was made to show the intricate facies relationships of the various formations and members of Middle and Upper Ordovician rocks of Kentucky, and the thicknesses shown are only approximate. However,

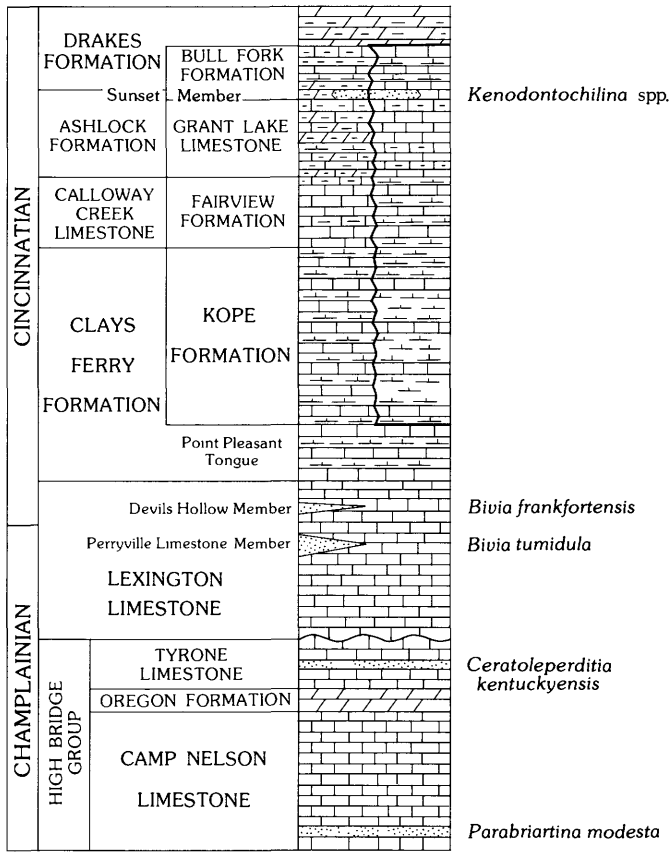

FIGURE 3.—Generalized stratigraphic section of the Middle and Upper Ordovician rocks exposed in north central Kentucky showing the most important leperditicope-bearing horizons (stippled areas) and most diagnostic taxa in the Ordovician of Kentucky. Leperditicope-bearing rocks are commonly composed of micrite. Approximately 1,600 feet of section shown. In southeast central Kentucky, the Grant Lake is reduced in thickness and designated a member of the Ashlock Formation.

this generalized diagram demonstrates the paucity of beds of a suitable facies for leperditicopes. The names of the most characteristic species are listed opposite the units in which they occur. These horizons containing leperditicopes cannot be considered as zones of any kind because, owing to the dependence of this group of ostracodes on a restricted facies, the taxa might have longer ranges in other areas if the right facies are present. For example, the absence of leperditicopes in the formations between the Devils Hollow Member of the Lexington Limestone and the Sunset Member of the Ashlock and Bull Fork Formations is due to the absence of the appropriate facies; in Tennessee, the Catheys Limestone, which is considered by Sweet and Bergstrom (1976, p. 132–133) to be the equivalent of the shaly Point Pleasant Tongue of the Clays Ferry Formation and the Kope Formation, has at least four leperditicope taxa, as illustrated by Bassler (1932). The

lack of leperditicopes in the Point Pleasant, Clays Ferry, and Kope may reflect the deepening of the seaway to the north and the migration of the shallow-water facies southward to Tennessee.

In spite of the problems of facies control of the leperditicopes, they probably will be useful stratigraphically for approximate correlation in Kentucky and adjacent States. For example, *Ceratoleperditia kentuckyensis* has not been found either above or below the Tyrone Limestone and is sufficiently distinctive that it could be easily recognized in well cores. The same is true of the species of *Bivia* and *Kenodontochilina*. When the facies mosaic of the Middle and Upper Ordovician formations is better understood, the leperditicopes may also be useful for more distant correlation; Copeland (1976) demonstrated that Silurian leperditicopes can be used for general correlation in Canada, and further study may prove that the Ordovician leperditicopes also have such value.

SYSTEMATIC PALEONTOLOGY

Class OSTRACODA Latreille, 1804
Order LEPERDITICOPIDA Scott, 1961

Discussion.—Scott (1961) defined the Leperditicopida as ostracodes with a long straight hinge, valves strongly unequal to subequal, and a large adductor muscle scar composed of numerous secondary elements (stigmata of Gramm, 1982); he stated that the family Leperditiidae had strongly unequal valves and the family Isochilinidae had subequal valves with flattened borders along the free margins. As previously noted, several leperditicopid genera have been described which are essentially equivalved or subequivalved, but which lack a marginal brim. These taxa do not fit the diagnosis of either family as currently defined. Consequently, I here propose to redefine the family Leperditiidae as composed of those leperditicopid genera which are distinctly inequivalved and which have a sinuous contact margin in ventral view, and to redefine the family Isochilinidae as those genera which are subequivalved and have a straight contact margin in ventral view.

Family LEPERDITIIDAE Jones, 1856
Genus EOLEPERDITIA Swartz, 1949

Type species.—*Cytherina fabulites* Conrad, 1843

Eoleperditia fabulites (Conrad, 1843)

Plate 1, figures 1–12

Cytherina fabulites Conrad, 1843, p. 332.

Leperditia fabulites (Conrad). Jones, 1856, p. 89; 1858a, p. 246, 255; 1891, p. 97–99; Ulrich, 1891, p. 173–174, pl. 11, figs. 1a–d; 1894, p. 634–636; Bassler, 1915, p. 702; Bassler and Kellett, 1934, p. 384–385 (see for extensive synonymy).

Eoleperditia fabulites (Conrad). Swartz, 1949, p. 318–319, pl. 66, figs. 1–10; Scott, 1951, p. 321–326, pl. 51, figs. 1–5; Harris, 1957, p. 129, 130; Swain, 1957, p. 545, 546; Bolton and Copeland, 1972, pl. A, figs. 13, 19, 20; Berdan, 1976, p. 60.

Leperditia canadensis var. *josephiana* Jones, 1858a, p. 340; 1858b, decade 3, p. 94–95, pl. 11, fig. 16; 1881, p. 343, 344; 1884, p. 341; 1891, p. 97, 98.

Leperditia josephiana (Jones). Billings, 1863, p. 954; Jones, 1884, p. 341; 1891, p. 98, 99; Ulrich, 1891, p. 174; 1894 (1897), p. 635.

Leperditia fabulites var. *josephiana* (Jones). Jones, 1881, p. 343–345, pl. 19, fig. 7, pl. 20, figs. 7, 8.

Diagnosis.—*Eoleperditia* with neither anterior nor posterior marginal brims, low eye tubercle, oval but not acuminate adductor scar. Right valve has four to six slitlike stop pits perpendicular to free margin on either side of ventral lappet and is flattened below midheight.

Description.—Lateral outline postplete; hinge line straight, anterior and posterior margins smoothly curved, ventral margin gently curved. Cardinal angles obtuse, not flattened, no anterior or posterior marginal brims. In anterior view, right valve smoothly curved to about midheight, flattened slightly in ventral half of valve and bent abruptly to ventral lappet, left valve smoothly curved to overlap platform, greatest width just below midheight. Stop ridge in left valve low and obscure. Stop pits in right valve tend to be elongated perpendicular to the commissure, four to six on either side of ventral lappet. Eye tubercle low and inconspicuous. Adductor scar oval, not acuminate, composed of 150 to 200 stigmata. Subocular stigmata in approximate rosette anteroventral of eye tubercle, anterodorsal scars also present (Swartz, 1949, pl. 66, fig. 4). Hinge simple tongue and groove.

Material.—Ten specimens (holotype and nine paratypes) of *Leperditia canadensis* var. *josephiana* from St. Joseph Island, Ontario, Canada; 12 specimens of *Leperditia fabulites* from Beloit, Wis.; more than 50 specimens of *Eoleperditia fabulites* from the Valley View quadrangle, Kentucky.

Types.—Holotype of *Leperditia canadensis* var. *josephiana* Jones, 1858 (= *Eoleperditia fabulites*), GSC 1334h, paratypes, GSC 1334, a–g, i; hypotypes, USNM 41263, USNM 334286, USNM 338651–338658.

Measurements.—GSC 1334h, a right valve, is 12.8 mm long and 8.4 mm high, with a hinge length of 8.1 mm. The hypotype carapace figured by Ulrich (1891, pl. 11, fig. 1, USNM 41263) is 12.4 mm long, 7.9 mm high, and 5.5 mm wide, with a hinge length of 7.2 mm. The measurements of eight hypotype specimens of *Eoleperditia fabulites* from the Tyrone Limestone, West Marble Creek section, Valley View quadrangle, Kentucky, are given in table 2. All measurements in table 2 were made with a micrometer ocular; other measurements were made with calipers having a vernier scale.

Discussion.—The history of *Eoleperditia fabulites* is only briefly indicated in the synonymy given above; for

TABLE 2.—*Measurements in millimeters of 8 specimens of* Eoleperditia fabulites *from USGS collection D1138–CO, Tyrone Limestone*

USNM No.	Valve	Length	Height	Hinge Length	Width
338653	Right[1]	2.5	1.8	1.7	1.2
338653	Left[1]	2.5	1.7	1.7	—
338657	Right	4.8	3.3	3.0	—
338657	Left	5.0	3.2	3.1	—
338654	do	7.0	4.4	—	—
338655	Right	7.4	5.1	4.8	—
338658	do	7.5	4.9	4.2	—
338656	Left	8.2	5.5	5.0	—
338658	Right	8.3	5.7	5.2	—

[1]Small carapace.

a more extensive record of the early literature on this taxon see Bassler and Kellett (1934, p. 384–385). Conrad (1843, p. 332) described briefly but did not figure his new species *Cytherina fabulites*, which he stated came from Mineral Point, Wis., from beds immediately below the lead-bearing horizon which he correlated with the Trenton Limestone of New York. These beds would now be considered part of the Platteville Limestone (Heyl and others, 1959, p. 11, 13, 269). Jones (1856, p. 89) suggested in a footnote that Conrad's *Cytherina fabulites* "is probably a *Leperditia*." Later, Jones (1858a, p. 340; 1858b, pl. 11, fig. 16) described and illustrated *Leperditia canadensis* var. *josephiana*, but noted that it might be the same as Conrad's *Leperditia fabulites*, and if so, Conrad's name would have priority. After various vicissitudes in the taxonomic treatment of *L. josephiana*, Jones (1891, p. 98, 99) apparently decided to consider it a junior synonym of *L. fabulites* (Conrad). In the same year, Ulrich (1891, p. 173–174) redescribed *Leperditia fabulites* and commented that as the eye tubercle of *L. josephiana* was more distinct and that as yet no pits had been detected on the ventral margin "***it is reasonable to suppose that Prof. Jones' species may prove distinct." However, Ulrich (1894, p. 635) subsequently revised his opinion and unequivocally placed *L. josephiana* in synonymy with *L. fabulites*. This practice was followed by Bassler (1915, p. 702) and Bassler and Kellett (1934, p. 385).

The location of Conrad's original material from Mineral Point, Wis., is not known, but the holotype and paratypes of *L. josephiana* are deposited in the collections of the Geological Survey of Canada. When Swartz (1949, p. 317–318) proposed his new genus *Eoleperditia*, with *E. fabulites* (Conrad) as the type species, 6 of the 10 specimens (Swartz, 1949, pl. 66, figs. 1–6) he figured were from St. Joseph Island, and therefore topotypes of *L. josephiana* rather than *L. fabulites* s.s. Furthermore, Swartz (1949, p. 319) stated "The types of *Eoleperditia fabulites* came from Middle Ordovician beds of St. Joseph Island, Canada. The topotype examples from the upper part of the Lowville limestone of this island, that are figured on accompanying plates, were loaned for the present study by the United States National Museum through the courtesy of Dr. R. S. Bassler." Clearly, Swartz based his concept of *Eoleperditia* and *E. fabulites* on specimens from St. Joseph Island and not on specimens from the type locality of Mineral Point, Wis. After examining the holotype and nine paratypes of *Leperditia josephiana* Jones, 1858, specimens from USGS colln. 467B–OS (cited as USNM 467B by Swartz, 1949, p. 317), also from St. Joseph Island, 11 specimens of *Leperditia fabulites* (Conrad) used by Ulrich (1891, p. 173) to redefine the species from Beloit, Wis., and specimens from Mineral Point, Wis. (USGS collns. 207Q–OS, 208Q–OS), I concur with Jones, Ulrich, and subsequent workers that the specimens from Wisconsin are conspecific with those from St. Joseph Island and *L. josephiana* is a junior synonym of *L. fabulites*. The principal difference between the two groups of specimens is that those from St. Joseph Island are better preserved and show more diagnostic features.

Conrad's specimens of *Cytherina fabulites* may be presumed lost; there is no record in the voluminous literature on *Eoleperditia fabulites* that any subsequent workers have seen them. However, it does not seem necessary to designate a neotype at this time because of the large number of well-preserved specimens from Wisconsin that can be compared to and are conspecific with the specimens from St. Joseph Island. According to the International Code of Zoological Nomenclature, Article 75 (Stoll and others, eds., 1964, p. 81), a neotype is to be designated only under exceptional circumstances such as the confused or doubtful identities of closely similar species. This does not apply at present to *E. fabulites*. If in the future it should become necessary to designate a neotype, and no suitable topotype specimens from Mineral Point can be found, consideration should be given to designating the carapace figured by Ulrich (1891, pl. 11, figs. 1a–d) from the Platteville Formation at Beloit, Wis., as it was used in the first thorough revision of the species. This specimen is USNM 41263a, which is not figured herein.

Scott (1951) described the shell morphology and instars of *E. fabulites* from Illinois in detail. The material from Kentucky is not sufficiently well preserved to add anything to Scott's analysis. As noted by Ulrich (1891, p. 173; 1894, p. 635), the specimens from Kentucky are generally slightly smaller than typical *E. fabulites*.

Eoleperditia fabulites differs from most species of *Eoleperditia* in lacking acute, flattened cardinal angles. It is most like *E. pauquettiana* (Jones, 1858) and *E. simplex* Harris, 1957, but both of these species

have more smoothly curved valves in end view. *E. trentonensis* (Wilson, 1921) is also less convex, to judge from the holotype (GSC 6228).

Occurrence.—*E. fabulites* has been recorded from Blackriveran and Rocklandian formations from Wisconsin, Iowa, Minnesota, Illinois, Ontario, New York, Pennsylvania, Kentucky, Tennessee, Alabama, Oklahoma, and Montana. Ulrich (1894, p. 635) noted that throughout its wide geographic range its characters were remarkably constant. The specimens in our collections from Kentucky are from the Tyrone Limestone, USGS collns. D1137–CO, D1138–CO, D1141–CO, and D1142–CO, all from the West Marble Creek section in the Valley View 7.5-minute quadrangle. Bassler and Kellett (1934, p. 52) listed *E. fabulites* as occurring in the Curdsville Limestone Member of the Lexington, but none has been found in our collections from the Curdsville.

Eoleperditia caecigena (Miller, 1881)

Plate 2, figures 1–5

Leperditia caecigena Miller, 1881, p. 262, pl. 6, figs. 5, 5a; 1889, p. 552, text fig. 1021; Ulrich, 1891, pl. 176–177, pl. 11, figs. 6a–d; Cumings, 1908, p. 1047, pl. 53, figs. 10–10c; Grabau and Shimer, 1910, p. 340, text fig. 1656d, e; Bassler, 1915, p. 700; Foerste, 1924, p. 250, pl. 45, figs. 6a, b; Bassler and Kellett, 1934, p. 381.

Diagnosis.—Cardinal angles obtuse, slightly flattened; eye tubercle, muscle scar, and stop pits very indistinct, size small.

Description.—Lateral outline postplete; hinge line straight, without posterodorsal bulge; anterior margin smoothly curved, not extending far beyond hinge line; ventral margin smoothly and gently curved; posterior margin evenly curved. Cardinal angles obtuse, slightly flattened. Eye tubercle not visible externally or very obscure. Muscle scar commonly not visible externally but may be slightly depressed on some specimens, oval in outline, individual stigmata not seen. No other muscle scars seen. Stop pits very obscure or not visible, apparently four or five on each side of ventral lappet of right valve. Ventral lappet distinct but not wide, overlap platform distinct and relatively wide, with distinct stop ridge. Marginal brim very weakly developed posteriorly. Shell surface smooth. Greatest width in anterior half of carapace.

Material.—Holotype carapace and more than 35 hypotype specimens.

Types.—Holotype, UC 8883; hypotypes, USNM 41276.

Measurements.—The holotype is approximately 3.2 mm long, 2.3 mm high, and 1.4 mm wide. The large right valve figured by Ulrich (1891, pl. 11, fig. 6a) is approximately 5.6 mm long and 4.1 mm high; it is slightly broken anteriorly.

Discussion.—Although *Eoleperditia caecigena* (Miller, 1881) has not yet been found in the collections studied from Kentucky, it is here redescribed and refigured (pl. 2, figs. 1–5) because the original illustrations of Miller (1881, pl. 6, figs. 5, 5a) are not adequate for recognition of the species. Ulrich (1891, p. 176, pl. 11, figs. 6a–d) briefly redescribed and refigured the species, but at a rather low magnification. As noted by Ulrich (1891), this species is superficially similar in outline to *Bivia frankfortensis* (Ulrich, 1891), but the latter has distinct anterior and posterior marginal brims, and also the stop pegs of *Bivia. Eoleperditia caecigena* is characterized by its small size and its obscure eye tubercle, muscle scar, and stop pits; it differs in these respects from *E. fabulites* (Conrad, 1843) and other species of *Eoleperditia.* The holotype of *E. caecigena* is in the Field Museum of Natural History, in the Walker Museum collection (UC 8883).

Occurrence.—Miller (1881, p. 262) stated that he had collected this species from "the upper part of the Hudson River Group at Versailles, and near Osgood, Indiana."; the holotype came from Versailles. Ulrich's collection (USNM 41276) is labeled "Ord. (Richmond-Saluda), Indian Kentuck Creek, near Madison, Ind."

Eoleperditia sp. aff. E. pauquettiana (Jones, 1858)

Plate 2, figures 6–9

Leperditia canadensis var. *pauquettiana* Jones, 1858a, p. 340; 1858b, p. 94, pl. 11, fig. 12.
Leperditia fabulites var. *pauquettiana* (Jones). Jones, 1881, p. 343.
Leperditia canadensis pauquettiana (Jones). Bassler, 1915, p. 701.
Leperditia pauquettiana (Jones). Jones, 1891, p. 99; Bassler and Kellett, 1934, p. 395.

Diagnosis.—*Eoleperditia* with right valve evenly curved in end view, greatest width below midheight of valve. Neither anterior nor posterior marginal brims, eye tubercle low to obsolete exteriorly. Right valve has 4–5 stop pits on either side of ventral lappet.

Description.—Lateral outline slightly postplete; hinge line straight, anterior and posterior margins smoothly curved, ventral margin gently curved. Cardinal angles obtuse, not flattened, no anterior or posterior marginal brims. In anterior view, greatest width of right valve is at or below midheight, and valve surface is smoothly curved, not flattened. Ventral lappet and overlap platform at about 90° to plane of valves. Stop ridge in left valve low and obscure. Stop pits in right valve indistinct, tend to be elongated perpendicular to commissure, 4–5 on each side of ventral lappet. Eye tubercle low to obsolete. Adductor scar ovate, slightly acuminate dorsally, number of individual stigmata and subocular and anterodorsal scars not seen. Hinge apparently tongue and groove.

Material.—Two specimens (holotype and paratype) of

Eoleperditia pauquettiana (Jones, 1858) from Paquette Rapids, Alumette Island, Canada, and more than 20 silicified specimens collected by E. L. Yochelson from the same locality. Five specimens of *Eoleperditia* sp. aff. *E. pauquettiana* from the West Marble Creek section, Kentucky.

Types.—Holotype of *E. pauquettiana*, GSC 1336a; paratype, GSC 1336; topotype, USNM 338661. Figured specimens of *Eoleperditia* sp. aff. *E. pauquettiana*, USNM 338659–338660.

Measurements.—The holotype of *E. pauquettiana* is approximately 7.0 mm long and 4.5 mm high, and has a hinge length of 4.5. The paratype is 7.9 mm long and 5.4 mm high. A topotype carapace (USNM 338661) is 9.1 mm long, 6.2 mm high, and 4.0 mm wide. A large right valve of *E.* sp. aff. *E. pauquettiana* from Kentucky is 7.8 mm long and 5.2 mm high; a smaller left valve is 5.4 mm long, 3.6 mm high, and has a hinge length of 3.5. All measurements are approximate because the margins of the valves are not well preserved on the specimens, including the holotype.

Discussion.—The specimens from Kentucky are referred to *Eoleperditia* sp. aff. *E. pauquettiana* because they are not adequately preserved, especially around the margins and the cardinal angles, and it is not possible to be certain that they belong to this species. However, they appear to have the same curvature in end view as *E. pauquettiana*, which they resemble more than other species of *Eoleperditia*. The foregoing description is based largely on the holotype (pl. 2, fig. 12), paratype (pl. 2, fig. 13), and topotypes (pl. 2, figs. 10, 11) of *E. pauquettiana*; the specimens from Kentucky do not show the adductor muscle scar or hinge.

Eoleperditia pauquettiana (Jones, 1858) is very similar to *E. fabulites* (Conrad, 1843); the principal difference between the two species appears to be the flattening of the ventral half of the right valve of *E. fabulites*, best seen in end view, as opposed to the evenly curved right valve of *E. pauquettiana*. Should further study of better preserved suites of specimens of *E. pauquettiana* indicate that this difference is not significant, it would be necessary to consider *E. pauquettiana* as a junior synonym of *E. fabulites*. At present, however, keeping the two species distinct seems desirable.

Occurrence.—The holotype and paratype of *E. pauquettiana* are from the Leray beds, Paquette Rapids, Alumette Island, Ottawa River, Canada (Bolton, 1966, p. 105). The specimens of *Eoleperditia* sp. aff. *E. pauquettiana* are all from the Camp Nelson Limestone, West Marble Creek section, Valley View quadrangle, Kentucky, USGS collns. D1147–CO, D1144–CO, and D1358–CO.

Genus BIVIA Berdan, 1976

Type species.—*Leperditia bivia* White, 1874.

Bivia tumidula (Ulrich, 1891)

Plate 3, figures 1–8; plate 4, figures 1–6

Leperditia tumidula Ulrich, 1891, p. 175–176, pl. 11, figs. 4a–c; Bassler, 1915, p. 704; Bassler and Kellett, 1934, p. 402.
Eoleperditia? tumidula (Ulrich). Levinson, 1951, p. 554.
Bivia tumidula (Ulrich). Berdan, 1976, p. 44, 50.
Leperditia appressa Ulrich, 1891, p. 176, pl. 11, figs. 5a–d; Bassler, 1915, p. 699; Bassler and Kellett, 1934, p. 378.
Eoleperditia? appressa (Ulrich). Levinson, 1951, p. 554.

Diagnosis.—Anterior and posterior marginal brims narrow, right valve has two anterior and one posterior stop pit and is inflated ventrally, left valve has posterodorsal inflation.

Description.—Lateral outline postplete, hinge line straight, approximately seven-tenths of greatest length. Cardinal angles distinct, anterior more acute than posterior. Anterior margin sharply curved; ventral margin of right valve has posteroventral bulge, ventral margin of left valve very gently curved to nearly straight; posterior margin smoothly curved. Narrow marginal brim on posterior and anterior margins of right valve extends to most ventral stop pits on either end; on left valve brim extends posteriorly to overlap platform, anteriorly to midheight of valve.

Valves asymmetrical; right valve has two anterior and one posterior stop pits and distinct posteroventral swelling, posterior third of valve behind swelling somewhat flattened. Left valve has deep overlap platform at approximately 90° to plane of valves, very low stop ridge and posterodorsal bulge. Eye tubercles distinct. Adductor muscle scar ovate, narrow end directed dorsally, composed of more than 60 stigmata, located just posteroventrally of eye tubercle. From five to nine or more stigmata form triangle with apex downward below eye tubercle. Stigmata of pre-ocular and anterodorsal groups present but difficult to determine. Hinge simple. Shell surface smooth, except for overlap platform, which is weakly punctate.

Material.—Holotype of *Bivia tumidula* (Ulrich), five syntypes of *B. appressa* (Ulrich). More than 50 silicified valves from USGS colln. 5015–CO, more than 25 silicified valves and more than 30 calcareous valves from USGS colln. 6137–CO, one silicified valve from USGS colln. 6916–CO, more than 15 silicified valves and many fragments from USGS colln. 6915–CO, 3 broken calcareous valves and many fragments from USGS colln. 7857–CO, more than 10 calcareous valves from USGS colln. 7856–CO.

Types.—Holotype, USNM 41284; syntypes of *B. appressa*, USNM 41282. Hypotypes, USNM 338662–338675.

Measurements.—As measured by me, the holotype of

Bivia tumidula is 8.7 mm long and 6.3 mm high. The two largest syntypes of *Bivia appressa* are 13.5 mm long and 9.3 mm high, and 12.2 mm long and 7.0 mm high, respectively. The measurements of 30 hypotypes are given in tables 3 and 4 and figure 4.

Discussion.—Ulrich (1891) proposed the three species *Leperditia linneyi*, *L. tumidula*, and *L. appressa*, all from "the uppermost division of the Trenton limestone" (Ulrich, 1891, p. 175). He stated that *L. tumidula* differed from *L. linneyi* "***in being a little less oblique, in having the ventral region of the right valve more tumid, the extremities of the hinge line simply angular instead of being produced spine-like, and in having only one pit on each side of the ventral overlap" (Ulrich, 1891, p. 176). However, the holotype (USNM 41284) of *Bivia tumidula* (pl. 3, fig. 5) has one posterior and two anterior stop pits, so that this criterion cannot be used to discriminate between the species. Ulrich's other criteria appear to be useful; *B. linneyi* has acute cardinal angles rather than almost obtuse as in *B. tumidula*, is relatively longer, and has the greatest width in ventral view at the midpoint or before the midpoint of the valve, rather than behind the midpoint as in *B. tumidula*. Although both species occur together, *B. tumidula* and *B. linneyi* are here considered to be valid species.

TABLE 3.—*Measurements in millimeters of 23 silicified specimens of* Bivia tumidula *from USGS collection 5015–CO, Perryville Limestone Member, Lexington Limestone*

USNM No.	Valve	Length	Height
338672	Right	3.9	2.7
338672	do	3.9	2.7
338672	do	4.1	2.7
338672	do	4.1	3.0
338672	do	4.2	3.0
338672	Left	4.3	2.8
338672	do	4.6	3.5
338672	do	4.7	3.0
338672	do	4.9	3.4
338672	Right	4.9	3.4
338672	Left	5.2	3.4
338672	do	5.2	3.4
338672	Right	5.5	4.1
338672	Left	5.6	3.8
338672	do	5.7	3.9
338673	do	5.8	3.6
338673	do	5.8	4.0
338673	Right	5.9	4.0
338673	Left	6.7	4.6
338673	Right	6.8	4.8
338673	Left	8.5	5.6
338673	Right	8.5	6.0
338669	do	9.8	6.8

TABLE 4.—*Measurements in millimeters of 7 specimens of* Bivia tumidula *from USGS collection 6137–CO, Perryville Limestone Member, Lexington Limestone*

USNM No.	Valve	Length	Height	Preservation
338662	Right	2.6	1.7	Calcareous
338667	do	4.9	3.4	Siliceous
338671	do	6.6	4.3	do
338674	Left	9.5	6.1	Calcareous
338675	do	9.8	5.7	do
338670	Right	11.5	7.9	Siliceous
338668	Left	12.8	8.5	Calcareous

The syntypes (USNM 41282) of *Leperditia appressa* Ulrich, 1891 are four left valves, one of which is from Danville, Ky., and the other three from "near Harrodsburg, Ky.," and one small, broken right valve, also from Harrodsburg. Although incomplete, the right valve shows the characteristic posteroventral swelling of *B. tumidula*. The left valves appear to be the same as left valves associated with typical right valves of *B. tumidula* in several collections and are believed to belong with the right valves although no carapaces of this species have been found. Consequently, *L. appressa* is here considered a synonym of *Bivia tumidula* (Ulrich, 1891). One of the better syntypes of *L. appressa* is shown for comparison with left valves of *B. tumidula* (pl. 4, fig. 3).

Occurrence.—The label with the holotype (USNM 41284) of *B. tumidula* (Ulrich, 1891) states "up. Trenton, Danville, Ky."; those with the syntypes (USNM 41282) of *L. appressa* Ulrich, 1891 state "Upper Trenton, Danville, Ky." and "Upper Trenton, near Harrodsburg, Ky." In the collections studied for this report, *Bivia tumidula* appears to be restricted to the Faulconer and Salvisa Beds of the Perryville Limestone Member of the Lexington Limestone in USGS collns. 5015–CO, 6137–CO, 6915–CO, 6916–CO, 7853–CO, 7856–CO, 7857–CO.

Bivia linneyi (Ulrich, 1891)

Plate 5, figures 1–7

Leperditia linneyi Ulrich, 1891, p. 174–175, pl. 11, figs. 3a–e; Bassler, 1915, p. 704; Bassler and Kellett, 1934, p. 391.
Bivia linneyi (Ulrich). Berdan, 1976, p. 44, 46, 50.

Diagnosis.—Anterior and posterior marginal brims distinct, cardinal angles acute. Right valve normally has two anterior and one posterior stop pits and rounded midventral lateromarginal bend; left valve has posterodorsal inflation, narrow overlap platform, and anterocentral convexity over muscle scar.

Description.—Lateral outline postplete, hinge line straight, approximately seven-tenths of greatest length. Cardinal angles distinct, 90° or slightly more, about equally sharp. Anterior margin sharply curved, anterodorsal part nearly straight, ventral margin gently curved, posterior margin smoothly curved. Distinct marginal brim on both valves, widest at about

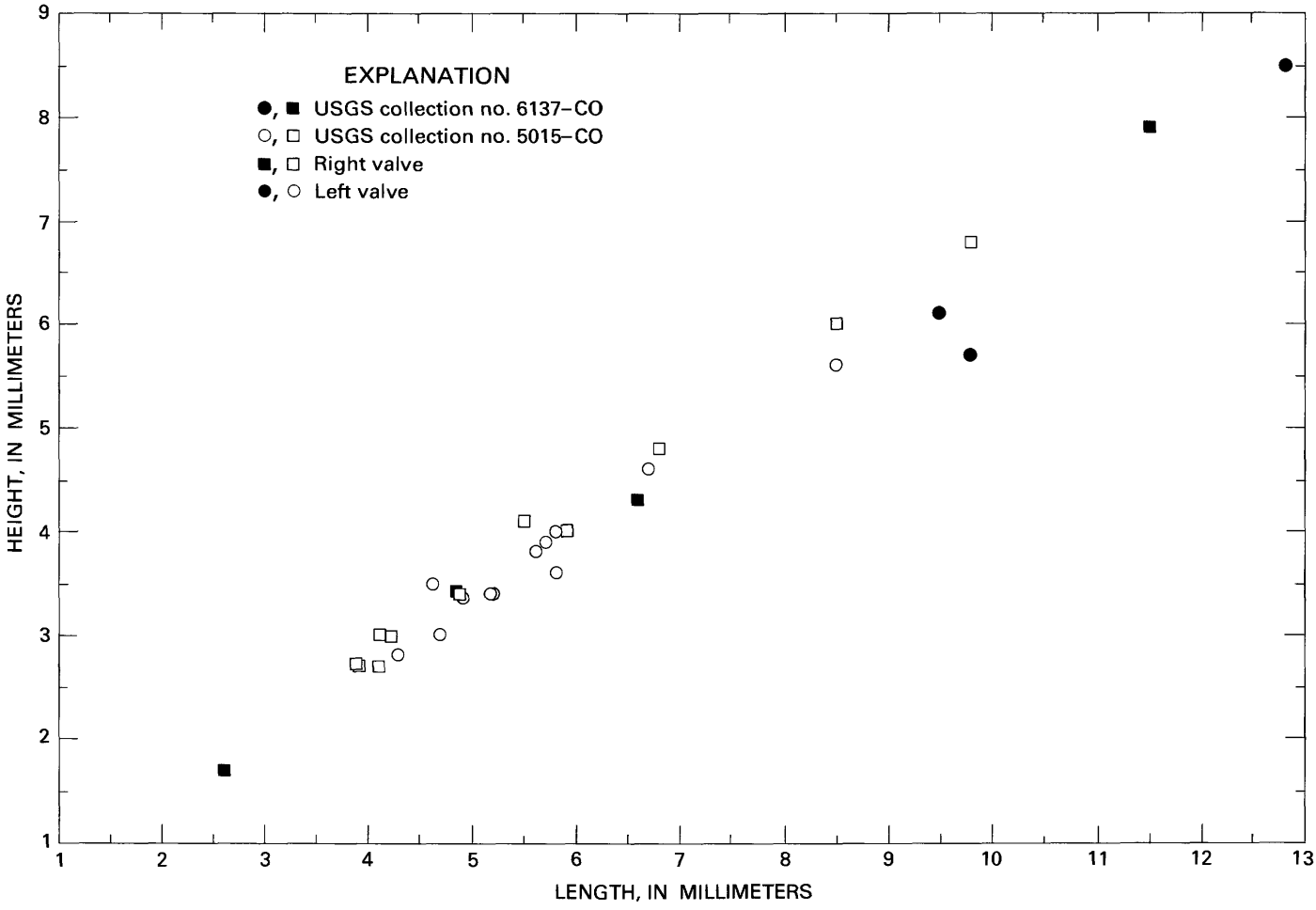

FIGURE 4.—Scatter diagram of maximum length versus maximum height for *Bivia tumidula* (Ulrich, 1891); 23 specimens from USGS collection 5105–CO, table 3, and 7 specimens from USGS collection 6137–CO, table 4. All from the Perryville Limestone Member of the Lexington Limestone.

midheight and narrowing dorsally. Brim extends to most ventral stop pits on right valve and to overlap platform on left valve. Valves asymmetrical but not strongly; right valve has two anterior and one posterior stop pits and ventral lateromarginal bend, left valve has narrow overlap platform inclined inward, very obscure stop ridge, and posterodorsal bulge. Eye tubercle distinct. Adductor muscle scar ovate, composed of more than 50 stigmata located posteroventrally of eye tubercle. Approximately five elongate stigmata below eye tubercle. Pre-ocular and anterodorsal muscle groups not seen. Hinge simple. Shell surface weakly punctate.

Material.—Eight syntypes (USNM 41272) of *Bivia linneyi* (Ulrich, 1891), 11 silicified specimens from USGS colln. 5015–CO.

Types.—Syntypes, USNM 41272; hypotype, USNM 338676. No lectotype has been designated for this species because none of the syntypes are sufficiently well preserved to show all the features of the species.

Measurements.—A large syntype right valve is 9.0 mm long and 5.7 mm high. A smaller syntype right valve, broken anteriorly, is estimated as 7.8? mm long and is 4.7 mm high. A syntype left valve is 7.6 mm long and 4.8 mm high. The other syntypes are broken, except for two small specimens that are probably juveniles of *B. tumidula.* The silicified specimens were not measured because the anterior and posterior margins are poorly preserved and the true length could not be obtained.

Discussion.—*Bivia linneyi* is very close to *B. tumidula,* and at one time I considered that they might be synonymous. However, the differences between the two species appear to be distinct, and gradational forms between them have not been observed. In addition to being relatively longer, less tumid, and having more distinct cardinal angles and marginal brims than *B. tumidula, B. linneyi* differs in having a lightly punctate rather than smooth shell surface, although this

character can be seen only on well-preserved calcareous specimens. Both *B. linneyi* and *B. tumidula* differ from other described species of *Bivia* (see Berdan, 1976) except *B. frankfortensis* (Ulrich, 1891) in having three rather than two stop pits, although one aberrant specimen of *B. linneyi* (pl. 5, figs. 5, 6) has four.

Ulrich (1891, p. 175–176) considered *B. linneyi* to be more abundant than *B. tumidula*. In the collections studied for this report the reverse has been found; *B. tumidula* occurs in more collections and is more abundant than *B. linneyi*.

Occurrence.—The syntypes of *Bivia linneyi* (USNM 41272) are described on the accompanying label as coming from "Up. Trenton, Perryville ls., near Harrodsburg, Ky." Silicified specimens come from USGS colln. 5015–CO, from the Salvisa Bed of the Perryville Limestone Member of the Lexington Limestone, 0.4 miles south of Perryville, Ky.

Bivia frankfortensis (Ulrich, 1891)

Plate 6, figures 1–17

Leperditia caecigena variety *frankfortensis* Ulrich, 1891, p. 177.
Leperditia caecigena frankfortensis Ulrich. Bassler, 1915, p. 700; Bassler and Kellett, 1934, p. 381.

Diagnosis.—Anterior and posterior marginal brims very narrow and obscure. Right valve has two anterior and one posterior stop pegs which may or may not be marked by stop pits externally. Cardinal angles obtuse.

Description.—Lateral outline postplete, hinge line straight, approximately five- to six-tenths of greatest length. Anterior margin smoothly curved, ventral margin gently curved, posterior margin smoothly curved. Obscure, narrow anterior and posterior marginal brims on both valves. Valves not strongly asymmetrical, no posterodorsal bulge on left valve. Stop pits obscure or lacking on exterior of right valve, but two anterior and one posterior stop pegs present on interior of right valve. Left valve has narrow overlap platform and obscure stop ridge. Anterior cardinal angle obtuse, posterior cardinal angle very obtuse and nearly unrecognizable. Eye tubercle indistinct but present. Adductor muscle scar ovate, composed of more than 30 stigmata located posteroventrally of eye tubercle. Approximately five to seven elongate stigmata below eye tubercle. Pre-ocular and anterodorsal muscle groups not seen. Hinge simple. Shell surface smooth.

Material.—More than six syntypes (USNM 41279). More than 130 silicified valves from USGS colln. 5095–CO; 12 calcareous valves from USGS colln. D1207–CO.

Types.—Lectotype, USNM 41279A; paralectotypes, USNM 41279; hypotypes, USNM 338677–338687.

Measurements.—The lectotype herein chosen is 5.9 mm long and 4.1 mm high. The measurements of 24 hypotypes are shown in table 5 and figure 5.

Discussion.—This small species is assigned to the genus *Bivia* because of the presence of three stop pegs in the right valve, although many specimens lack the corresponding stop pits on the exterior. The three stop pegs suggest a relationship to *B. tumidula* and *B. linneyi*, but it differs from both these species in its relative shorter hinge line, obtuse posterior cardinal angle and poorly developed anterior and posterior marginal brims. Ulrich (1891, p. 177) considered *Bivia frankfortensis* to be a variety of *Eoleperditia caecigena* (Miller, 1881), the type of which (UC 8883) is here redescribed and illustrated for comparison (pl. 2, figs. 1–4). Ulrich (1891, p. 176–177, pl. 11, figs. 6a–d) redescribed and refigured "*Leperditia*" *caecigena* but did not illustrate his new variety *frankfortensis*. He considered that the differences between the two taxa were that *B. frankfortensis* had more distinct cardinal angles, marginal brims at both ends of the valves, and the ventral margin slightly more convex. The first and third of these criteria are doubtful, but as suggested by Ulrich (1891, p. 177) the eye tubercle and adductor muscle scar are more visible on *B. frankfortensis*.

Although the holotype carapace (UC 8883) of *Eoleperditia caecigena* (Miller, 1881) does not show stop pits externally, specimens of this species (USNM 41276)

TABLE 5.—*Measurements in millimeters of 24 silicified specimens of* Bivia frankfortensis *from USGS collection 5095–CO, Devils Hollow Member, Lexington Limestone*

USNM No.	Valve	Length	Height
338687	Right	2.30	1.65
338687	do	2.3+	1.80
338687	do	2.45	1.75
338687	do	2.50	1.75
338687	Left	2.60	1.85
338687	do	2.70	1.80
338687	do	2.80	1.90
338687	Right	2.90	2.20
338687	Left	2.95	2.10
338687	Right	3.00	2.20
338687	Left	3.20	2.20
338687	Right	3.30	2.40
338687	do	3.35	2.45
338687	do	3.40	2.50
338687	Left	3.50	2.40
338687	do	3.60	2.50
338687	Right	3.60	2.60
338687	Left	3.70	2.60
338687	Right	3.80	2.90
338687	Left	4.20	2.90
338687	do	4.20	2.90
338684	Right	4.40	3.00
338687	Left	5.20	3.60
338685	do	5.70	3.90

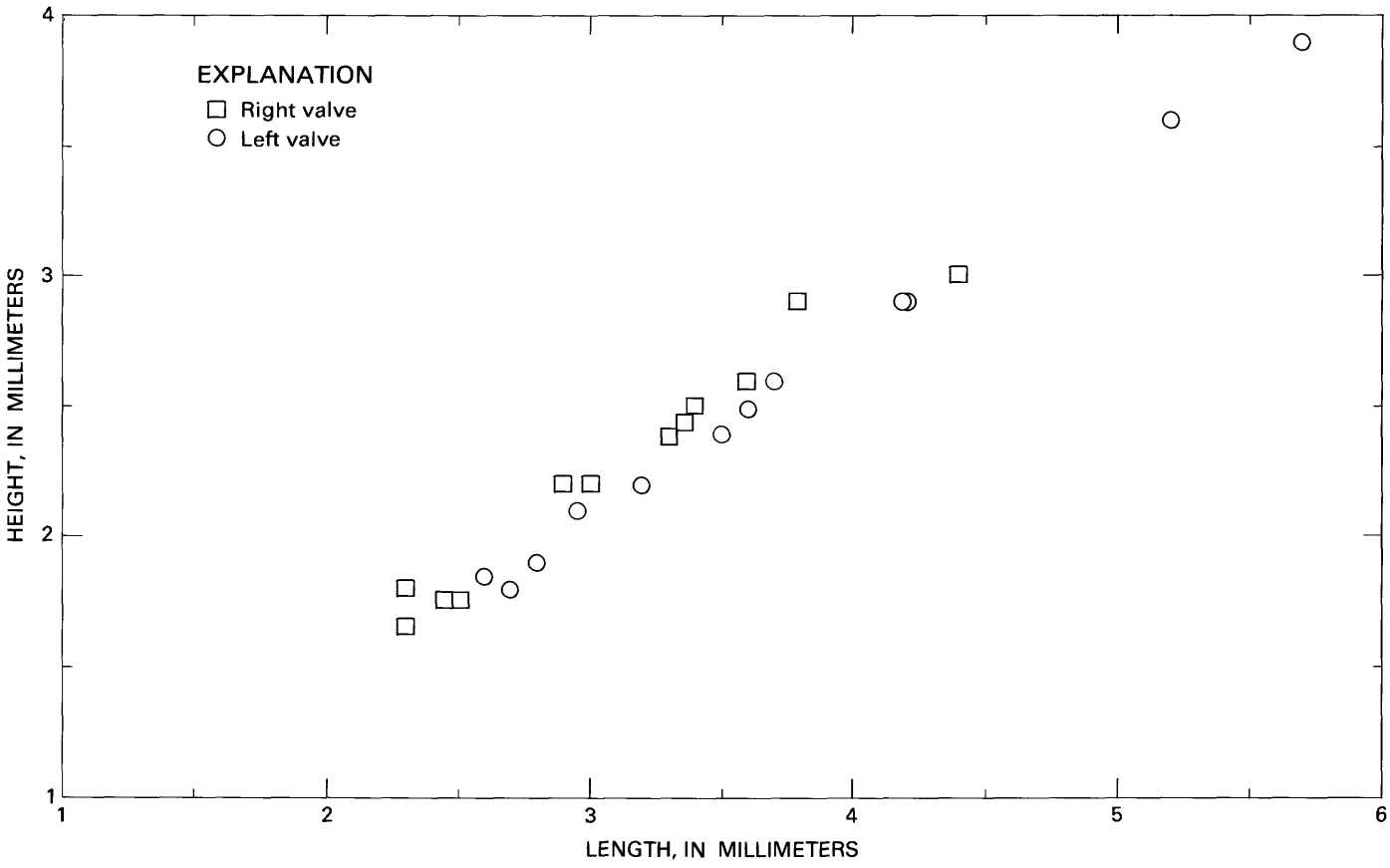

FIGURE 5.—Scatter diagram of maximum length versus maximum height in mm for *Bivia frankfortensis* (Ulrich, 1891); 24 silicified specimens from USGS collection 5095–CO from the Devils Hollow Member of the Lexington Limestone.

studied by Ulrich have obscure, lightly impressed stop pits with the arrangement characteristic of *Eoleperditia*. The stop pits may also not be visible on the exterior of *B. frankfortensis*, and as both taxa are small and have a similar lateral outline, they could easily be confused. However, in addition to the differences cited previously, Ulrich's specimens of *E. caecigena* have a deeper overlap platform on the left valve than specimens of *B. frankfortensis*.

Occurrence.—The lectotype and paralectotypes (USNM 41279A, 41279) of *Bivia frankfortensis* are labeled "Trenton (upper Cynthiana), Reservoir Hill, Frankfort, Ky." This species is in the collections studied for this report from the Devils Hollow Member of the Lexington Limestone (USGS collns. 4989–CO, 5095–CO, and D1207–CO). As the Devils Hollow Member is mapped on the only hill in Frankfort that has a reservoir (Moore, 1975), Ulrich's types also probably came from beds that would now be considered Devils Hollow.

Family ISOCHILINIDAE Swartz, 1949
Genus ISOCHILINA Jones, 1858

Type species.—*Leperditia* (*Isochilina*) *ottawa* Jones, 1858.

Isochilina copelandi n. sp.
Plate 7, figures 1–7

Diagnosis.—*Isochilina* with prominent eye tubercle, adductor scar tends to be raised above surface of valve, distinct but narrow marginal brim on both valves, less distinct ventrally on left valve.

Description.—Lateral outline postplete to amplete; hinge line straight, anterior and posterior margins smoothly curved, ventral margin gently curved. Hinge line between half and two-thirds length of valve. Anterior cardinal angle obtuse, flattened, posterior cardinal angle very obtuse, flattened. Marginal brim narrow, extending from anterior cardinal angle anterodorsally of posterior cardinal angle, very narrow ventrally on left valve. Greatest width in anterior

third of valve, over adductor muscle scar. Eye tubercle prominent, area of valve anterodorsal of eye tubercle tends to be inflated. Adductor muscle scar posteroventral of eye tubercle slightly raised above valve surface on large specimens. Adductor scar ovate, acuminate dorsally, composed of approximately 50 stigmata. Three or four vertically elongated stigmata below eye tubercle. Locking pits on right valve obscure externally. Narrow overlap platform on left valve. Shell surface smooth. Hinge not seen.

Material.—More than 30 specimens from one locality.

Types.—Holotype, USNM 338694; paratypes, USNM 338688–338693.

Measurements.—The holotype left valve is 5.6 mm long and 3.7 mm high, and has a hinge length of 3.1 mm. The measurements of five paratypes are given in table 6.

Discussion.—This small species differs from *Isochilina ottawa* Jones, 1858 as shown on pl. 8, figs. 1, 2, and by Swartz (1949, pl. 67), in having a shorter hinge line, less well developed cardinal angles, and a tendency for the adductor scar to be raised above the valve surface. In addition, the locking pits are poorly developed externally and can be determined only on wetted specimens. Although the adductor scar is raised above the valve surface as a low swelling, the individual stigmata are difficult to see on the material at hand, and could only be determined by etching a valve with weak hydrochloric acid and then coating the specimen with magnesium oxide.

Isochilina copelandi is superficially similar to *I. columbina* Bassler, 1935, but the latter has two or three stop pits (Swain, 1957, p. 551), a ventral lappet on the right valve, and a distinct overlap platform on the left valve; it therefore should be assigned to the genus *Bivia*.

Occurrence.—The specimens studied are from the Sunset Member of the Ashlock Formation at the Lake Reba section, USGS colln. 4492–CO. One small specimen that appears to belong to this species, USNM 41277, was identified as "*Leperditia caecigena* Miller, Richmond gr. (Saluda), Moreland, Ky."

TABLE 6.—*Measurements in millimeters of 5 specimens of* Isochilina copelandi *from USGS collection 4492–CO, Ashlock Formation, Sunset Member*

USNM No.	Valve	Length	Height
338688	Left	1.4	0.9
338689	do	2.2	1.5
338690	Right	2.9	1.9
338692	do	3.7	2.3
338693	do	4.3	2.7

Isochilina sp.

Plate 7, figures 8, 9

Description.—Lateral outline only slightly postplete; hinge line straight, about four-fifths of maximum length; anterior and posterior margins smoothly curved; ventral margin very gently curved. Cardinal angles about 90° to hinge line, flattened. Marginal brim narrow but distinct. Eye tubercle distinct. Adductor scar not markedly raised above valve surface, individual stigmata not seen. Approximately 12 locking pits on right valve distinct along ventral margin. Hinge not seen.

Material.—One right valve, one left valve, and many broken specimens.

Types.—Figured right valve, USNM 338695, figured left valve, USNM 338696.

Measurements.—The figured right valve is 3.9 mm long, 2.2 mm high, and has a hinge length of 2.9 mm.

Discussion.—Unfortunately, the specimens of this form are too poorly preserved to describe it adequately or to identify it. Most are dolomitized, and details of the surface and other features are obscured. This species differs from *Isochilina copelandi* n. sp. in having a relatively longer hinge line; it is most like *I. ottawa* Jones, 1858 in outline, but the material from Kentucky is not adequate to determine specific identity or the lack of it.

Occurrence.—The figured right valve is from the Rowland Member of the Drakes Formation, Fredericktown section, USGS colln. D1283–CO. The figured left valve is also from the same stratigraphic unit in the same section, USGS colln. D1284–CO.

Genus TEICHOCHILINA Swartz, 1949

Type species.—Isochilina jonesi Wetherby, 1881.

Species included.—Isochilina ampla Ulrich, 1891.

Diagnosis.—Isochilinids having narrow marginal brim ventrally, narrow overlap platform, and not more than three locking pits or pegs in right valve.

Discussion.—Swartz (1949, p. 324–325) proposed the genus *Teichochilina* to include isochilinids that have on the left valve "***a well developed marginal flange that is overlapped by the right valve." He did not illustrate the genus, but referred (Swartz, 1949, p. 325) to figures by Ulrich and Bassler (1923, p. 295, fig. 13, 6–8) and Bassler and Kellett (1934, p. 13, fig. 4, 8–10), which show an overlap platform on the left valve of *Isochilina jonesi* Wetherby. Wetherby's types are apparently lost (Ellis and Messina, 1955, v. 7; Branstrator, 1979, written commun.), but the specimens studied by Ulrich and Bassler are presumably those under USNM 41292 labeled "Hypotypes, *Isochilina jonesi* Wetherby, Mohawkian (Trenton), Near Harrodsburg, Ky. (Perryville ls.). Identified by E.O.U." None of these specimens conforms to Ulrich and Bassler's drawings,

but one specimen (pl. 8, fig. 4), which is a sheared carapace, shows a very narrow ventral area in the left valve that could be interpreted as an overlap platform, and this and another broken carapace may have been the source of Ulrich and Bassler's illustrations. The exact character of the overlap of *Isochilina*, as represented by *I. ottawa* Jones, 1858 has not been definitely determined by sectioning, but the ventral margin of the left valve must be bent inward to fit between the contact margin of the right valve and the locking pegs, although not as pronouncedly as in *Teichochilina*.

Swartz (1949, p. 325) stated that right valve submarginal pits and corresponding internal nodes, the locking pits and pegs of this report, were lacking in *Teichochilina*. However, specimens of *T. jonesi* Wetherby from USNM 41292 show two, and on some a small third, pits on the marginal brim of the right valve. The diagnosis of *Teichochilina* has been revised accordingly.

Isochilina ampla Ulrich, 1891 is considered to belong in *Teichochilina* because the only right valve of the syntypes (USNM 41291) shows two locking pits rather than the numerous locking pits of *Isochilina* s.s. Swartz (1949, p. 325) noted that "Further work will be required to determine the constituent species of the genus***" and undoubtedly additional species will be assigned to *Teichochilina* in the future. However, as noted by Berdan (1976, p. 46), the specimens described by Kirk (1928, p. 410–414, figs. 4a–h) as *Leperditia ampla* (Ulrich, 1891) from the Catheys Limestone of Tennessee are not *T. ampla* but are conspecific with *Bivia pondi* (Ulrich and Bassler, 1935).

Range.—Middle Ordovician of the East-Central United States.

Teichochilina jonesi (Wetherby, 1881)

Plate 8, figures 3–5; plate 9, figures 1–9

Isochilina jonesi Wetherby, 1881, p. 80–81, pl. 2, figs. 7, 7a; Miller, 1889, p. 522, text fig. 1018; Ulrich 1891, p. 179, pl. 11, figs. 9a–c; Jones, 1903, p. 303; Grabau and Shimer, 1910, p. 342; Bassler, 1915, p. 673; Ulrich and Bassler, 1923, p. 295, text fig. 13, figs. 6–8; Bassler and Kellett, 1934, p. 13, text fig. 4, fig. 4, figs. 8–10, p. 340; Shimer and Shrock, 1944, p. 644, pl. 280, figs. 14–16.

Teichochilina jonesi (Wetherby). Swartz, 1949, p. 324–325; Levinson, 1951, p. 554, pl. 77, figs. 5a, b.

Diagnosis.—Eye tubercle distinct but not conspicuous, adductor scar very slightly raised, marginal brim very narrow ventrally.

Description.—Lateral outline postplete; hinge line straight, anterior margin smoothly curved, ventral margin gently curved, slanting posteriorly, posterior margin more fully curved in ventral half of valve. Cardinal angles flattened, sharp, about 90° with hinge line, merging with marginal brim. Marginal brim about twice as wide posteriorly as anteriorly, very narrow ventrally, distinctly set off from domicilium. Greatest width anterior of midlength of valve. Eye tubercle distinct, area anterodorsal of eye tubercle slightly inflated. Adductor muscle scar very slightly raised above valve surface, composed of about 100 stigmata. About five ventrally elongated subocular stigmata in chevron shape below eye tubercle, other muscle scars not seen. Right valve has two or three widely spaced locking pits and three locking pegs, left valve has narrow, curved overlap platform. Hinge adont, simple.

Material.—Eighteen calcareous specimens from near Harrodsburg, Ky., one calcareous specimen from 8 miles southeast of Frankfort, Ky., one calcareous specimen from Versailles, Ky., four calcareous specimens from Perryville, Ky.; more than nine silicified fragments from the Bryantsville quadrangle, one silicified specimen from the Perryville quadrangle, all of the above from the Perryville Limestone Member of the Lexington Limestone. One calcareous specimen, more than 40 silicified specimens and many fragments from the Frankfort E. quadrangle, all from the Devils Hollow Member of the Lexington Limestone.

Types.—Neotype, USNM 41292A, paraneotypes, USNM 41292B–J; hypotypes, USNM 338709–338722.

Measurements.—The neotype left valve is 18.5 mm long and 13.1 mm high. A paraneotype right valve (USNM 41292B) is 18.8 mm long and 12.6 mm high. The measurements of eight specimens from the Devils Hollow Member of the Lexington Limestone are shown in table 7.

Discussion—Wetherby (1881, p. 80–81) described *Isochilina jonesi* and stated that it occurred in great numbers at a single locality in the Trenton Limestone of Mercer County, Ky., but gave no more precise locality data. Earlier, Wetherby (1880, p. 148) mentioned "***about two miles west of Harrodsburg junction, are several more or less heavily-bedded limestones, containing one or two layers which hold many specimens of very large bivalve Crustaceans; *Leperditia*, *Isochilina*, etc., as yet undescribed." Harrodsburg is in

TABLE 7.—*Measurements in millimeters of eight specimens of* Teichochilina jonesi *from the Lexington Limestone, Devils Hollow Member, USGS collection 5095–CO*

USNM No.	Valve	Length	Height
338711	Right	5.4	3.5
338717	Left	7.6	5.1
338718	do	8.2	5.5
338719	do	9.2	6.2
338720	do	9.7	6.7
338721	Right	10.7	7.3
338722	Left	11.2	7.4
338709	do	12.8	8.5

Mercer County, and probably this statement refers to the type locality of *I. jonesi*, as Wetherby described only this one ostracode. Ulrich (1891, p. 179, pl. 11, figs. 9a–c) discussed *I. jonesi* and illustrated a specimen about 19 mm long, which he stated was the largest example yet seen; he also stated that the species was very abundant in the massive gray limestone forming the top of the Trenton near Harrodsburg, Ky. Ulrich and Bassler (1923, p. 295, text fig. 13, 6–8) and Bassler and Kellett (1934, p. 13, text fig. 4, figs. 8–10) provided additional figures of *I. jonesi*, also from Harrodsburg, Ky., which they cited as evidence for the presence of an overlap platform in the genus *Isochilina* Jones, 1858. Swartz (1949, p. 324–325) proposed the genus *Teichochilina* for isochilinids with an overlap platform and designated *T. jonesi* (Wetherby, 1881) as the type, accepting the statement by Teichert (1937, p. 106) that *I. ottawa* Jones, 1858 lacks an overlap platform or has only a very narrow one, but rejecting *Anisochilina* Teichert, 1937 as an isochilinid. Swartz (1949, p. 325) did not figure *T. jonesi*, but referred to the illustrations of Ulrich and Bassler and Bassler and Kellett.

If we are to stabilize the nomenclature of *T. jonesi* (Wetherby, 1881) and the genus *Teichochilina* Swartz, 1949, a neotype for *T. jonesi* must be selected, because Wetherby's specimens are lost. The specimens studied by Ulrich and Bassler from near Harrodsburg, Mercer County, Ky., are probably topotypes, and are also the specimens on which Swartz based his concept of *Teichochilina*. These specimens, under USNM 41292, are in two boxes, both labeled "Plesiotypes," but one box containing 10 specimens also has a green diamond on the label. Consequently, I am here selecting a left valve, USNM 41292A (pl. 9, fig. 3) from this box to serve as the neotype of *Isochilina jonesi* Wetherby, 1881, and am considering the other nine specimens as paraneotypes.

As noted by Ulrich (1891, p. 179), *Teichochilina ampla* (Ulrich, 1891) is relatively shorter and higher than *T. jonesi*, although otherwise these species are similar. Swain (1957, pl. 60, fig. 9a, b; pl. 61, fig. 1) refigured the syntypes of *T. ampla*; these figures may be compared with the neotype of *T. jonesi* (pl. 9, fig. 3). Levinson (1951, p. 554, pl. 77, figs. 5a, b) illustrated thin sections of *T. jonesi*, which he considered to have three layers of shell.

Specimens of *T. jonesi* from the Devils Hollow Member of the Lexington Limestone are smaller and tend to be more postplete than those from the Perryville Limestone Member, but are otherwise so similar that they cannot be discriminated as a separate species.

Occurrence.—*Teichochilina jonesi* (Wetherby, 1881) has been found in the Perryville Limestone Member of the Lexington Limestone near Harrodsburg, Ky. (USNM 41292), in the Salvisa Bed of the Perryville in the Perryville quadrangle (USGS colln. 5015–CO) and Bryantsville quadrangle (USGS colln. 6137–CO), and in the Faulconer Bed of the Perryville in the Perryville quadrangle (USGS colln. 7853–CO). It occurs in the Devils Hollow Member of the Lexington Limestone in the Frankfort East quadrangle (USGS collns. D1207–CO, 5087–CO, 5095–CO, 7789–CO).

Genus PARABRIARTINA n. gen.

Type species.—*Briartina modesta* Ulrich and Swain in Swain, 1957.

Species included.—*Briartina extenta* Ulrich and Swain in Swain, 1957.

Diagnosis.—Leperditicopes with ventral margin nearly parallel to hinge line, oval adductor but no chevron scar, no distinct ventral lappet on right valve and very narrow overlap platform on left valve. No marginal brim.

Discussion.—Swain (1957, p. 550–551) described two species of leperditicopid ostracodes, *Briartina extenta* Ulrich and Swain in Swain, 1957 and *B. modesta* Ulrich and Swain in Swain, 1957, from Middle Ordovician formations, which he assigned to the genus *Briartina* Kegel, 1933 because of their almost amplete lateral outline. However, *Briartina*, from the Middle Devonian of the Eifel district, Germany, has a subocular chevron scar and a well-developed overlap platform on the left valve (Kegel, 1933, p. 924–929, pl. 46, figs. 11–14). These features are lacking on the two Ordovician species described by Swain. The differences between the Middle Devonian and Middle Ordovician forms are such that it seems desirable to place Swain's species in the new genus *Parabriartina*. The familial placement of this new genus may be somewhat questionable. Unlike *Eoleperditia, Bivia* and other leperditiid genera, *Parabriartina* lacks a ventral lappet in the right valve and has only a very narrow overlap platform in the left valve; although no carapaces have as yet been found, the valves appear to meet evenly. However, unlike *Isochilina, Teichochilina,* and other isochilinid genera, there is no marginal brim on either valve. It is here considered an isochilinid according to the revision of the family Isochilinidae.

Range.—Middle Ordovician (Blackriveran-Kirkfieldian) of eastern North America.

Parabriartina modesta (Ulrich and Swain in Swain, 1957)

Plate 7, figures 12–15

Briartina modesta Ulrich and Swain in Swain, 1957, p. 550–551, pl. 59, fig. 12.

Diagnosis.—*Parabriartina* having greatest width just anterior of midlength and at or just below midheight. Cardinal angles distinct but not flattened. In end view,

curve of valve is smooth but plunges sharply to commissure.

Description.—Lateral outline amplete; hinge line straight, anterior margin straight to gently curved to midheight of valve, rounding smoothly into gently curved ventral margin, posterior margin smoothly curved. Cardinal angles obtuse but distinct, not flattened, anterior more acute than posterior. In anterior view, both valves smoothly curved for about seven-eighths of height and then sharply curved to commissure. No ventral lappet on right valve, very narrow overlap platform on left valve, commissure apparently plane. No stop pits seen on right valve, very weak stop ridge on left valve. Eye tubercle low and obscure. Adductor scar oval, acuminate dorsally, individual stigmata not seen. No other muscle scars seen. Hinge not known. Shell surface smooth to weakly punctate.

Material.—Holotype and 14 paratypes from bottom of gorge, High Bridge, Ky.; more than seven hypotypes, also from High Bridge, Ky.

Types.—Holotype, USNM 54246; paratypes, USNM 54246A; hypotypes, USNM 338701–338704.

Measurements.—The holotype, a left valve, is 4.6 mm long, 2.7 mm high, and has a hinge length of 3.5 mm. A hypotype left valve (USNM 338703) is 6.3 mm long, 3.5 mm high, and has a hinge length of 4.8 mm. A hypotype right valve (USNM 338701) is 4.4 mm long, 2.6 mm high, and has a hinge length of 3.4 mm. A smaller hypotype right valve (USNM 338702) is 3.7 mm long, 2.2 mm high, and has a hinge length of 2.9 mm. A small hypotype left valve (USNM 338704) is 3.2 mm long, 1.8 mm high, and has a hinge length of 2.6 mm. All measurements made with a micrometer ocular.

Discussion.—The holotype and paratypes of *Parabriartina modesta* are preserved on the surface of slabs of dolomitic limestone in such a way that some of the diagnostic characters are difficult or impossible to see. The description given above is based largely on better preserved hypotype material which, like the primary types, is also from the lowest part of the section in the gorge of the Kentucky River at High Bridge, Ky., but probably slightly higher in the section, as according to Swain (1957, p. 551), the beds from which the types were collected are now under water. Unfortunately, even the better preserved hypotype specimens do not show the individual stigmata of the adductor scar in enough detail to count them. No stop pits have been seen on the exterior of the right valves, but when wetted, indications are that small stop pegs may be present internally. However, as yet this cannot be conclusively demonstrated.

Occurrence.—The holotype (USNM 54246) and paratypes (USNM 54246A) are labeled as coming from "near bottom of Kentucky River gorge at High Bridge, Ky."; these beds would now be included in the Camp Nelson Limestone. The hypotypes are also from the Camp Nelson, USGS colln. 7861–CO, from 0.6 feet above the base of the High Bridge section.

Parabriartina sp.

Plate 7, figures 10, 11

Description.—Lateral outline amplete; hinge line straight, anterior and posterior margins smoothly curved, ventral margin gently curved. Cardinal angles acute, flattened. In anterior view, both valves smoothly curved, maximum width slightly anterior to midpoint of valves. Very narrow overlap platform on left valve, ventral commissure plane. Eye tubercle low and obscure. Muscle scars and hinge not seen. Shell surface smooth.

Material.—Six specimens from the Tyrone Limestone, West Marble Creek section.

Types.—Figured specimens, USNM 338697, 338698, measured specimens USNM 338699, 338700.

Measurements.—The largest figured specimen, a right valve, is 3.3 mm long and 2.0 mm high, and the smallest figured specimen, a left valve, is 2.2 mm long and 1.3 mm high. An unfigured right valve is 3.4 mm long and 2.1 mm high, and an unfigured left valve is 1.9 mm long and 1.2 mm high. All measurements made with a micrometer ocular.

Discussion.—This form differs from other species of *Parabriartina* in having acute, flattened cardinal angles, and from *P. modesta* (Ulrich and Swain in Swain, 1957) in being more evenly curved in anterior view. It is left in open nomenclature because the few specimens available do not show many of the diagnostic features, and are so small that they may be juvenile instars.

Occurrence.—All specimens are from the Tyrone Limestone at the West Marble Creek section, USGS collns. D1139–CO, D1140–CO, and D1141–CO.

Genus CERATOLEPERDITIA Harris, 1960

Type species.—*Ceratoleperditia arbucklensis* Harris, 1960.

Ceratoleperditia kentuckyensis (Ulrich, 1891)

Plate 7, figures 16–21

Isochilina kentuckyensis Ulrich, 1891, p. 179–180, pl. 11, figs. 11a–d.
Heterochilina kentuckyensis (Ulrich). Swain, 1957, p. 549, pl. 59, figs. 13a, 13b.
Ceratoleperditia kentuckyensis (Ulrich). Harris, 1960, p. 212.
(Not) *Leperditia (Isochilina) armata* Walcott, 1883, p. 7.

Diagnosis.—Alate leperditicopids with midventral alae projecting perpendicular to plane of commissure. Large specimens tend to develop anteroventral swelling anterior to alae on both valves.

Description.—Lateral outline slightly postplete; hinge line straight, anterior margin sharply curved

beneath cardinal angle, ventral margin gently curved, posterior margin broadly curved. Cardinal angles acute, posterior more acute than anterior and may project posteriorly; both angles flattened. Flattened area at posterior angle extends ventrally about one-third to one-half height of posterior margin, otherwise no marginal brim. Large, blunt, flattened alar process at midlength in ventral quarter of both valves. Process falciform, curved posteriorly, elongated parallel to length and projecting perpendicular to plane of commissure. In large specimens, anteroventral bulge may be present anterior to and ventral of alae on both valves. Right valve has small locking pits along ventral margin, left valve has narrow overlap platform (pl. 7, fig. 20).

Eye tubercle low and inconspicuous. Adductor scar oval, acuminate dorsally, vertically elongate subocular scars may be present. Individual stigmata of adductor not seen. Shell surface smooth or lightly punctate. Hinge not seen.

Material.—Holotype of *Isochilina kentuckyensis* Ulrich, 1891, 11 hypotypes and many fragments from the West Marble Creek section, Valley View quadrangle, Ky.

Types.—Holotype, USNM 43155; hypotypes, USNM 338705–338708.

Measurements.—The holotype is 4.6 mm long, 2.9 mm high, and has a hinge length of 3.7 mm. A small right valve (USNM 338705) is 4.5 mm long, 2.7 mm high, and has a hinge length of 3.5 mm. A larger right valve (USNM 338707) is 6.6 mm long and 5.1 mm high. A large left valve (USNM 338708) is 9.0 mm long, 5.1 mm high, and has a hinge length of 7.2 mm.

Discussion.—Unfortunately, most of the specimens of *C. kentuckyensis* are poorly preserved and it has not been possible to extract many of them from the matrix with the margins and alae intact. However, as may be seen from the measurements above, the holotype is not a mature specimen. In the smaller instars such as the holotype, the alar process is not as well developed as it becomes in the larger instars, but not enough unbroken specimens are available to plot the change. One partly exfoliated right valve (USNM 338707; pl. 7, fig. 19) shows an oval adductor scar with many individual flecks and a train of larger subocular flecks that extends below the adductor scar; this is similar to the subocular scar figured for the Ordovician species *Paraeoleperditia fukujiensis* by Adachi and Igo (1980, figs. 2, 4), but is longer. However, this feature has been seen on only one specimen and might be an accident of preservation.

Bassler (1915, p. 672, 673) and Bassler and Kellett (1934, p. 337, 340) considered *Isochilina kentuckyensis* Ulrich, 1891 a junior synonym of *Isochilina armata* Walcott, 1883. This view was rejected by Swain (1957, p. 549) and Harris (1960, p. 212–213). The location of Walcott's holotype of *I. armata* is not known, and the species has not been restudied. Walcott (1883, pl. 17, fig. 10) illustrated a specimen which has a larger and more acute alar process than *C. kentuckyensis* specimens of the same or larger size. Although the two species are very similar and may prove to be synonymous, it seems desirable to keep them as separate taxa until Walcott's type is found or until topotype specimens have been carefully studied.

Harris (1960, p. 211–212) assigned his genus *Ceratoleperditia* and the type species *C. arbucklensis* to the family Leperditiidae and stated that the right valve overlapped the left with maximum overlap along the venter. However, his illustrations of *C. arbucklensis* (Harris, 1960, pl. 1, figs. 1–4) show no indication of an overlap platform or ventral lappet. Although *C. kentuckyensis*, like *C. arbucklensis*, lacks the marginal brim of typical isochilinids, the narrow overlap platform of the left valve and the lack of ventral lappet on the right valve, as well as the character of the subocular muscle scars, suggest that it is more closely allied to the Isochilinidae than to the Leperditiidae. I have not seen the types or other specimens of *C. arbucklensis*, but as Harris (1960, p. 212) assigned *C. kentuckyensis* to *Ceratoleperditia*, it seems reasonable to assume that this species is representative of *Ceratoleperditia*. Consequently, *Ceratoleperditia* is here classified under the family Isochilinidae. This agrees with Ulrich's original assignment of *C. kentuckyensis* to *Isochilina*.

Occurrence.—The holotype (USNM 43155) of *Ceratoleperditia kentuckyensis* (Ulrich, 1891) is labeled as coming from the upper Tyrone Limestone, High Bridge, Ky. The hypotype specimens (USNM 338705–338708) are all from the Tyrone, West Marble Creek section, Valley View quadrangle, Ky., USGS collns. D1137–CO, D1138–CO, D1139–CO, and D1141–CO.

Genus KENODONTOCHILINA n. gen.

Type species.—*Kenodontochilina pustulosa* n. sp.

Species included.—*Isochilina subnodosa subnodosa* Ulrich, 1891; *Kenodontochilina subnodosa glabra* n. subsp.; *Isochilina nelsoni* Ulrich and Bassler, 1935; ?*Beyrichia clavigera* Jones, 1891.

Diagnosis.—Isochilinids with locking pegs or pits in right valve very obscure or lacking, adductor muscle scar raised above valve surface as boss and separated from eye tubercle by sulcus. Distinct round node posterodorsal of adductor scar near hinge line. Marginal brims of both valves distinct, narrow ventrally, widest posteriorly. Subocular muscle scars weak or lacking.

Discussion.—This genus differs from *Isochilina*

Jones, 1858 and *Teichochilina* Swartz, 1949 in having greater relief on the surface of the valves, a more distinct marginal brim, and lacking any conspicuous locking pegs or pits on the margin of the right valve. It is most similar to *Dihogmochilina* Teichert, 1937 in the surface sculpture of the valves and the apparent lack of locking pegs and pits, but as redescribed by Copeland (1970, p. 10–13, pl. 2, 3), *Dihogmochilina* has a trailing subocular muscle scar anterior to the adductor scar, and also lacks the prominent dorsal node above the adductor scar. Another similar genus, *Hogmochilina* Solle, 1935, also lacks the dorsal node and, according to Abushik (1960b, p. 61), has a subocular muscle scar.

Swain (1957, p. 554) compared *Isochilina mimica* Ulrich and Swain, 1957 with the holotype left valve of *Kenodontochilina subnodosa subnodosa* (Ulrich, 1891) and noted similarities in the lobation of both species. However, the holotype of *Isochilina mimica* (USNM 113429) has two distinct locking pits, one at either end of the ventral margin, and this species is therefore not included in the genus *Kenodontochilina*. The peculiar species *Beyrichia clavigera* Jones, 1891 (pl. 11, fig. 5), redescribed by Copeland (1958) as *Ctenobolbina*, is questionably included in *Kenodontochilina* because of similarities in the pattern of lobation, although *K.? clavigera* is much more highly ornamented than other species assigned to the genus.

The generic name *Kenodontochilina* is derived from *kenodontis* (Gr.) meaning "toothless" and *cheilos* (Gr.) meaning "lip," in reference to the apparent lack of locking pegs on the margin of the right valve.

Range.—Middle and Upper Ordovician of eastern North America.

Kenodontochilina pustulosa n. sp.

Plate 10, figures 1, 2

Diagnosis.—Eye tubercle and dorsocentral node large, prominent, surface ornamented by lines of granules radiating from adductor scar.

Description.—Lateral outline amplete; hinge line straight, anterodorsal and posterodorsal margins nearly straight, anteroventral and posteroventral margins curved, ventral margin gently curved. Cardinal angles obtuse to about 90°, flattened, merging into marginal brim. Marginal brim wide anteriorly, distinctly set off from domicilium, wider posteriorly and sloping into domicilium, narrow ventrally. Eye tubercle large and distinct, separated from adductor scar by narrow, shallow sulcus. Anterodorsal part of valve anterior of eye tubercle inflated, separated from anteroventral part by shallow, transverse depression. Adductor scar raised above valve surface on swelling, acuminate dorsally, defined posteriorly by indistinct shallow sulcus and posterodorsally by oblique shallow sulcus separating adductoral swelling from large dorsocentral node, which is about same size as eye tubercle. Domicilium inflated anteriorly and ventrally, slopes into marginal brim posteriorly but develops posterodorsal swelling. Adductor scar ovate, acuminate dorsally; stigmata, subocular or other muscle scars not seen. Locking pits, if present, extremely small. Shell thick. Shell surface ornamented with lines of granules radiating from adductor scar.

Material.—One right valve, two left valves, and one crushed and broken left valve.

Types.—Holotype, USNM 338723; paratypes, USNM 338724–25.

Measurements.—The holotype right valve is 8.3 mm long and 4.4 mm high. A paratype left valve (USNM 338725) is 7.5 mm long and 4.0 mm high. A smaller paratype left valve (USNM 338724) is 5.2 mm long and 2.8 mm high.

Discussion.—This species differs from others assigned to *Kenodontochilina* by the radiating character of its surface ornament. *Kenodontochilina subnodosa subnodosa* (Ulrich, 1891) is more weakly granulose, and *K. nelsoni* (Ulrich and Bassler, 1935) has the granules evenly distributed over the surface. Neither of these species is as strongly lobate as *K. pustulosa*. *K.? clavigera* (Jones, 1891) is more strongly lobate and its granules do not appear to radiate from the adductor as in *K. pustulosa*. This type of ornamentation is most similar to that of *Saffordellina muralis* (Ulrich and Bassler, 1923), but *K. pustulosa* lacks the strong ridge parallel to the free margins that is characteristic of the genus *Saffordellina*.

Occurrence.—This species has been found in the Sunset Member of the Ashlock and Bull Fork Formations in USGS collns. 4492–CO, 8313–CO and 8315–CO.

Kenodontochilina subnodosa subnodosa (Ulrich, 1891)

Plate 10, figure 3

Isochilina subnodosa Ulrich, 1891, p. 177–178, pl. 11, figs. 7a–c; Ulrich and Bassler, 1908, p. 282, fig. 2; Grabau and Shimer, 1910, p. 342, text fig. 1656, l–k; Bassler, 1915, p. 674; Swain, 1957, p. 554, pl. 60, fig. 8.

Diagnosis.—Eye tubercle and adductor scar prominent, raised, posterior marginal brim more than twice as large as anterior, shell surface sparsely granulose or weakly punctate.

Description.—Lateral outline amplete to slightly postplete; hinge line straight, anterior margin evenly curved, ventral margin gently curved, posterior margin smoothly curved. Cardinal angles obtuse, flattened, merging into marginal brim. Marginal brim more than twice as wide posteriorly as anteriorly, very narrow ventrally. Eye tubercle large, separated from large adductor scar by shallow, short, poorly defined

sulcus. Adductor scar raised above valve surface on large swelling, defined posteriorly by shallow sulcus extending from dorsum about half height of valve and defined dorsally by shallow transverse sag or groove separating swelling from dorsocentral round node. Domicilium inflated and sharply set off from brim anteriorly and ventrally, but lower and sloping into marginal brim posteriorly, tending to be divided into ventral and dorsal lobes by shallow depression. Adductor scar oval; stigmata, subocular or other muscle scars not seen. No locking pits or pegs around marginal brim. Shell thin, shell surface sparsely granulose or weakly punctate.

Material.—One complete left valve and two left valves broken dorsally.

Types.—Holotype, USNM 41294.

Measurements.—The holotype, a left valve, is 7.9 mm long and 4.5 mm high.

Discussion.—Swain (1957, p. 554) redescribed the holotype of *Kenodontochilina subnodosa subnodosa* (Ulrich, 1891) and mentioned that the ornamentation appeared both granulose and punctate, rather than entirely punctate as described by Ulrich (1891, p. 178). This ornamentation is here considered to be one of the diagnostic criteria of *K. subnodosa subnodosa.* This species and subspecies may be distinguished from *K. nelsoni* (Ulrich and Bassler, 1935), figured on pl. 11, fig. 12, by its larger and more inflated adductor scar and more obscure ornamentation. *K.? clavigera* (Jones, 1891), shown on pl. 11, fig. 5, is more highly lobate and more highly ornamented. The differences between *K. subnodosa subnodosa* and other new taxa are discussed under those taxa.

Although Ulrich (1891, p. 178) stated that *K. subnodosa subnodosa* came from "Upper Trenton limestone, associated with *Leperditia linneyi*, at Perryville, Ky.," no specimens have been found in the collections studied from Perryville. However, these collections were from the Perryville Limestone Member of the Lexington Limestone, and it is possible that the species occurs in one of the other members.

Occurrence.—Lexington Limestone at Perryville, Ky.

Kenodontochilina subnodosa glabra n. subsp.

Plate 10, figures 4–10

Diagnosis.—Eye tubercle and adductor scar prominent, raised, posterior marginal brim more than twice as wide as anterior, shell surface smooth, cardinal angles sharp.

Description.—Lateral outline amplete to slightly preplete; hinge line straight, anterior margin sigmoidally curved anterodorsally, smoothly curved ventrally, ventral margin very gently curved to straight, posterior margin smoothly curved. Cardinal angles distinct, flattened, approximately 90°. Marginal brim about twice as wide posteriorly as anteriorly, narrow ventrally. Eye tubercle prominent, separated from large adductor scar by shallow, short sulcus. Adductor scar distinctly raised above valve surface on large swelling, defined posteriorly by shallow sulcus extending from dorsum to about half height of valve and defined dorsally by shallow transverse sag or groove separating swelling from dorsocentral round node. Domicilium inflated and sharply set off from brim anteriorly and ventrally, less sharply set off posteriorly, divided posteriorly into ventral and dorsal lobes by shallow depression. Adductor scar oval, composed of approximately 80 stigmata. No subocular or other muscle scars seen. No locking pits or pegs around marginal brim. Hinge simple, adont. Shell thin, shell surface smooth.

Material.—Fifteen calcareous specimens and more than 40 silicified fragments, from seven collections.

Types.—Holotype, USNM 338728, paratypes, USNM 338726–27, 338729–32.

Measurements.—The holotype, a right valve, is 8.9 mm long and 5.4 mm high. A paratype right valve (USNM 338727) is 8.4 mm long and 4.9 mm high. A paratype left valve (USNM 338732) is 9.1 mm long and 5.4 mm high. A small instar (USNM 338729) is 2.9 mm long and 1.2 mm high. Many specimens are broken and unsuitable for measurement.

Discussion.—*Kenodontochilina subnodosa glabra* is very similar to *K. subnodosa subnodosa* but differs in being smooth rather than having granulose ornamentation. It also has more acute cardinal angles and generally more distinct lobation, especially on the right valve. The lack of surface ornamentation also distinguishes it from any of the other species assigned to *Kenodontochilina.* Unfortunately, no carapaces of *K. subnodosa glabra* have been found, so it is not possible to determine exactly the overlap of the valves. The marginal brim appears to flare away from the plane of the valves in the anterodorsal corner of both valves, which suggests that the valves gaped slightly, but this cannot be demonstrated. Ventrally, the left valve has a very fine ridge in the position of the stop ridge and a very narrow "overlap platform," and the right valve curves smoothly to the contact margin.

Occurrence.—This subspecies has been found in the Sunset Member of the Bull Fork and Ashlock Formations and the Grant Lake and Gilbert Members of the Ashlock Formation in USGS collns. 4318–CO, 4491–CO, 6129–CO, 8315–CO, 8317–CO, 9420–CO, and 9421–CO.

Genus SAFFORDELLINA (Ulrich and Bassler, 1923)

Saffordella Ulrich and Bassler, 1923, p. 295, *non Saffordella* Dunbar, 1920.

Saffordellina Bassler and Kellett, 1934, p. 13, 14, 470; Hennings-

moen, 1953, p. 274; Pokorný, 1958, p. 129; Moore, 1961, p. Q132.

Type species.—*Saffordella muralis* Ulrich and Bassler, 1923.

Species included.—*Saffordellina striatella* n. sp.

Original diagnosis.—"Similar to Isochilina except that the surface is more nodose and has a long curved submarginal ridge." (Ulrich and Bassler, 1923, p. 295; Bassler and Kellett, 1934, p. 14).

Revised diagnosis.—Isochilinids having prominent adductoral boss, prominent eye tubercle, distinct dorsocentral node, and strong ridge approximately parallel to and inside free margin. Posterior nodes may be developed.

Discussion.—This genus was diagnosed and figured as a line drawing by Ulrich and Bassler (1923, p. 295, fig. 13, 9) without a description or discussion. Bassler and Kellett (1934, p. 13, fig. 4, 11) changed the name *Saffordella* to *Saffordellina* because the former was preoccupied by the brachiopod genus *Saffordella* Dunbar, 1920, but otherwise reproduced the original diagnosis and figure. Although Ulrich and Bassler and Bassler and Kellett had classified *Saffordellina* with the leperditicopids, Moore (1961, p. Q132) placed it under the Palaeocopida and suggested that it might belong with the Drepanellidae. However, the lobation, although greatly exaggerated, is typical of the Isochilinidae, and *Saffordellina* is here considered to belong in that family as suggested by Henningsmoen (1953, p. 274) and Pokorný (1958, p. 129). Because the type species, *S. muralis* (Ulrich and Bassler, 1923) is poorly known, it is here described and refigured.

Range.—Middle and Upper Ordovician of Southeastern United States.

Saffordellina muralis (Ulrich and Bassler, 1923)

Plate 11, figures 1-4

Saffordella muralis Ulrich and Bassler, 1923, p. 295, fig. 13, 9; Bassler, 1932, pl. 21, fig. 20.

Saffordellina muralis (Ulrich and Bassler). Bassler and Kellett, 1934, p. 13, 14, 470, fig. 4, 11; Pokorný, 1958, p. 129, fig. 650; Moore, 1961, p. Q132, fig. 64, 6.

Diagnosis.—Eye tubercle and adductoral boss prominent, dorsocentral node horizontally elongate, posterocentral node enclosed by ridge inside free margin, free margin thickened. Surface covered with lines of granules radiating from adductoral boss, eye tubercle, and posterocentral node.

Description.—Lateral outline amplete to slightly postplete; hinge line straight, anterior margin sharply curved, ventral margin gently curved but sinuate posteriorly, posterior margin smoothly curved. Cardinal angles flattened, anterior angle sharp, about 90°, posterior angle obtuse. Marginal brim thickened and curved under to contact margin, widest posteriorly, narrow ventrally, rises steeply to ridge that extends from about midheight on anterior end approximately parallel to contact margin to above midheight on posterior third of valve. Eye tubercle large and nodose, adductoral boss large, acuminate dorsally, with narrow rim and horizontal sag dorsally. Dorsocentral node irregular, elongated parallel to hinge line. Irregularly rounded node present inside ridge at about midheight on posterior third of valve. Surface covered with lines of granules that radiate from eye tubercle and adductor. Individual stigmata not seen, hinge not seen. Apparently no locking pits on right valve.

Material.—Fourteen specimens in type lot and 40 additional specimens from one locality.

Types.—Lectotype, here designated, USNM 41561A; figured paralectotypes, USNM 41561B–D; unfigured paralectotypes, USNM 41561.

Measurements.—The lectotype right valve is 5.4 mm long and 2.8 mm high. Two paralectotype left valves (USNM 41561B and USNM 41561D) are 6.3 mm long and 3.0 mm high and 5.5 mm long and 2.7 mm high, respectively.

Discussion.—The radiating lines of granules on the surface of *Saffordellina muralis* (Ulrich and Bassler, 1923) are similar in their general pattern to some of the so-called vascular markings radiating from the adductor scars of corroded specimens of other leperditicopes. These granules are believed to be the surface expression of structural elements in the thickness of the shell. The large nodes and the ridge all involve the entire thickness of the shell and are not surficial.

Bassler and Kellett (1934, p. 470) gave USNM 41561 as the number of the "holotype." However, USNM 41561 applies to a box containing 14 specimens and a label stating "Genotypes—41561, Saffordella muralis U. & B." and also to a box with the same number labeled as "seconds" of *S. muralis*, which contains 40 specimens. A lectotype, USNM 41561A (pl. 11, fig. 1), has therefore been designated, and because Ulrich and Bassler (1923, fig. 13, 9) figured a right valve, the most complete right valve was selected, although it is not the largest.

Occurrence.—All known specimens of *Saffordellina muralis* are from the "lower ostracod bed" of the Catheys Limestone at "Penitentiary quarry, West Nashville, Tenn."

Saffordellina striatella n. sp.

Plate 11, figures 6-11

Diagnosis.—Eye tubercle and adductoral boss large, prominent, dorsocentral node globular, separated from adductoral boss by shallow depression, one or two swellings in posterior third of valve. Ridge extending from midheight of anterior end to posterior third of

valve, merging with posterior swelling. Surface covered with lines of very fine granules, especially on ridge.

Description.—Lateral outline slightly postplete; anterior margin sigmoidally to evenly curved, ventral margin very gently curved, posterior margin evenly curved. Cardinal angles sharp, nearly 90°. Marginal brim slightly thickened and recurved anteriorly, flattened posteriorly and about twice as wide, very narrow ventrally. Eye tubercle large, prominent. Adductoral boss large, acuminate dorsally, separated from globular dorsocentral node by shallow horizontal sag. Ridge rises abruptly at about midheight above anterior marginal brim and swings above free margin, ending in posteroventral third of valve and tending to merge with posteroventral swelling. Irregular and variable posterodorsal swelling in posterior third of valve separated from posteroventral swelling by transverse depression. Surface covered with very fine granules in lines radiating from adductoral boss, most distinct over ridge. More than 80 stigmata in adductor scar, subocular muscle scars not seen. Hinge not seen. No locking pegs or pits.

Material.—Fifteen calcareous specimens from three localities, more than 20 silicified fragments from an additional locality.

Types.—Holotype, USNM 338735; paratypes, USNM 338733–338734, 338736–741.

Measurements.—The holotype right valve (USNM 338735) is 5.6 mm long and 3.2 mm high, and has a hinge length of 4.2 mm. The measurements of six paratypes are given in table 8.

Discussion.—This species has been assigned to *Saffordellina* because of its pronounced ridge and similarities of lobation. It differs from *S. muralis* (Ulrich and Bassler, 1923) in having the ridge ending below and almost confluent with the posteroventral node or swelling, in having a posterodorsal swelling, a larger adductor scar, and much finer surface ornamentation. *Kenodontochilina subnodosa glabra* is superficially similar to this species but lacks the distinct ridge and the granulose ornamentation.

The holotype and the measured paratypes from USGS colln. 4318–CO are probably not adult specimens. Larger specimens have been found in other collections (USGS 8317–CO, pl. 11, fig. 11; 8315–CO), but unfortunately these are broken and cannot be measured. However, it should be noted that in these larger specimens the ridge merges with and extends over the posteroventral swelling. Although these forms possibly could be considered another species, the difference may also be ontogenetic, and they are here placed in *S. striatella.*

TABLE 8.—*Measurements in millimeters of 6 specimens of* Saffordellina striatella *from USGS collection 4318–CO, Bull Fork Formation, Sunset Member*

USNM No.	Valve	Length	Height
338734	Left	3.5	2.0
338739	Right	4.2	2.5
338733	Left	4.4	2.4
338740	Right	5.7	3.4
338737	Left	5.8	3.4
338741	do	5.9	3.5

Occurrence.—*Saffordellina striatella* has been found in the Sunset Member of the Bull Fork Formation (USGS collns. 4318–CO, 8315–CO), in the Grant Lake Member of the Ashlock Formation (USGS colln. 8317–CO), and in the Gilbert Member of the Ashlock Formation (USGS colln. 6129–CO).

LOCALITY REGISTER

This register includes information only on the 32 USGS collections from which leperditicopid ostracodes were obtained, and only on collections made between 1961 and 1972 as part of the cooperative mapping program between the U.S. Geological Survey and the Kentucky Geological Survey. Older collections in the U.S. National Museum of Natural History and other institutions are discussed in the text. The 32 collections were made in 12 7.5-minute quadrangles, all in the State of Kentucky, which are shown on figure 1. The localities are arranged sequentially by the collection number assigned to each in the U.S. Geological Survey register of Cambrian and Ordovician localities (–CO). This sequence is also approximately the order in which the collections were made. The letter D before a collection number indicates that this number is entered in the U.S. Geological Survey Cambrian and Ordovician locality register kept in Denver, Colo. All other collections are entered in the USGS Cambrian and Ordovician locality register kept in Washington, D.C.

Each locality is indicated geographically and with a set of coordinates as was done in USGS Professional Paper 1066–A (Pojeta, 1979, p. A19). The coordinates are given in millimeters, measured first east and then north from the lower left corner of the 1:24,000 quadrangle map that shows the locality. Thus, locality 4491–CO is 193 mm east of the southwest corner of the Owingsville, Ky., quadrangle and 98 mm north of the 193 mm mark. In addition to the locality information, the following data are provided for each collection: The formation or member from which the collection was made, any available data on the stratigraphic position of the collection within the formation or section being collected, whether the collection was silicified, the weight (where known) of each silicified collection, and

the name of the quadrangle in which the collection was made. Many collections are from measured sections that have been designated by names and numbers; where such data are available they are listed. One asterisk (*) after a collection number indicates that the locality is published on a 1:24,000-scale geologic quadrangle map (GQ) of the area where the collection was made. Two asterisks (**) indicate that the section is published in U.S. Geological Survey Professional Paper 768 (Cressman, 1973) for collections from the Lexington Limestone, or U.S. Geological Survey Professional Paper 1151–E (Weir, Peterson, and Swadley, in press) for collections from younger formations.

Collection number ----**4318–CO****.
Geographic location ---Just north of Licking River in saddle crossed by light duty road heading almost due south, elevation approximately 715 ft.
Coordinates----------202 mm east, 12 mm north.
Formation ----------Sunset Member, Bull Fork Formation.
Quadrangle name -----Hillsboro, Ky., GQ–876.

Collection number ----**4491–CO***.
Geographic location ---Roadcut about 3.5 mi west of courthouse in Owingsville, Ky., on U.S. Route 60, near headwaters of Hurricane Creek.
Coordinates----------193 mm east, 98 mm north.
Formation ----------Sunset Member, Bull Fork Formation.
Quadrangle name -----Owingsville, Ky., GQ–1242.

Collection number ----**4492–CO****.
Geographic location ---Roadcuts on Kentucky Route 52, 2.5 mi east of Richmond, east of Lake Reba, elevation about 890 ft.
Coordinates----------Base of section at 8 mm east, 538 mm north.
Formation ----------Sunset Member, Ashlock Formation.
Quadrangle name -----Moberly, Ky., GQ–664.
Section name---------Lake Reba.

Collection number ----**4989–CO****.
Geographic location ---Roadcuts in east-bound lanes of Interstate Route 64, 0.5 mi east of Frankfort-Lawrenceburg, Ky., interchange.
Coordinates----------Base of section at 417 mm east, 148 mm north.
Formation ----------Devils Hollow Member, Lexington Limestone.
Stratigraphic position--55 ft above the base of the Brannon Member, Lexington Limestone.
Quadrangle name -----Frankfort West, Ky., GQ–1221.
Section name---------Frankfort West A.
Section number-------88.

Collection number ----**5015–CO****.
Geographic location ---Quarry 0.4 mi south of Perryville, Ky., on east side of Mitchellsburg Road, east side of Chaplin River.
Coordinates----------191 mm east, 92 mm north.
Formation ----------Salvisa Bed, Perryville Limestone Member, Lexington Limestone.
Stratigraphic position--5 ft above base of Salvisa Bed.
Silicified ----------Yes (1,423 lbs).
Quadrangle name -----Perryville, Ky., GQ–1185.
Section name---------Perryville B (Perryville South).
Section number-------30B.

Collection number ----**5087–CO***.
Geographic location ---Small roadcut on U.S. Route 421, 0.5 mi east of U.S. Routes 60 and 421 junction.
Coordinates----------242 mm east, 287 mm north.
Formation ----------Upper part of Devils Hollow Member, Lexington Limestone.
Silicified ----------Yes (458 lbs).
Quadrangle name -----Frankfort East, Ky., GQ–707.

Collection number ----**5095–CO****.
Geographic location ---Roadcut on north side of westbound lanes of Interstate Route 64, about 0.5 mi east of bridge over Kentucky River.
Coordinates----------123 mm east, 195 mm north.
Formation ----------Devils Hollow Member, Lexington Limestone.
Stratigraphic position--6–8 ft above the base of the Devils Hollow Member.
Silicified ----------Yes (542 lbs).
Quadrangle name -----Frankfort East, Ky.,[1] GQ–707.
Section name---------Frankfort East A.
Section number-------86.

Collection number ----**6129–CO.**
Geographic location ---Lebanon Stone quarry, north side of Kentucky Routes 49 and 52, 0.3 mi east of intersection of Kentucky Route 327 and Kentucky Routes 49 and 52.
Coordinates----------163 mm east, 464 mm north.
Formation ----------Gilbert Member, Ashlock Formation.
Silicified ----------Yes (68 lbs).
Quadrangle name -----Lebanon West, Ky., GQ–1509.

Collection number ----**6137–CO***.
Geographic location ---Roadcut on Kentucky Route 52, 1.45 mi east of junction with U.S. Route 150; 0.15 east of crossing of Kentucky Route 52 and Balls Branch Run.
Coordinates----------74 mm east, 35 mm north.
Formation ----------Salvisa Bed, Perryville Limestone Member, Lexington Limestone.
Stratigraphic position--8 ft above the Perryville Limestone Member-Tanglewood Limestone Member contact.
Silicified ----------Yes (105 lbs).
Quadrangle name -----Bryantsville, Ky., GQ–945.
Section name---------Bryantsville B.

Collection number ----**6915–CO****.
Geographic location ---Boyle County quarry, west side of U.S. route 68, 1.3 mi northeast of Perryville, Ky.
Coordinates----------217 mm east, 176 mm north.
Formation ----------Salvisa Bed, Perryville Limestone Member, Lexington Limestone.
Stratigraphic position--Basal 2 ft of the Salvisa Bed, 42 ft above the contact of the Tanglewood Limestone Member and the Perryville Limestone Member. Collected from northwest wall of quarry.

[1]The geologic map of this quadrangle incorrectly places this collection in the Tanglewood Limestone Member, Lexington Limestone.

Silicified ----------Yes (532 lbs).
Quadrangle name -----Perryville, Ky., GQ-1185.
Section name---------Perryville A (Perryville North).
Section number-------30A.

Collection number ----**6916-CO**.**
Geographic location ---The same as for 6915-CO.
Coordinates---------- Do.
Formation ----------Salvisa Bed, Perryville Limestone Member, Lexington Limestone.
Stratigraphic position--The same as for 6915-CO, but collected from east wall of quarry.
Silicified ----------Yes (236 lbs).
Quadrangle name -----Perryville, Ky., GQ-1185.
Section name---------Perryville A (Perryville North).
Section number-------30A.

Collection number ----**7789-CO**.**
Geographic location ---Eastbound lanes of Interstate Route 64 (both north and south sides), 0.8 mi. east of Kentucky River bridge crossing.
Coordinates----------The same as for 5095-CO.
Formation ----------Upper part of Devils Hollow Member, Lexington Limestone.
Silicified ----------Yes (422 lbs).
Quadrangle name -----Frankfort East, Ky., GQ-707.
Section name---------Frankfort East A.
Section number-------86.

Collection number ----**7853-CO**.**
Geographic location ---Quarry 0.4 mi south of Perryville, Ky., on east side of Mitchellsburg Road, east side of Chaplin River.
Coordinates----------The same as for 5015-CO.
Formation ----------Faulconer Bed, Perryville Limestone Member, Lexington Limestone.
Stratigraphic position--1 ft below Salvisa-Faulconer contact.
Quadrangle name -----Perryville, Ky., GQ-1185.
Section name---------Perryville B (Perryville South).
Section number-------30B.

Collection number ----**7856-CO**.**
Geographic location ---Dry Branch Road 0.5 mi south of junction with U.S. Route 68.
Coordinates----------Base of section at 53 mm east, 528 mm north.
Formation ----------Salvisa Bed, Perryville Limestone Member, Lexington Limestone.
Stratigraphic position--7 ft above Salvisa-Faulconer contact.
Quadrangle name -----Danville, Ky., GQ-985.
Section name---------Dry Branch Road.
Section number-------1009.

Collection number ----**7857-CO**.**
Geographic location ---The same as for 7856-CO.
Coordinates---------- Do.
Formation ----------Salvisa Bed, Perryville Limestone Member, Lexington Limestone.
Stratigraphic position--10 ft above Salvisa-Faulconer contact.
Quadrangle name -----Danville, Ky., GQ-985.
Section name---------Dry Branch Road.
Section number-------1009.

Collection number ----**7861-CO.**
Geographic location ---Roadcut along road up from Kentucky River lock no. 3 to High Bridge, Kentucky, and junction with Kentucky Route 29, 1,000 ft northwest of railroad bridge.
Coordinates----------Base of section at 104 mm east, 324 mm north.
Formation ----------Camp Nelson Limestone.
Stratigraphic position--0.6 ft above base of section.
Quadrangle name -----Wilmore, Ky., GQ-847.
Section name---------High Bridge.

Collection number ----**8313-CO**.**
Geographic location ---Along road to Peeled Oak, Kentucky Route 647, beginning 0.3 mi east of Howards Mill; elevation of base of section about 790 ft.
Coordinates----------Base of section at 140 mm east, 294 mm north.
Formation ----------Sunset Member, Bull Fork Formation.
Stratigraphic position--46 to 56.5 ft above base of section.
Quadrangle name -----Preston, Ky., GQ-1334.
Section name---------Howards Mill.
Section number-------207.

Collection number ----**8315-CO**.**
Geographic location ---The same as for 8313-CO.
Coordinates---------- Do.
Formation ----------Sunset Member, Bull Fork Formation.
Stratigraphic position--30 to 37 ft above base of section.
Quadrangle name -----Preston, Ky., GQ-1334.
Section name---------Howards Mill.
Section number-------207.

Collection number ----**8317-CO**.**
Geographic location ---The same as for 8313-CO.
Coordinates---------- Do.
Formation ----------Grant Lake Member, Ashlock Formation.
Quadrangle name -----Preston, Ky., GQ-1334.
Section name---------Howards Mill.
Section number-------207.

Collection number ----**9420-CO.**
Geographic location ---Along road heading south and east toward Licking River from benchmark 900; elevation about 800 ft.
Coordinates----------95 mm east, 131 mm north.
Formation ----------Sunset Member, Bull Fork Formation.
Quadrangle name -----Hillsboro, Ky., GQ-876.

Collection number ----**9421-CO.**
Geographic location ---Along road heading southeast from fork at elevation 801 in valley of South Lick Branch, 1.75 mi southeast of Tilton; elevation about 860 ft.
Coordinates----------447 mm east, 332 mm north.
Formation ----------Sunset Member, Bull Fork Formation.
Quadrangle name -----Sherburne, Ky., GQ-854.

Collection number ----**D1137-CO*.**
Geographic location ---Creek to west and parallel with Marble Creek, northwest of YMCA Daniel Boone Camp.
Coordinates----------Base of section at 115 mm east, 465 mm north.
Formation ----------Tyrone Limestone.
Stratigraphic position--31 ft above base of Tyrone.
Quadrangle name -----Valley View, Ky., GQ-470.

Section name----------West Marble Creek.
Section number--------32.

Collection number ----**D1138-CO***.
Geographic location ---The same as for D1137-CO.
Coordinates----------Do.
Formation ----------Tyrone Limestone.
Stratigraphic position--29 ft above base of Tyrone.
Quadrangle name ------Valley View, Ky., GQ-470.
Section name----------West Marble Creek.
Section number--------32.

Collection number ----**D1139-CO***.
Geographic location ---The same as for D1137-CO.
Coordinates----------Do.
Formation ----------Tyrone Limestone.
Stratigraphic position--33 ft above base of Tyrone.
Quadrangle name ------Valley View, Ky., GQ-470.
Section name----------West Marble Creek.
Section number--------32.

Collection number ----**D1141-CO***.
Geographic location ---The same as for D1137-CO.
Coordinates----------Do.
Formation ----------Tyrone Limestone.
Stratigraphic position--27 ft above base of Tyrone.
Quadrangle name ------Valley View, Ky., GQ-470.
Section name----------West Marble Creek.
Section number--------32.

Collection number ----**D1142-CO***.
Geographic location ---The same as for D1137-CO.
Coordinates----------Do.
Formation ----------Tyrone Limestone.
Stratigraphic position--14 ft above base of Tyrone.
Quadrangle name ------Valley View, Ky., GQ-470.
Section name----------West Marble Creek.
Section number--------32.

Collection number ----**D1144-CO***.
Geographic location ---The same as for D1137-CO.
Coordinates----------Do.
Formation ----------Camp Nelson Limestone.
Stratigraphic position--114 ft below base of Tyrone Limestone.
Quadrangle name ------Valley View, Ky., GQ-470.
Section name----------West Marble Creek.
Section number--------32.

Collection number ----**D1147-CO***.
Geographic location ---The same as for D1137-CO.
Coordinates----------Do.
Formation ----------Camp Nelson Limestone.
Stratigraphic position--196 ft below base of Tyrone Limestone.
Quadrangle name ------Valley View, Ky., GQ-470.
Section name----------West Marble Creek.
Section number--------32.

Collection number ----**D1207-CO****.
Geographic location ---Westbound lanes of Interstate Route 64, exposures beginning about 0.5 mi east of bridge crossing of Kentucky River.
Coordinates----------Base of collected section at 112.5 mm east, 188 mm north.
Formation ----------Devils Hollow Member, Lexington Limestone.
Stratigraphic position--256 ft above top of Tyrone Limestone.
Quadrangle name ------Frankfort East, Ky., GQ-707.
Section name----------Frankfort East A.
Section number--------86.

Collection number ----**D1283-CO****.
Geographic location ---Roadcuts along U.S. Route 150, 7 mi east of Bardstown Courthouse, near Fredericktown.
Coordinates----------Base of section at 82 mm east, 62 mm north.
Formation ----------Rowland Member, Drakes Formation.
Stratigraphic position--120 ft above base of Tate Member of Ashlock Formation.
Quadrangle name ------Maud, Ky., GQ-1043.
Section name----------Fredericktown (or Maud).

Collection number ----**D1284-CO****.
Geographic location ---The same as for D1283-CO.
Coordinates----------Do.
Formation ----------Rowland Member, Drakes Formation.
Stratigraphic position--125 ft above base of Tate Member of Ashlock Formation.
Quadrangle name ------Maud, Ky., GQ-1043.
Section name----------Fredericktown (or Maud).

Collection number ----**D1358-CO***.
Geographic location ---Creek to west and parallel with Marble Creek, northwest of YMCA Daniel Boone Camp.
Coordinates----------The same as for D1137-CO.
Formation ----------Camp Nelson Limestone.
Stratigraphic position--159 ft below base of Tyrone Limestone.
Quadrangle name ------Valley View, Ky., GQ-470.
Section name----------West Marble Creek.
Section number--------32.

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PLATES 1-11

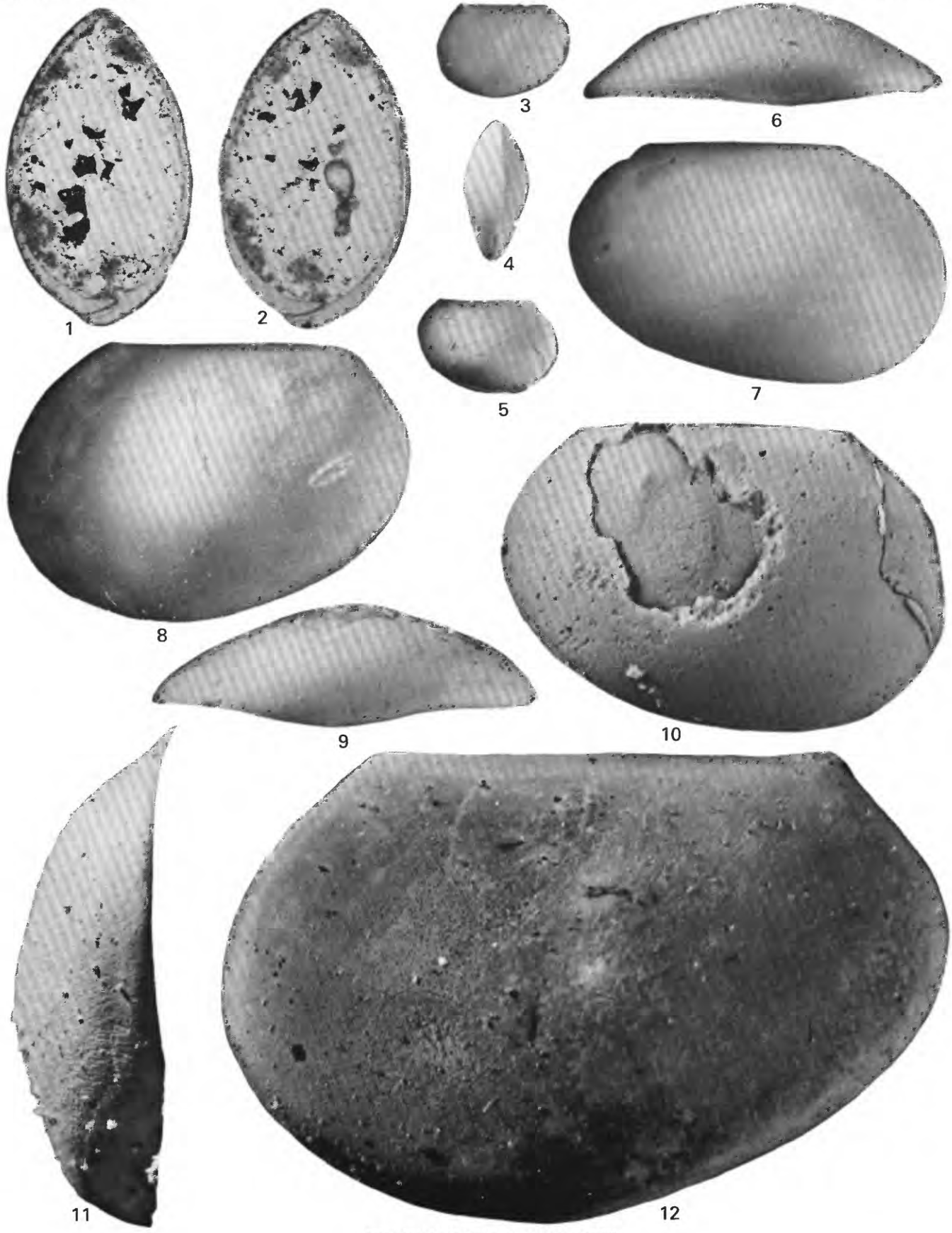
Contact photographs of the plates in this report are available, at cost, from the U.S. Geological Survey Library, Federal Center, Denver, CO 80225.

PLATE 1

[All figures × 10]

FIGURES 1–12. *Eoleperditia fabulites* (Conrad, 1843) (p. J18)

1. Acetate peel of section (USNM 338651) through anterior part of carapace from the Platteville Formation, Grant County, Wis., showing left valve abutting against stop peg in right valve.
2. Acetate peel of section (USNM 338652) of same specimen beyond stop peg.
3–5. Right lateral, ventral and left lateral views of small carapace (USNM 338653) from the Tyrone Limestone, USGS colln. D1138–CO.
6, 7. Ventral and lateral views of left valve (USNM 338654) from the Tyrone Limestone, USGS colln. D1138–CO.
8, 9. Lateral and ventral views of right valve (USNM 338655) from the Tyrone Limestone, USGS colln. D1138–CO.
10. Lateral view of partly exfoliated left valve (USNM 338656) from the Tyrone Limestone, USGS colln. D1138–CO, showing eye tubercle and muscle scar on steinkern.
11, 12. Anterior and lateral views of right valve of *Leperditia canadensis* var. *josephiana* Jones, 1858, holotype, GSC 1334h.



EOLEPERDITIA FABULITES

PLATE 2

[Figures 1–5 × 15, figures 6–13 × 10]

FIGURES 1–5. *Eoleperditia caecigena* (Miller, 1881) (p. J20)

1–4. Right, left, ventral and dorsal views of *Leperditia caecigena* Miller, 1881, holotype, UC 8883.

5. Right valve, USNM 41276A, from "Richmond-Saluda, Indian Kentuck Creek near Madison, Ind."

6–9. *Eoleperditia* sp. aff. *E. pauquettiana* (Jones, 1858) (p. J20)

6, 7. Ventral and lateral views of left valve (USNM 338659) from the Camp Nelson Limestone, USGS colln. D1147–CO.

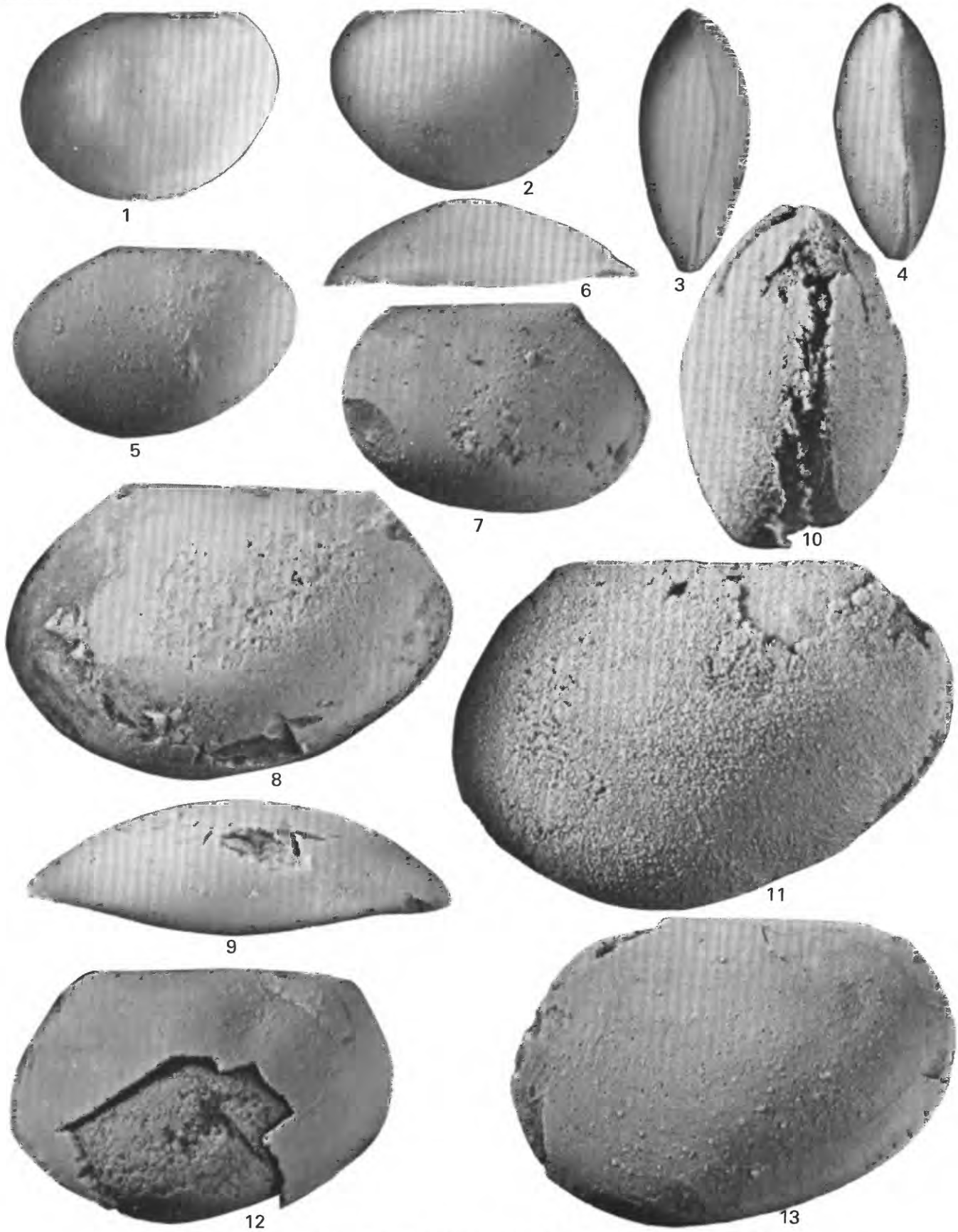
8, 9. Lateral and ventral views of right valve (USNM 338660) from the Camp Nelson Limestone, USGS colln. D1147–CO.

10–13. *Eoleperditia pauquettiana* (Jones, 1858) (p. J21)

10, 11. Anterior and right lateral views of silicified carapace, topotype, (USNM 338661) from Paquette Rapids, Ontario.

12. Lateral view of holotype right valve (GSC 1336a) from Paquette Rapids, Ottawa River, Ontario.

13. Lateral view of paratype right valve (GSC 1336) from Paquette Rapids, Ottawa River, Ontario, broken and exfoliated posteriorly but showing stop pits.



EOLEPERDITIA CAECIGENA, EOLEPERDITIA sp. aff. *E. PAUQUETTIANA, EOLEPERDITIA PAUQUETTIANA*

PLATE 3

[All figures × 10]

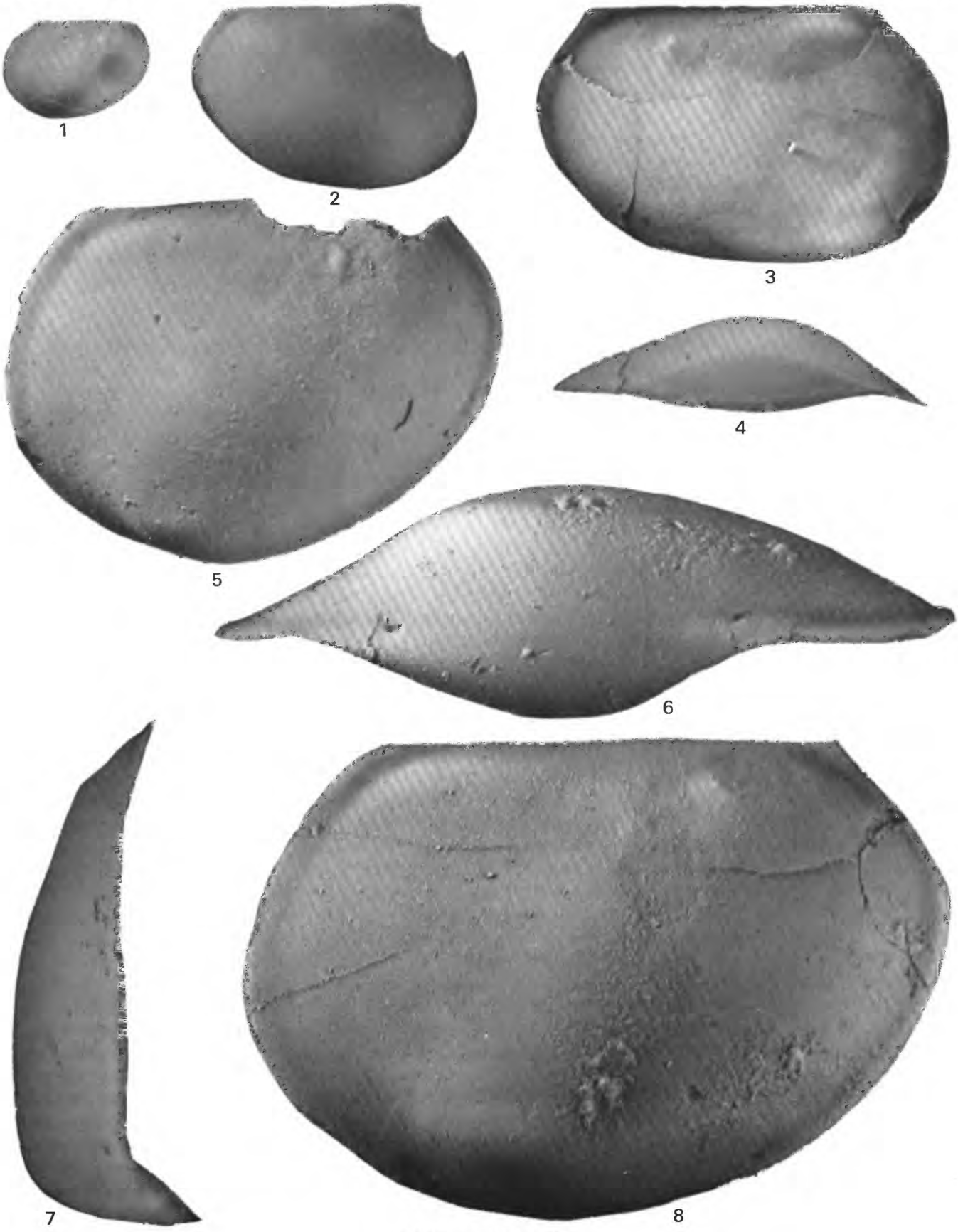
FIGURES 1–8. *Bivia tumidula* (Ulrich, 1891) (p. J21)

1. Lateral view of small right valve (USNM 338662), A–6?, from the Salvisa Bed of the Perryville Limestone Member, Lexington Limestone, USGS colln. 6137–CO.
2. Lateral view of broken left valve (USNM 338663), A–5?, from USGS colln. 6137–CO.

3, 4. Lateral and ventral views of left valve (USNM 338664), A–3?, from USGS colln. 6137–CO.

5. Lateral view of holotype right valve (USNM 41284) of *Leperditia tumidula* Ulrich, 1891.

6–8. Ventral, anterior and lateral views of right valve (USNM 338665), adult, from USGS colln. 6137–CO.



BIVIA TUMIDULA

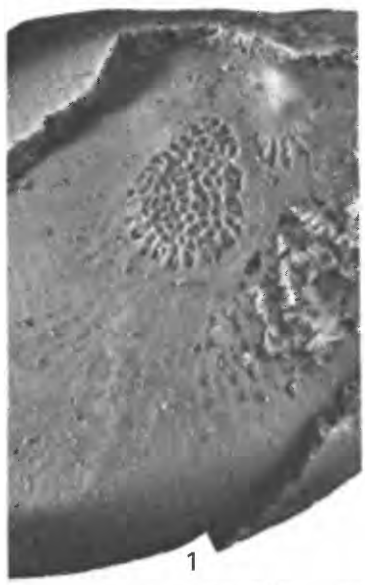
PLATE 4

[All figures × 10]

FIGURES 1–6. *Bivia tumidula* (Ulrich, 1891) (p. J21)

1. Anterior part of partly exfoliated right valve (USNM 338666) showing adductor and subocular muscle scars, lines radiating from adductor scar and anteroventral pits on steinkern, from USGS colln. 6137–CO.
2. Interior of incomplete silicified right valve (USNM 338667) showing three stop pegs on ventral margin of valve, from USGS colln. 6137–CO. Arrows point to stop pegs.
3. Lateral view of syntype left valve (USNM 41282A) of *Leperditia appressa* Ulrich, 1891, "Trentonian, near Harrodsburg, Ky."

4–6. Ventral, lateral, and anterior views of left valve (USNM 338668) from USGS colln. 6137–CO, for comparison with *Leperditia appressa*.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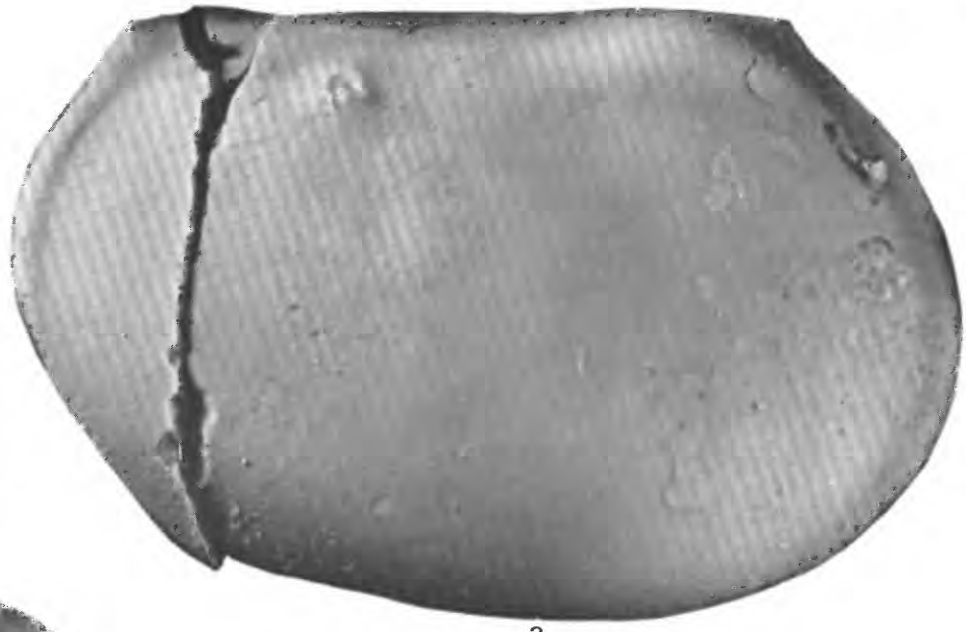
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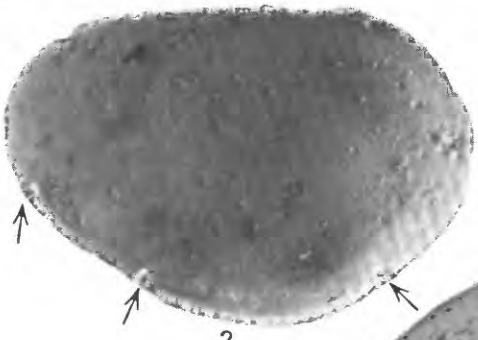
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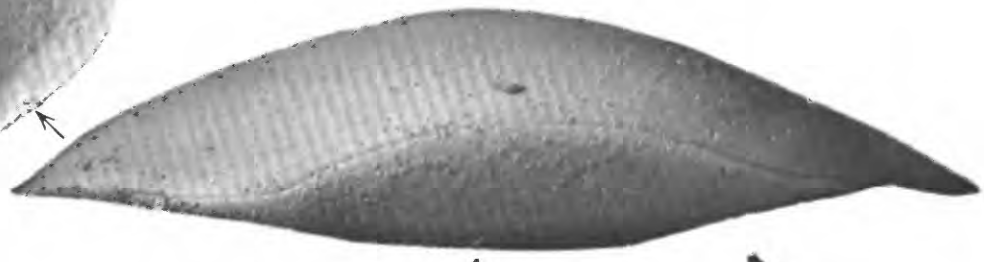
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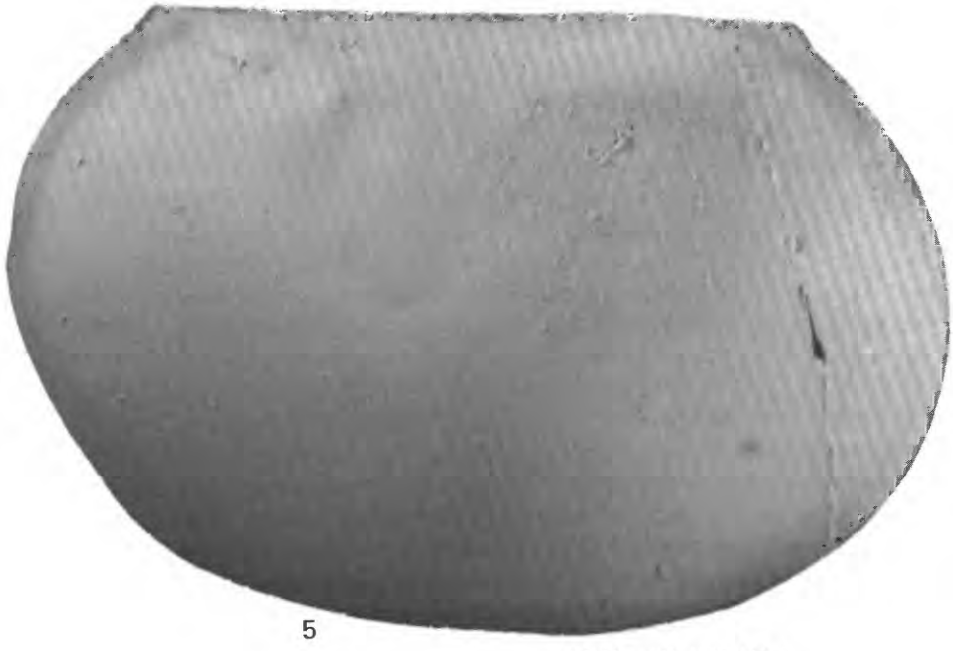
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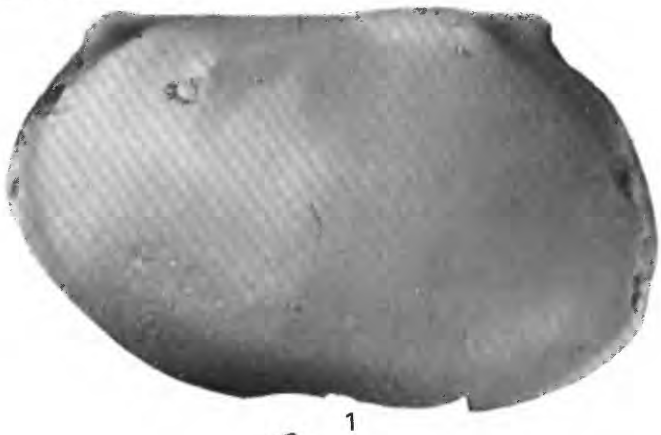
BIVIA TUMIDULA

PLATE 5

[All figures × 10]

FIGURES 1–7. *Bivia linneyi* (Ulrich, 1891) (p. J22)

1. Lateral view of left valve, syntype (USNM 41272B) of *Leperditia linneyi* Ulrich, 1891, from "up. Trenton, Salvisa ls., near Harrodsburg, Ky.", broken ventrally.
2–4. Left lateral, anterior and right lateral views of sheared incomplete carapace, syntype (USNM 41272A) of *Leperditia linneyi* Ulrich, 1891.
5, 6. Interior and exterior views of aberrant silicified right valve (USNM 338676) from USGS colln. 5015–CO. Cardinal angles broken, interior shows four stop pegs and muscle scars.
7. Lateral view of right valve, syntype (USNM 41272C) of *Leperditia linneyi* Ulrich, 1891 showing anterior stop pits.



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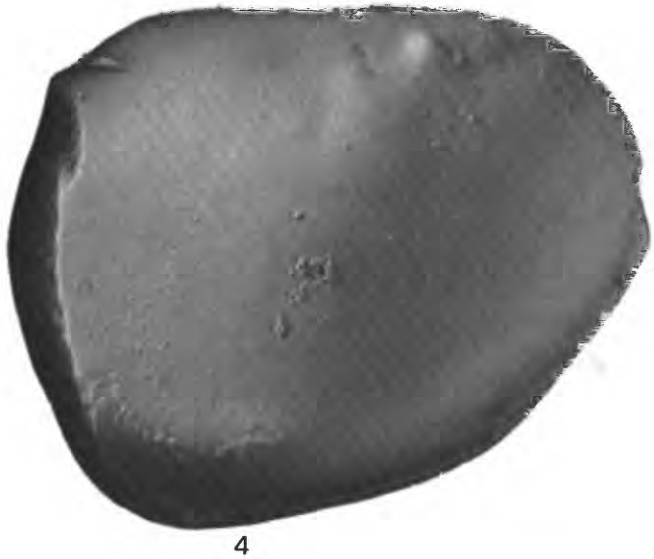

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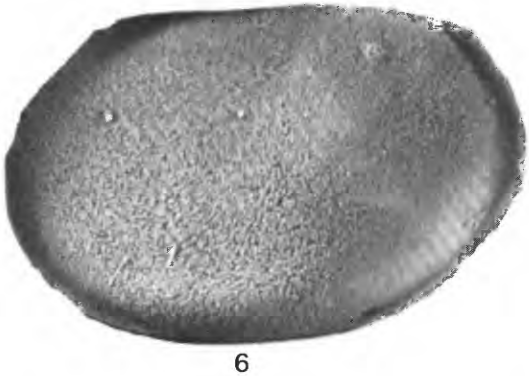

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BIVIA LINNEYI

PLATE 6

[All figures × 10]

FIGURES 1–17. *Bivia frankfortensis* (Ulrich, 1891) (p. J24)

1. Lateral view of small right valve (USNM 338677), A–5?, from the Devils Hollow Member, Lexington Limestone, USGS colln. D1207–CO.

2, 3. Lateral and ventral views of left valve (USNM 338678), A–4?, from the Devils Hollow Member, Lexington Limestone, USGS colln. D1207–CO.

4. Lateral view of left valve (USNM 338679), A–2?, from the Devils Hollow Member, Lexington Limestone, USGS colln. D1207–CO.

5, 6. Lateral and ventral views of right valve, (USNM 338680), A–2?, from the Devils Hollow Member, Lexington Limestone, USGS colln. D1207–CO.

7. Interior of small silicified left valve (USNM 338681), from the Devils Hollow Member, Lexington Limestone, USGS colln. 5095–CO.

8. Lateral view of left valve (USNM 338682), A–1?, from the Devils Hollow Member, Lexington Limestone, USGS colln. D1207–CO.

9, 10. Interior and lateral views of silicified right valve (USNM 338683), interior showing three stop pegs, from the Devils Hollow Member, Lexington Limestone, USGS colln. 5095–CO. Arrows point to stop pegs.

11. Interior of silicified right valve (USNM 338684) showing adductor muscle scar, from the Devils Hollow Member, Lexington Limestone, USGS colln. 5095–CO.

12–14. Lateral, interior and ventral views of silicified left valve (USNM 338685); interior view showing muscle scars and lines radiating from adductor scar, ventral view showing selvage line on overlap platform. From Devils Hollow Member, Lexington Limestone, USGS colln. 5095–CO.

15. Interior view of broken silicified right valve (USNM 338686) showing stigmata in adductor muscle scar, from the Devils Hollow Member, Lexington Limestone, USGS colln. 5095–CO.

16, 17. Anterior and lateral views of lectotype (USNM 41279A) of *Leperditia frankfortensis* Ulrich, 1891, from "Trenton, (upper Cynthiana), Reservoir Hill, Frankfort, Ky."


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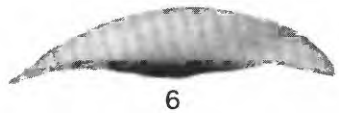
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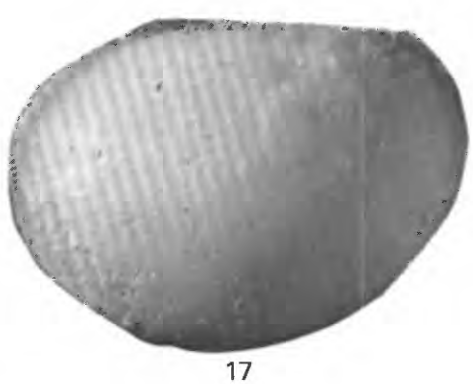
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BIVIA FRANKFORTENSIS

PLATE 7

[All figures × 10]

FIGURES 1–7. *Isochilina copelandi* n. sp. (p. J25)

1. Lateral view of small left valve, paratype (USNM 338688), from the Sunset Member, Ashlock Formation, USGS colln. 4492–CO.
2. Lateral view of larger left valve, paratype (USNM 338689), from the Sunset Member, Ashlock Formation, USGS colln. 4492–CO.
3. Lateral view of right valve, paratype (USNM 338690), from the Sunset Member, Ashlock Formation, USGS colln. 4492–CO.
4. Lateral view of left valve, paratype (USNM 338691), broken posteriorly, from the Sunset Member, Ashlock Formation, USGS colln. 4492–CO.
5. Lateral view of right valve, paratype (USNM 338692), from the Sunset Member, Ashlock Formation, USGS colln. 4492–CO.
6. Lateral view of right valve, paratype (USNM 338693), from the Sunset Member, Ashlock Formation, USGS colln. 4492–CO.
7. Lateral view of slightly crushed left valve, holotype (USNM 338694), showing eye tubercle and raised boss over adductor muscle scar, from the Sunset Member, Ashlock Formation, USGS colln. 4492–CO.

8, 9. *Isochilina* sp. (p. J26)

8. Lateral view of right valve, (USNM 338695) from the Rowland Member, Drakes Formation, USGS colln. D1283–CO.
9. Lateral view of left valve (USNM 338696) from the Rowland Member, Drakes Formation, USGS colln. D1284–CO.

10, 11. *Parabriartina* sp. (p. J29)

10. Lateral view of right valve (USNM 338697), broken posteriorly, from the Tyrone Limestone, USGS colln. D1141–CO.
11. Lateral view of left valve (USNM 338698), from the Tyrone Limestone, USGS colln. D1139–CO.

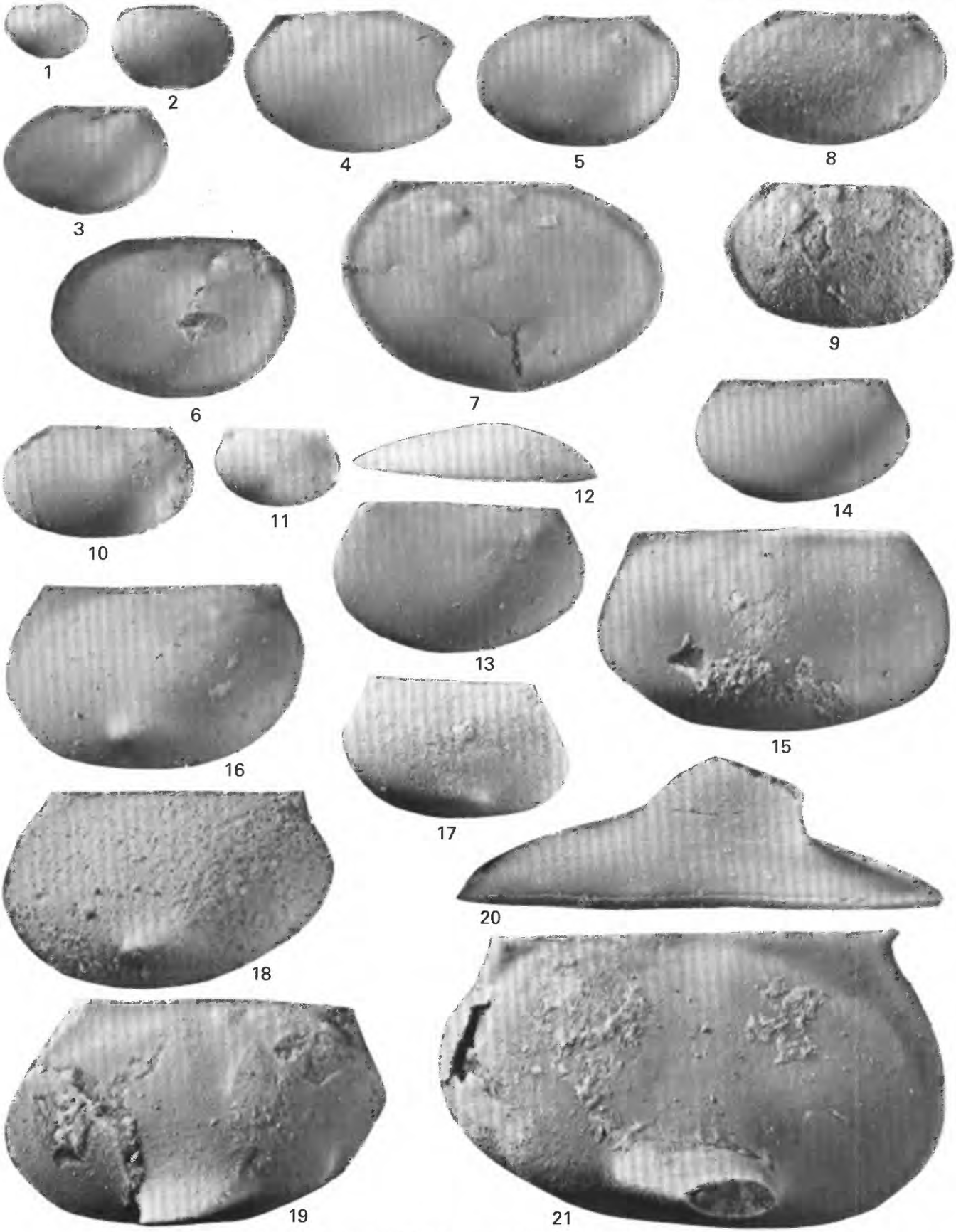
12–15. *Parabriartina modesta* (Ulrich and Swain in Swain, 1957) (p. J28)

12, 13. Ventral and lateral views of right valve (USNM 338701), from the Camp Nelson Limestone, USGS colln. 7861–CO.
14. Lateral view of right valve (USNM 338702), from the Camp Nelson Limestone, USGS colln. 7861–CO.
15. Lateral view of left valve (USNM 338703), from the Camp Nelson Limestone, USGS colln. 7861–CO, showing slight posterodorsal inflation.

16–21. *Ceratoleperditia kentuckyensis* (Ulrich, 1891) (p. J29)

16. Lateral view of right valve (USNM 338705), from the Tyrone Limestone, USGS colln. D1137–CO.
17. Lateral view of small left valve (USNM 338706), from the Tyrone Limestone, USGS colln. D1139–CO.
18. Lateral view of holotype right valve (USNM 43155) of *Isochilina kentuckyensis* Ulrich, 1891, from "Upper Tyrone ls. (Lowville), High Bridge, Kentucky".
19. Lateral view of partly exfoliated right valve (USNM 338707), from the Tyrone Limestone, USGS colln. D1138–CO, showing muscle scar on steinkern.

20, 21. Ventral and lateral views of left valve (USNM 338708), from the Tyrone Limestone, USGS colln. D1139–CO.



ISOCHILINA COPELANDI, ISOCHILINA sp., *PARABRIARTINA* sp., *PARABRIARTINA MODESTA, CERATOLEPERDITIA KENTUCKYENSIS.*

PLATE 8

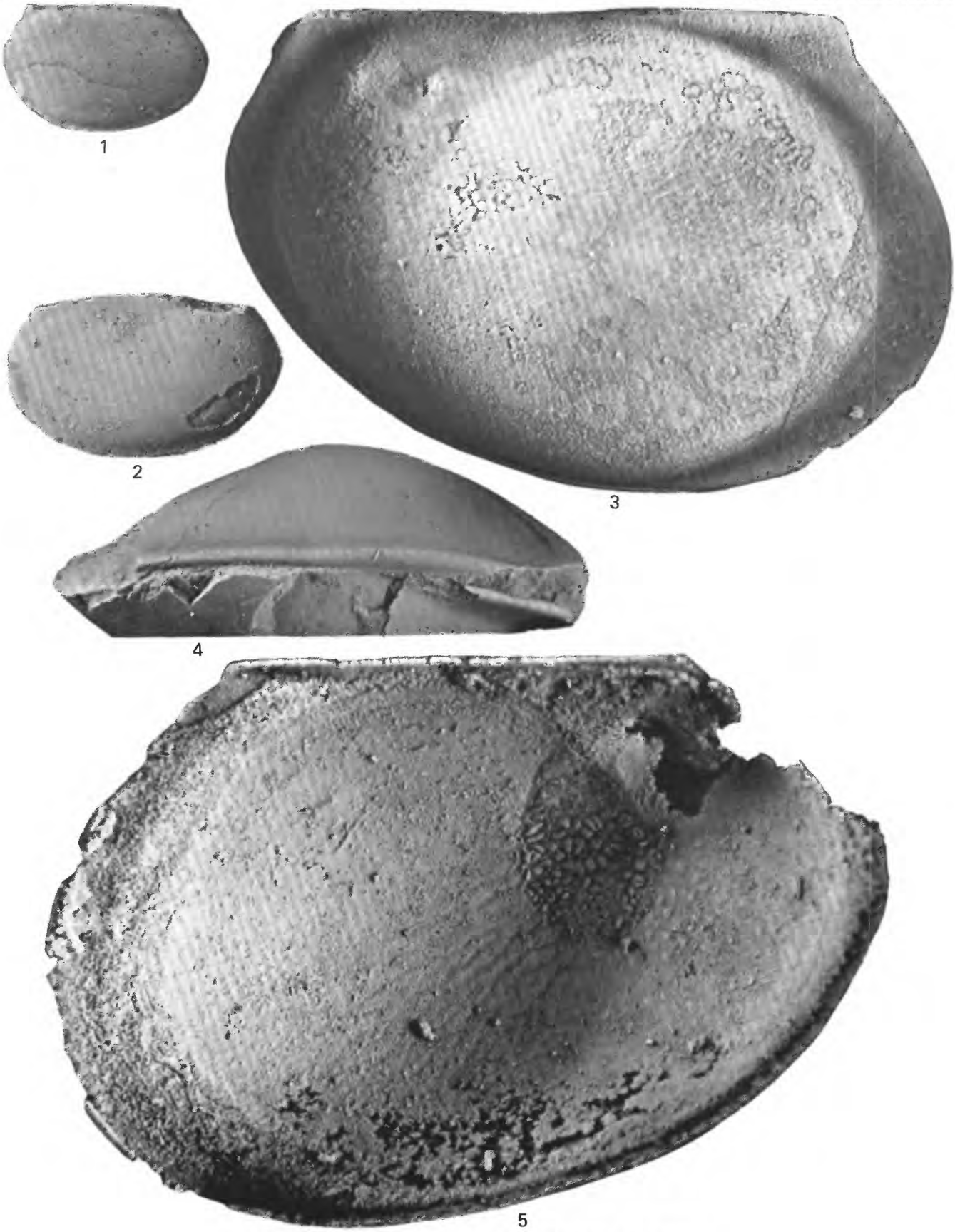
[Figures 1–3 and 5 × 10; figure 4 × 5]

FIGURES 1, 2. *Isochilina ottawa* Jones, 1858 (p. J26)

1. Lateral view of holotype left valve (GSC 1077) of *Leperditia (Isochilina) ottawa* Jones, 1858, from "Beekmantown, canal at Grenville, Argenteuil County, Quebec".
2. Lateral view of paratype right valve (GSC 1077a) of same species from the same locality.

3–5. *Teichochilina jonesi* (Wetherby, 1881) (p. J27)

3. Lateral view of silicified left valve (USNM 338709) from the Devils Hollow Member, Lexington Limestone, USGS colln. 5095–CO, showing lines radiating from the adductor scar on a partly corroded valve.
4. Ventral view of a sheared carapace (USNM 41292C) from "Mohawkian (Trenton), near Harrodsburg, Ky., Perryville ls." identified by E. O. Ulrich, showing the overlap platform on the left valve. Possibly a specimen on which Ulrich and Bassler (1923, p. 295, fig. 13, 7, 8) based their drawing of the overlap platform.
5. Interior of silicified left valve (USNM 338710) from the Devils Hollow Member, Lexington Limestone, USGS colln. 5087–CO, showing "venous" markings for comparison with figure 3, adductor muscle scar and anteroventral tubercles.



ISOCHILINA OTTAWA, TEICHOCHILINA JONESI

PLATE 9

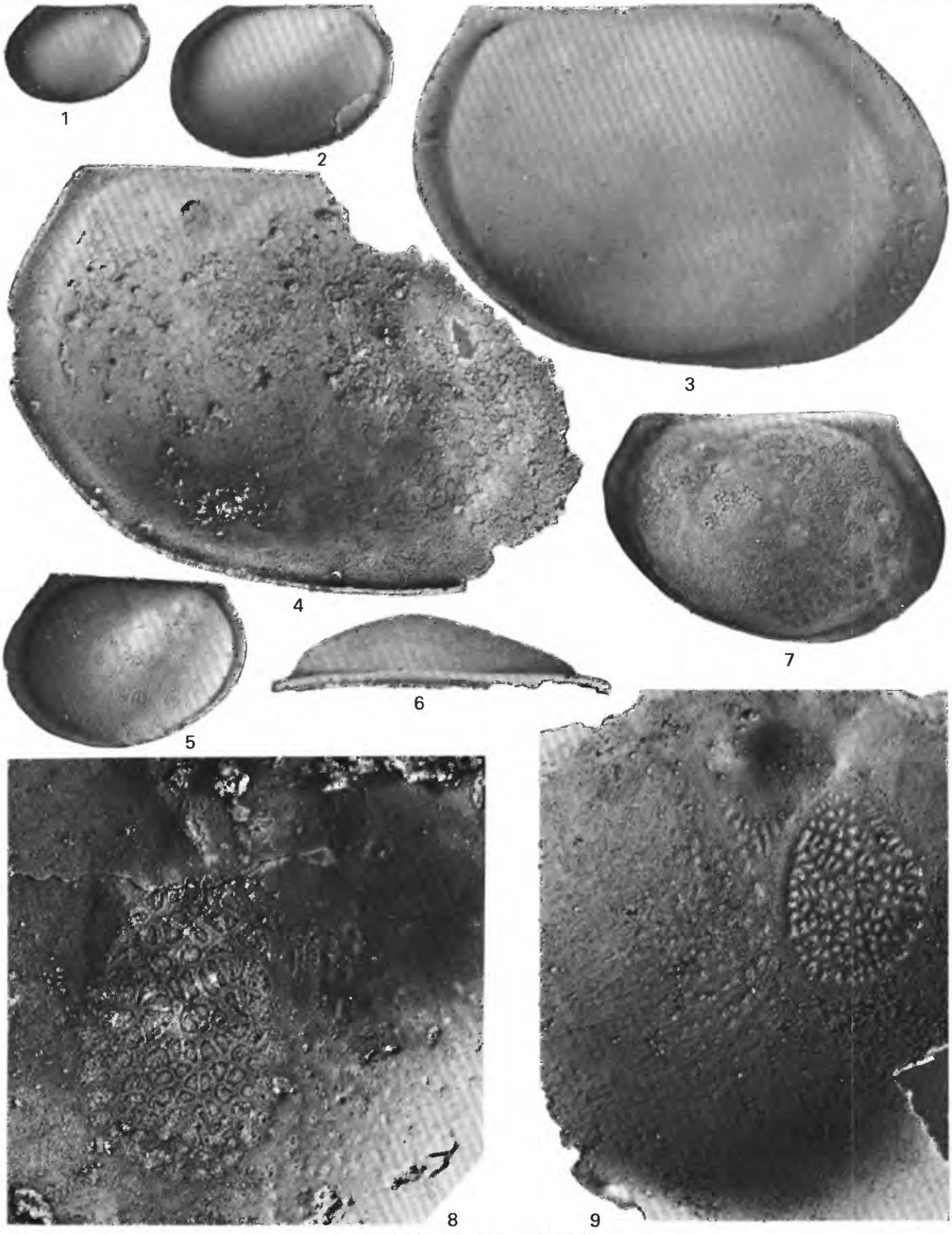
[Figures 1–7 × 5; figures 8, 9 × 10]

FIGURES 1–9. *Teichochilina jonesi* (Wetherby, 1881) (p. J27)

1. Lateral view of small silicified right valve (USNM 338711), from the Devils Hollow Member, Lexington Limestone, USGS colln. 5095–CO.
2. Lateral view of calcareous right valve (USNM 338712), from the Perryville Limestone Member, Lexington Limestone, USGS colln. 7853–CO.
3. Lateral view of calcareous left valve, neotype (USNM 41292A), from "Mohawkian (Trenton), near Harrodsburg, Ky. (Perryville)."
4. Interior of silicified right valve (USNM 338713), from the Perryville Limestone Member, Lexington Limestone, USGS colln. 5015–CO, showing three stop pegs.
5. Lateral view of silicified right valve (USNM 338714), from the Devils Hollow Member, Lexington Limestone, USGS colln. 7789–CO.

6, 7. Ventral and lateral views of silicified left valve (USNM 338709), from the Devils Hollow Member, Lexington Limestone, USGS colln. 5095–CO.

8. Interior view of adductor and subocular muscle scars, left valve (USNM 338715), from the Perryville Limestone Member, Lexington Limestone, USGS colln. 5015–CO.
9. Interior view of adductor and subocular muscle scars and randomly placed anteroventral tubercles, silicified right valve (USNM 338716), from the Perryville Limestone Member, Lexington Limestone, USGS colln. 6137–CO.



TEICHOCHILINA JONESI

PLATE 10

[All figures × 10]

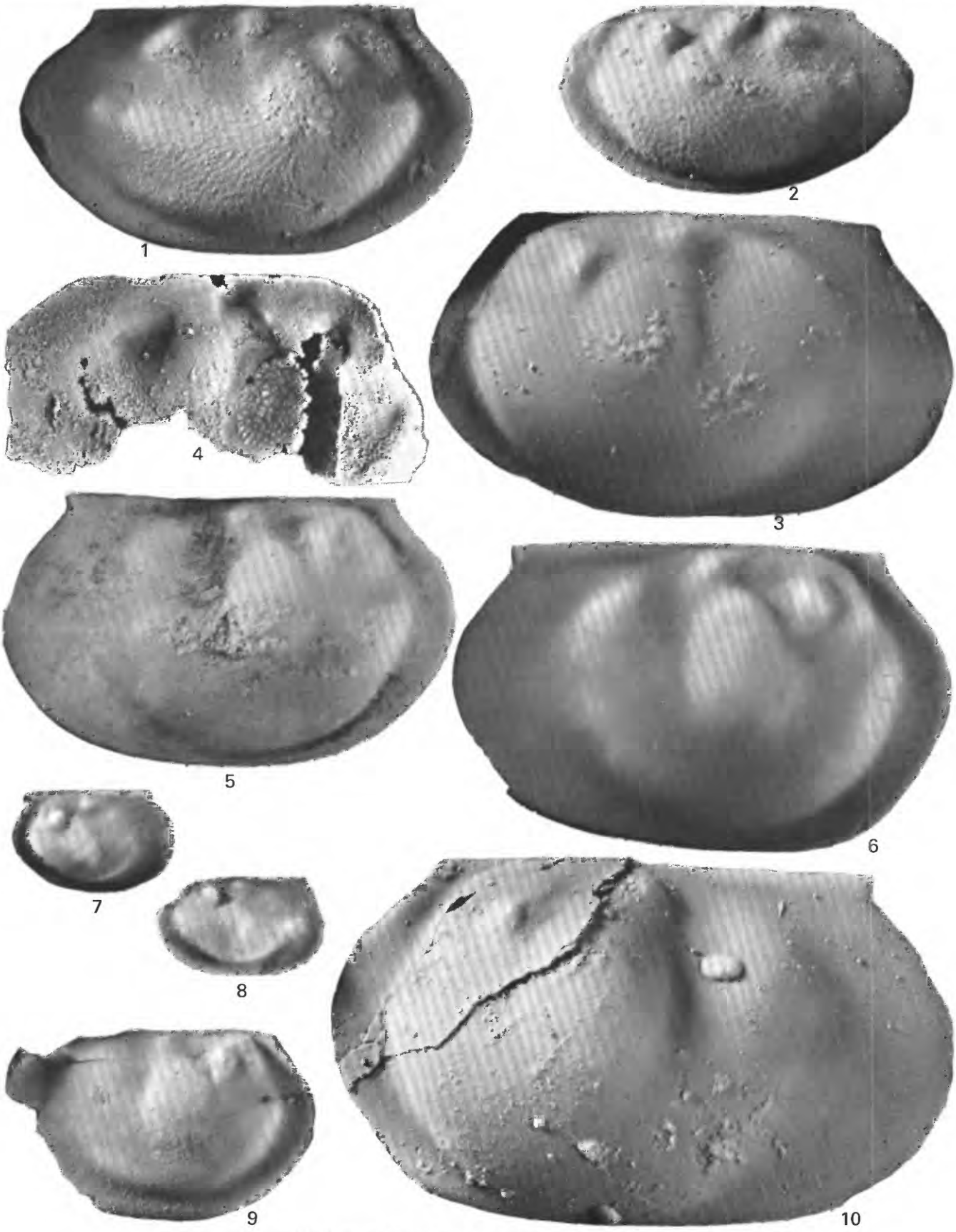
FIGURES 1, 2. *Kenodontochilina pustulosa* n. sp. (p. J31)

1. Lateral view of right valve, holotype (USNM 338723), from the Sunset Member, Bull Fork Formation, USGS colln. 8313–CO.
2. Lateral view of left valve, paratype (USNM 338724), from the Sunset Member, Ashlock Formation, USGS colln. 4492–CO.

3. *Kenodontochilina subnodosa subnodosa* (Ulrich, 1891) (p. J31)
   Lateral view of left valve, holotype (USNM 41294) of *Isochilina subnodosa* Ulrich, 1891, from "Mohawkian (Trenton), Perryville, Ky."

4–10. *Kenodontochilina subnodosa glabra* n. subsp. (p. J32)

4. Interior of broken silicified left valve, paratype (USNM 338726), from the Gilbert Member, Ashlock Formation, USGS colln. 6129–CO, showing adductor muscle scar.
5. Lateral view of right valve, paratype (USNM 338727), from the Sunset Member, Bull Fork Formation, USGS colln. 9421–CO.
6. Lateral view of right valve, holotype (USNM 338728), from the Sunset Member, Bull Fork Formation, USGS colln. 9421–CO.
7. Lateral view of small left valve, paratype (USNM 338729), from the Sunset Member, Bull Fork Formation, USGS colln. 4318–CO.
8. Lateral view of small left valve, paratype (USNM 338730), from the Sunset Member, Bull Fork Formation, USGS colln. 4318–CO.
9. Lateral view of broken right valve, paratype (USNM 338731), from the Sunset Member, Bull Fork Formation, USGS colln. 9420–CO.
10. Lateral view of large left valve, paratype (USNM 338732), from the Sunset Member, Bull Fork Formation, USGS colln. 9421–CO.



KENODONTOCHILINA PUSTULOSA, KENODONTOCHILINA SUBNODOSA SUBNODOSA, KENODONTOCHILINA SUBNODOSA GLABRA.

PLATE 11

[All figures × 10]

FIGURES 1–4. *Saffordellina muralis* (Ulrich and Bassler, 1923) (p. J33)

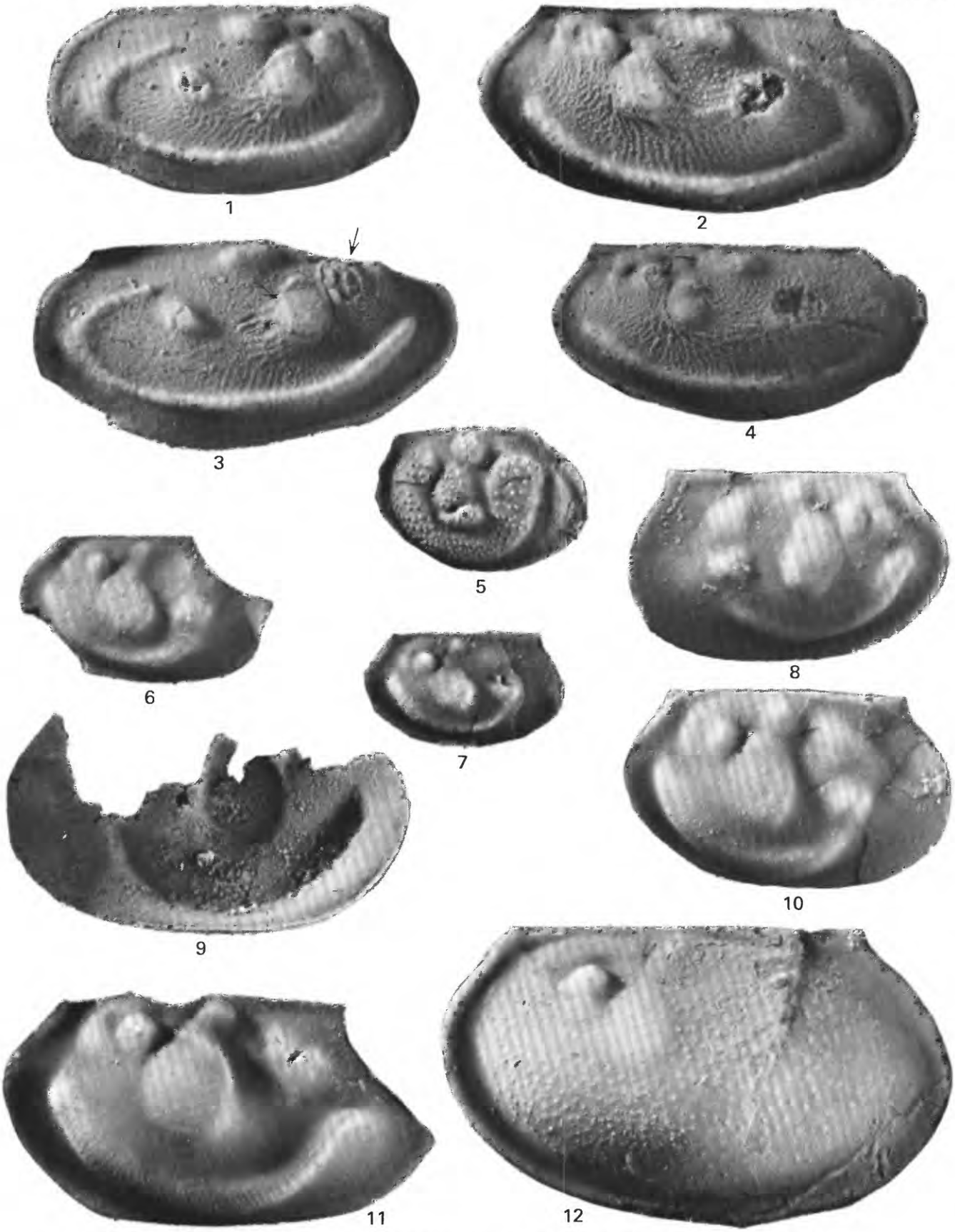
1. Lateral view of right valve, lectotype (USNM 41561A), from "Upper Trenton = Catheys form., lower ostracod bed at penitentiary, West Nashville, Tenn."
2. Lateral view of left valve, paralectotype (USNM 41561B), from the same locality as above.
3. Lateral view of broken right valve, paralectotype (USNM 41561C), from same locality as above. Arrows point to eye tubercle (broken) and adductoral boss.
4. Lateral view of left valve, paralectotype (USNM 41561D), from same locality as above.

5. *Kenodontochilina? clavigera* (Jones, 1891) (p. J31)
   Lateral view of latex squeeze of left valve (USNM 41654A), from "Shales near top of Chazy gr., Broad St., Aylmer, Can."

6–11. *Saffordellina striatella* n. sp. (p. J33)

6. Lateral view of broken left valve, paratype (USNM 338733), from the Sunset Member, Bull Fork Formation, USGS colln. 4318–CO.
7. Lateral view of small left valve, paratype (USNM 338734), from the Sunset Member, Bull Fork Formation, USGS colln. 4318–CO.
8. Lateral view of right valve, holotype (USNM 338735), from the Sunset Member, Bull Fork Formation, USGS colln. 4318–CO.
9. Interior of broken silicified valve, paratype (USNM 338736), from the Gilbert Member, Ashlock Formation, USGS colln. 6129–CO, showing adductor muscle scar and subocular scars.
10. Lateral view of crushed left valve, paratype (USNM 338737), from the Sunset Member, Bull Fork Formation, USGS colln. 4318–CO.
11. Lateral view of large broken left valve, paratype (USNM 338738), from the Grant Lake Member, Ashlock Formation, USGS colln. 8317–CO.

12. *Kenodontochilina nelsoni* (Ulrich and Bassler, 1935) (p. J30)
    Lateral view of left valve, paratype (USNM 68765E), from "Trenton (Catheys—ostracode zone), City Reservoir Hill, Nashville, Tenn."



SAFFORDELLINA MURALIS, KENODONTOCHILINA? CLAVIGERA, SAFFORDELLINA STRIATELLA, KENODONTOCHILINA NELSONI.