Philomedinae (5). *?L.Carb.-?U. Carb., Rec.* (SY)

[133-*137*] Cylindroleberididae (3;1). *Rec.* (SY)

[134-*102*] Cyprellidae (1). *L.Carb.-U.Carb.* (SY)

[135-*82*] Cypridinellidae (4). *L.Dev.-U.Carb.* (SY)

[136-*103*] Rhombinidae (2). *L.Carb.-U.Carb.* (SY)

[137-*92*] Sarsiellidae (3). *?M.Dev., Rec.* (SY)
Family Uncertain (1). *L.Sil.-U.Sil.*

[138-*34*] Halocypridacea *(superfamily)* (5). *Rec.* (SY)

[139-*139*] Halocyprididae (5). *Rec.* (SY)

[140-*12*] Cladocopina *(suborder)* (4). *?L.Dev.-?U.Dev., L.Miss.-Rec.* (SY)

[141-*90*] Polycopidae (3). *?L.Dev.-?U.Dev., L.Jur.-Rec.* (SY)
Family Uncertain (1). *Miss.*
Order and Suborder Uncertain (21). *Dev.*

[142-*78*] Buregiidae (1). *Dev.* (SH)
Family Uncertain (20). *L.Ord.-Mio.*
Nomina Dubia (78)

SYSTEMATIC DESCRIPTIONS

By R. H. Benson, J. M. Berdan, W. A. van den Bold, Tetsuro Hanai, Ivar Hessland, H. V. Howe, R. V. Kesling, S. A. Levinson, R. A. Reyment, R. C. Moore, H. W. Scott, R. H. Shaver, I. G. Sohn, L E. Stover, F. M. Swain, and P. C. Sylvester-Bradley

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Subclass OSTRACODA Latreille, 1806

[=Ostrachoda Latreille, 1802; Ostrapoda Straus, 1821] [Type-genus designated Sylvester-Bradley, herein, *Cypris* Müller, 1776] [Diagnosis by P. C. Sylvester-Bradley, University of Leicester]

Laterally compressed Crustacea with bivalve carapace, more or less calcified, and hinged along dorsal margin, enclosing bisegmented body with head undifferentiated, bearing 4 pairs of cephalic appendages, 1 to 3 pairs of thoracic appendages and a pair of furcal rami, but no abdominal appendages. *L.Cam.-Rec.*

Order ARCHAEOCOPIDA Sylvester-Bradley, n. order

[=*Bradorina* Raymond, 1935] [Type-genus, designated Sylvester-Bradley, herein, *Bradoria* Matthew, 1899] [Diagnosis and discussion by P. C. Sylvester-Bradley, University of Leicester]

Hinge line long, straight or sinuous. Eye tubercles prominent in most families, absent in Indianidae. Shell only slightly calcified, more or less flexible. Surface finely punctate or wrinkled in most species, ornamented with strong folds in some, smooth in others. *L.Cam.-M.Cam., ?U.Cam.-?L.Ord.*

The range of the Ostracoda is commonly regarded as extending from earliest Ordovician (Canadian) to Recent, Cambrian genera described by Matthew (1886, 1896, 1899, 1902) and referred by him to the ostracodes being regarded by most workers as representatives of some other order of Crustacea. Ulrich & Bassler (1931), who monographed these forms, came to the conclusion that they could not be ostracodes (1) because the main muscle scar is situated close to the anterocardinal angle, just behind and beneath the eye tubercle; 2) because the shell is less calcareous than in typical ostracodes and in many species flexible; (3) because the valves are not completely separated along the dorsal margin; and (4) because the free margins do not close tightly, but show a narrow gape. Ulrich & Bassler classed the various Cambrian genera in 3 families, and placed them as members of the order Conchostraca in the Branchiopoda (which they ranked as a superorder). This was rather a surprising decision, for the forms in question differ far more radically from true Conchostraca than from Ostracoda. At the same time Ulrich & Bassler stated that they believed

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these forms to be probable ancestors of the Ostracoda.

RAYMOND (1935, 1946) removed the genera in question from the Conchostraca, creating for them a separate order, Bradorina, assigned to the subclass Archaeostraca. He also regarded them as ancestral to the Ostracoda. Other orders of the Archaeostraca, according to RAYMOND, included the Ceratocarina, Rhinocarina, and Discinocarina, but not the Ostracoda, which were placed in a distinct subclass. Once again it is concluded that the Bradorina differ from these other Archaeostraca more fundamentally than from the Ostracoda. Seemingly they are more closely related to the Ostracoda than to any other Crustacea and therefore taxonomic arrangement should express this inferred relationship. Either the Bradorina should be regarded as a superorder of equal standing with the Ostracoda, and included with Ostracoda in a subclass of their own, or they should be regarded as an order of the Ostracoda, equivalent in rank to other orders of the Ostracoda.

A review of the evidence used by ULRICH & BASSLER for removal of the group from the Ostracoda reveals weakness in some of their arguments. They state that "in all the forms studied by us, with the exception possibly of certain species placed in the emended genus *Indiana,* the main muscle spot is located close to the anterocardinal angle just behind and beneath the ocular tubercle, whereas in the Ostracoda what is regarded as the corresponding scar is located somewhere near the middle of the valves." Surprisingly, however, the only mention of a muscle scar in the descriptive part of their monograph refers to the scar developed in *Walcottella,* of the family Bradoriidae, and in this genus the muscle impression is developed in the median third of the length, in a position exactly analogous to that of the adductor in most Ostracoda. Moreover, the adductor muscle scar in many (perhaps all) ostracodes of the family Leperditiidae is developed "behind and beneath the ocular tubercle," more closely so in forms without chevron scars (e.g., *Eoleperditia*).

The thinner, flexible, less calcareous shell stands as a valid distinction of the Cambrian genera from Paleozoic ostracodes with thick calcareous shells. The ostracode carapace is not by any means invariably calcified, however, and in the Myodocopida most species of the family Halocypridiidae possess uncalcified shells. The family includes the most abundant and widely distributed of all Recent ostracodes, but the lack of calcification has led to a poor fossil record. Certainly post-Cambrian ostracodes with calcified shells must have evolved from Cambrian and Precambrian ancestors with uncalcified valves. The distinction is therefore valid but not fundamental.

ULRICH & BASSLER's third criterion for separating the group from the Ostracoda was their contention that some reason exists "for believing that the valves were always tightly joined along the back, often perhaps by the fusion of the cardinal edges." This is not a valid distinction, for Ostracoda having a chitinous rather than calcareous carapace (e.g., Halocypridiidae) are likewise joined along the dorsal margin, though ostracodes with a calcareous carapace have valves which are quite distinct from each other.

The last distinction listed by ULRICH & BASSLER is that the free margins of the valves in the Bradoriidae do not overlap each other, but are separated by a narrow gape. In fossil Ostracoda compression usually results in a tightly closed carapace, but in Recent ostracodes the valves often gape after death of the animals. Most specimens figured by ULRICH & BASSLER are of single valves or carapaces exposed on one side only. The few specimens that show a continuous gape possibly suggest that the valves could not be closed in life, but the evidence is inconclusive.

This review suggests that the Cambrian fossils under discussion differ from later Ostracoda, but the differences are not profound. The Cambrian forms almost certainly are ancestral to the post-Cambrian ostracodes, and are here regarded as true Ostracoda belonging to a primitive order for which the name Archaeocopida is introduced.

Characters of the Archaeocopida suggesting their relationship with the Leperditicopida are the similar general shape (especially the long, straight hinge line), and the possession of an eye tubercle in the same position and of the same nature as that developed in *Leperditia.* The genus

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Cambria suggests relationship with the Beyrichiacea.

The stratigraphic occurrence of genera assigned to the Archaeocopida is indicated in Figure 36.

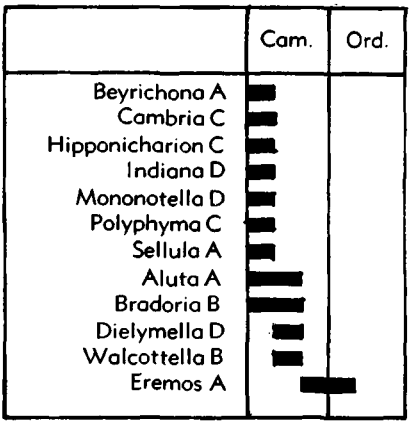

FIG. 36. Stratigraphic distribution of archaeocopid ostracodes (Moore, n). Classification of genera in families indicated by letter symbols (A.—Beyrichonidae, B.—Bradoriidae, C.—Hipponicharionidae, D—Indianidae.)

Family BRADORIIDAE Matthew, 1902

[Materials for this family prepared by P. C. SYLVESTER-BRADLEY, University of Leicester]

Surface finely punctate or wrinkled, otherwise unornamented except for development of either an eye tubercle at anterodorsal corner or an anteromedian tubercle corresponding to muscle scar. *L.Cam.-M.Cam.*

Bradoria MATTHEW, 1899 [**B. scrutator;* SD ULRICH & BASSLER, 1931] [=*Bradorona* MATTHEW, 1903]. Eye tubercle more or less conspicuous. Greatest length in upper third of carapace; consequent forward and backward projection of anterior and posterior margins rounded in most species but angular in some. *L.Cam.-M.Cam.*, N.Am.-Eu.——FIG. 37,*1b*. **B. robusta*, L.Cam., Can. (Nova Scotia); RV lat., ×15 (Ulrich & Bassler, 1931).——FIG. 37,*1a*. *B. scrutator* (MATTHEW), L.Cam., Can. (Nova Scotia); LV lat., ×8 (Ulrich & Bassler, 1931).

Walcottella ULRICH & BASSLER, 1931 [**W. apicalis*]. Surface finely punctate; prominent anteromedian tubercle; eye tubercle weak or absent. *M.Cam.*, N.Am.——FIG. 37,*2a*. **W. apicalis*, USA(Ariz.); LV lat., ×10 (Ulrich & Bassler, 1931).——FIG. 37,*2b,c*. *W. concentrica* ULRICH & BASSLER, USA (Ariz.); *2b,c*, ?LV lat., RV lat., ×10 (Ulrich & Bassler, 1931).

Family BEYRICHONIDAE Ulrich & Bassler, 1931

[Materials for this family prepared by P. C. SYLVESTER-BRADLEY, University of Leicester]

Carapace subtriangular, corneous, smooth, or rarely punctate; compressed anterodorsally behind eye tubercle, the resulting postocular hollow bordered by variously arranged ridges or nodes. *L.Cam.-M.Cam., ?U.Cam.-?L.Ord.*

Beyrichona MATTHEW, 1886 [**B. papilio;* SD S. A. MILLER, 1889] [=*Escasona* MATTHEW, 1902]. Postocular hollow bordered by ill-defined ridges; carapace compressed also in posteroventral region to give a second dorsal hollow only slightly less marked than postocular hollow. *L.Cam.*, Eu.-N. Am.——FIG. 38,*1a*. **B. papilio*, Can.(N.B.); RV lat., ×15 (Ulrich & Bassler, 1931).——FIG. 38, *1b*. *B. tinea* MATTHEW, Can.(N.B.); carapace opened out, ×15 (Ulrich & Bassler, 1931).

Aluta MATTHEW, 1896 [**A. flexilis*]. Anterodorsal corner sharply angular, acute in most species. Postocular hollow bordered anteroventrally by prominent tubercle or ridge. *L.Cam.-M.Cam.*, cosmop.——FIG. 38,*4a*. **A. flexilis*, M.Cam., Can. (N.B.); LV lat., ×15 (Ulrich & Bassler, 1931).——FIG. 38,*4b*. *A. troyensis* (FORD), L.Cam., USA (N.Y.); LV lat., ×6 (Ulrich & Bassler, 1931).

?Eremos MOBERG & SEGERBERG, 1906 [**E. bryograptorum*]. Carapace elongate, otherwise like *Aluta* in outline. Anterior tubercle in upper third (?ocular tubercle) joined ventrally to marginal ridge. *L.Ord.(Tremadoc.)*, NW.Eu.——FIG. 38,*2*. **E. bryograptorum*, Swed.; LV lat. (Moberg & Segerberg, 1906).

Sellula WIMAN, 1902 [**S. fallax*]. Like *Beyrichona* but with an obtuse triangular projection of anterior border. *L.Cam.*, N.W.Eu.——FIG. 38,*3*. **S. fallax*, Swed.; LV lat., ×20 (Wiman, 1902).

Family HIPPONICHARIONIDAE Sylvester-Bradley, n. fam.

[Materials for this family prepared by P. C. SYLVESTER-BRADLEY, University of Leicester, with additions by IVAR HESSLAND and R. A. REYMENT, University of Stockholm]

Carapace with narrow marginal rim; strongly developed ridges or lobes parallel border or cover whole surface. *L.Cam.*

Hipponicharion MATTHEW, 1886 [**H. eos;* SD S. A. MILLER, 1889]. Hinge line straight; carapace subtriangular in lateral view, with strongly developed lobes paralleling anterior and posterior margins. *L.Cam.*, N.Am.-Eu.——FIG. 39,*1a*. **H. eos*, Can. (N.B.); RV lat., ×10 (Matthew, 1886).——FIG. 39,*1b*. *H. minus* MATTHEW, Can.(N.B.); RV lat., ×10 (Ulrich & Bassler, 1931).

?Cambria NECKAJA & IVANOVA, 1956 [**C. sibirica*]. Carapace large. Hinge line sinuous, shorter than length of valve, terminating in acute projections, plenate end regarded as anterior; terminal lobes extending downward from dorsal margin to about

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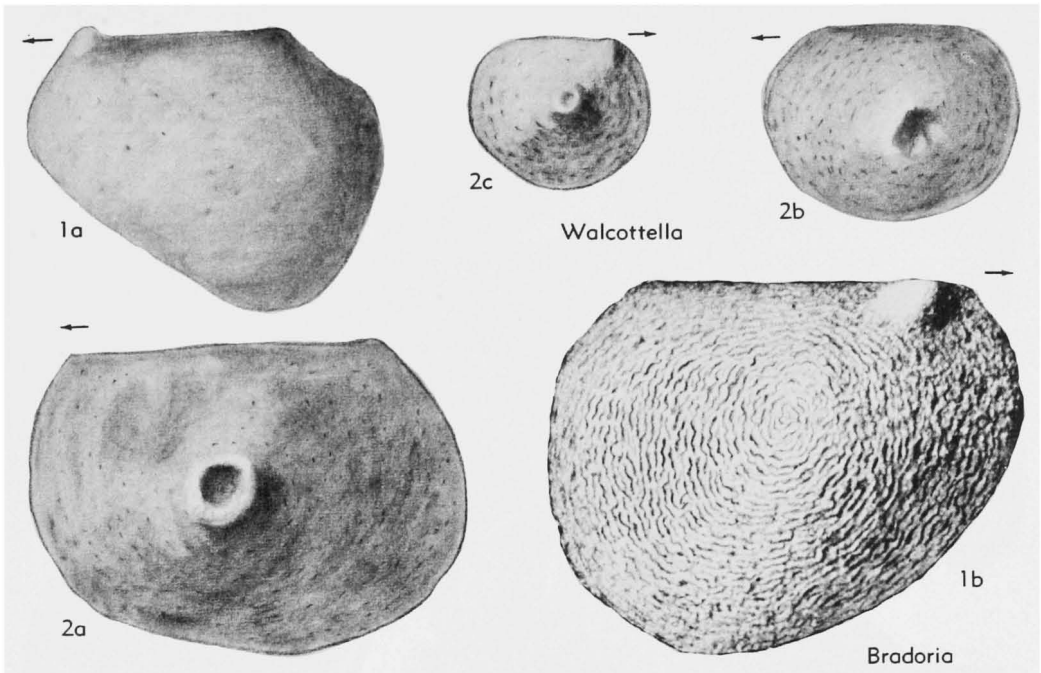

FIG. 37. Bradoriidae (p. Q102).

0.5 height of valve, anterior one sickle-shaped, convex toward anterior; lobes separated by sulcate depression; elongate lobe paralleling ventral margin, perhaps analogous to velum of Palaeocopida. Surface may be papillate. *L.Cam.*, Sib.——FIG. 40, *1*. **C. sibirica;* RV lat., ×10 (Neckaja & Ivanova, 1956).

Polyphyma GROOM, 1902 [**P. lapworthi*]. Hinge line straight; carapace elongate; anterior, ventral, and posterior margins evenly arcuate in lateral view, almost symmetrical, or highest point slightly posterior (when antiplenate end is regarded as anterior, as in other members of suborder but not as in *Cambria*). L.Cam., Eu.——FIG. 39,*2*. **P. lapworthi,* Eng.(Malverns); RV lat., ×20 (Groom, 1902).

Family INDIANIDAE Ulrich & Bassler, 1931

[=*Indianitidae* ULRICH & BASSLER, 1931 (obj.)] [Materials for this family prepared by P. C. SYLVESTER-BRADLEY, University of Leicester]

Carapace smooth, unornamented, with no eye tubercle; surface polished, in some species finely punctate. *L.Cam.-M.Cam.*

Indiana MATTHEW, 1902 [**I. lippa*; ICZN pend.] [=*Indianites* ULRICH & BASSLER, 1931 (obj.)]. Carapace inequilateral, antiplenate end being taken as anterior (in conformity with most other members of order bearing eye tubercles). *L.Cam.*, N. Am.-Eu.——FIG. 39,*3*. **I. lippa,* Can.(Nova Scotia); *3a-c,* carapace R, dors., ant., ×10 (Ulrich & Bassler, 1931).

Dielymella ULRICH & BASSLER, 1931 [**D. recticardinalis*]. Like *Indiana* but anterodorsal corner produced to form small rostrum. *M.Cam.*, N.Am.-Eu. ——FIG. 39,*5*. **D. reticardinalis,* USA(Ariz.); RV lat., ×4 (Ulrich & Bassler, 1931).

?Mononotella ULRICH & BASSLER, 1931 [**Primitia ?fusiformis* MATTHEW, 1895]. Like *Indiana* but valves apparently fused along dorsal margin. *L. Cam.*, N.Am.——FIG. 39,*4*. **M. fusiformis* (MATTHEW), Can.(N.B.); *4a,b,* carapace R, dors., ×6 (Ulrich & Bassler, 1931).

Order LEPERDITICOPIDA Scott, n. order

[=Leperditiida POKORNÝ, 1953] [Type genus designated SCOTT, herein, *Leperditia* ROUAULT, 1851] [Diagnosis and discussion by H. W. SCOTT, University of Illinois]

Hinge long, straight; shell thick, well calcified; surface usually smooth, some finely ornamented to nodose; valves strongly unequal to subequal; adductor muscle scar large, composed of numerous secondary elements. *?U.Cam., L.Ord.-U.Dev.*

The leperditiid ostracodes are universally recognized as a group distinct from all others. Their large size and strongly calcified shells are adequate to distinguish them readily. They are commonly some four or

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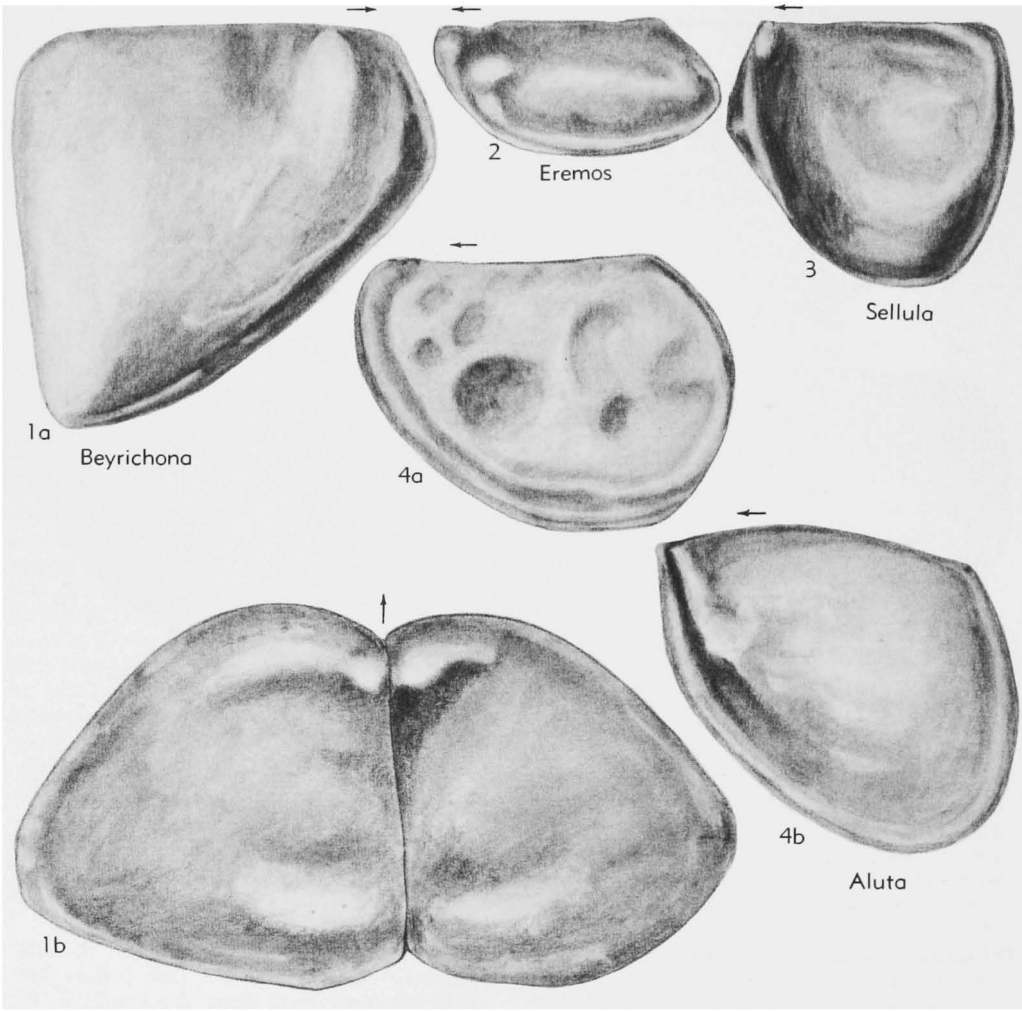

FIG. 38. Beyrichonidae (p. Q102).

five times larger than other ostracodes and the shell is usually proportionately thicker.

Internally the leperditiids show unique muscle-scar patterns. The adductor muscle scar is very large and is composed of as many as 200 small secondary scars. The diameter of the scar is so great that it is equal to approximately 30 percent of the height of the shell. The size of the adductor muscle and the number of fibers composing it are greater than found in any other ostracode. Other muscle scars, representing anterior appendages, as well as scars along the hinge, have been found. The interior surface commonly is marked by venose lines, especially in the ventral half of *Eoleperditia* and the anterior portion of *Isochilina*.

Abundant molts of leperditiids can usually be found with adults. The thick shells were favorable for fossilization and numerous very small molts can be observed in most populations. The number of instars is not definitely known, and no evidence of dimorphism has been reported. Strong muscles were necessary to handle the heavy, large shells so common in this group. Shell characters of the group indicate a benthonic habitat.

The leperditiids are believed to be true ostracodes. The presence of venose lines and large compound muscles probably represent primitive characters. They may be related to the thinly calcified archaeocopids, especially forms with a long straight dorsal

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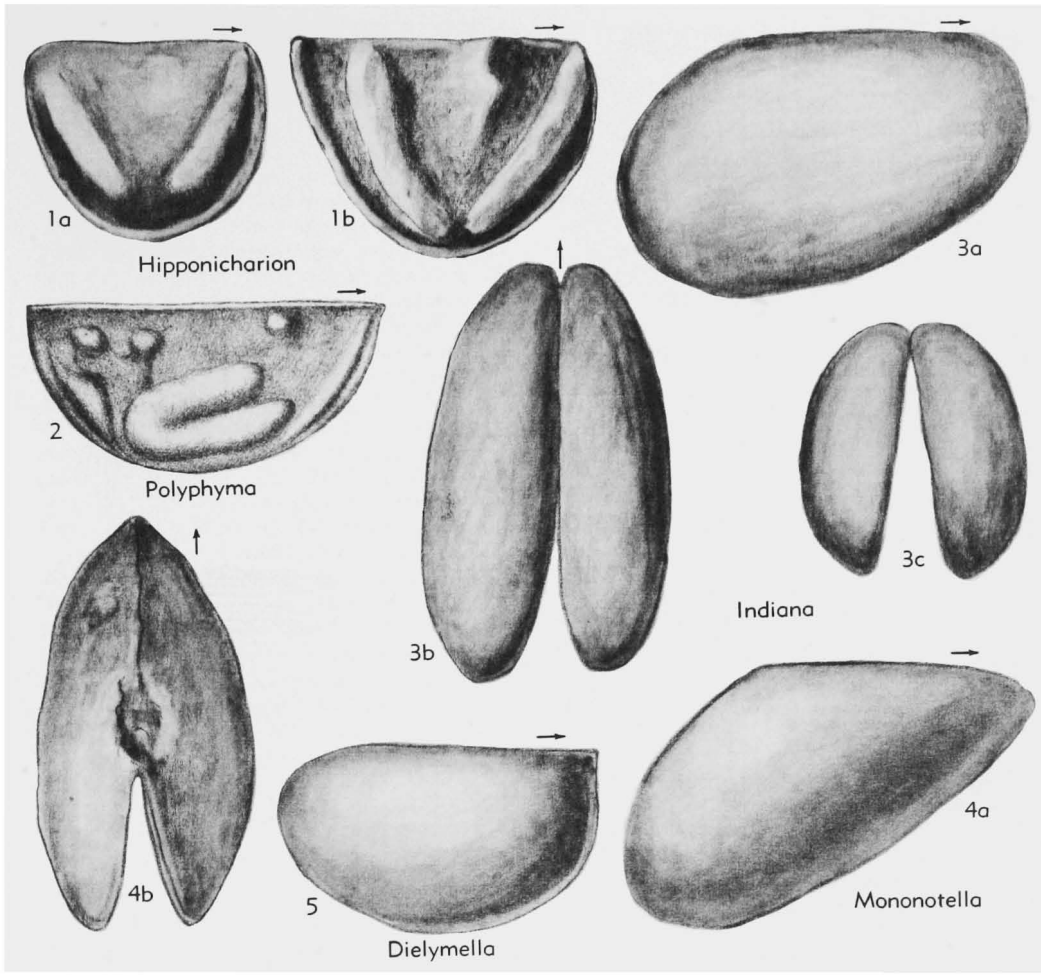

FIG. 39. Hipponicharionidae, Indianidae (p. Q102-Q103).

margin. They do not appear to be directly related to the smaller palaeocopids. No direct evidence pertaining to their ancestry has been found, nor is there any indication that they were the ancestors of other Paleozoic groups. They seem to represent an isolated assemblage of Cambrian to Devonian benthonic Ostracoda that reached a climax of development in Mohawkian (M.Ord.) times and remained abundant through the Middle Silurian.

Reported stratigraphic occurrences of leperditicopid genera are indicated graphically in Figure 41.

Family LEPERDITIIDAE Jones, 1856

[*nom. correct.* S. A. MILLER, 1889 (*pro* Leperditidae JONES, 1856)] [=Leperditiadae JONES, 1870] [Materials for this family prepared by H. W. SCOTT, University of Illinois, with additions by W. A. VAN DEN BOLD, Louisiana State University] [Includes Hermanninae ABUSHIK, 1960]

Large, thick-walled; cardinal angles well defined; greatest height medial to posterior; dorsal margin straight, valves strongly unequal, surface smooth to slightly ornamented; adductor muscle scar large, composed of numerous secondary scars (Figs. 43, 29); anterodorsal eye tubercle present in most species. *?U.Cam., L.Ord.-U.Dev.*

This family comprises one of the most important early Paleozoic assemblages of Ostracoda. It is represented by several genera, some of which are among the largest known ostracodes. They commonly occur in such great numbers as to cover rock surfaces along bedding planes. They differ from all other Ostracoda in large size of the adductor muscle scar. Internal features are unusually well preserved for Paleozoic specimens (Fig. 29). Numerous molts of various instars

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FIG. 40. Hipponicharionidae (p. Q102).

often are found associated with one another. Thus, they represent one of the best groups of Paleozoic Ostracoda for the study of instar stages.

The ostracode, described as *"Leperditia harrisi"* (FREDERICKSON, 1946), from Upper Cambrian rocks of Oklahoma is probably a leperditiid, although indeterminable generically. As such, it is the oldest member of the order so far recorded.

Leperditia ROUAULT, 1851 [**L. britannica*]. Nonsulcate, unornamented, smooth or punctate; posterodorsal swelling in LV but absent in RV; chevron-like muscle scar subjacent to eye tubercle and anterodorsal to larger adductor scar; hinge finely denticulate; inner margin shoulder of overlapped edge of LV serving as stop for RV. *L.Sil.-U.Dev.*, cosmop.——FIG. 45,*5*. **L. britannica*, Dev., Fr.; *5a,b*, carapace R, L, ×5 (Oehlert, 1877). ——FIG. 42,*3*. *L. scalaris* JONES, Sil., USA(Pa.); LV int. (muscle scar), ×10 (Swartz, 1949).—— FIG. 43. *L.* sp., U.Sil., Swed.(Gotl.); LV lat., showing eye protuberance in anterodorsal region and impression of large muscle area slightly below and behind it, ×3.8 (Triebel, 1941).

Anisochilina TEICHERT, 1937 [**A. punctulifera*]. Like *Eoleperditia*, but valves subequal, internal details unknown. *Ord.*, Greenl.——FIG. 42,*5*. **A. punctulifera*; LV ext., ×10 (Teichert, 1937).

Briartina KEGEL, 1932 [**Leperditia quenstedti* GÜMBEL, 1874]. Like *Leperditia* but carapace more subrectangular, ends subequally rounded; dorsum subparallel to venter. *Dev.*, Eu.——FIG. 42,*4*. **B. quenstedti*, M.Dev., Ger.; LV lat., ×8 (Kegel, 1932).

Eoleperditia SWARTZ, 1949 [**Cytherina fabulites* CONRAD, 1843]. Nonsulcate, unornamented, thick-shelled; RV overlapping free margin of LV, nondenticulate hinge, no marginal flattening; large adductor muscle scar composed of numerous secondary scars, other muscle scars and venose lines commonly present, lacking subocular chevron mark; prongs on inner margin of RV. *M.Ord.*, cosmop.——FIG. 29, 42,*2*. **E. fabulites* (CONRAD); 42,*2a,b*, carapace (Ontario) R, L, ×5 (Swartz, 1949); 42,*2c*, LV (Illinois) int., showing muscle scar, ×10 (Scott, 1951); 29, RV (Illinois) int., showing eye spot, muscle scar, and tubercles along inner ventral margin, ×10 (Scott, 1951).

Gibberella ABUSHIK in MANDELSTAM *et al.*, 1958 [**Leperditia chmielewski* SCHMIDT, 1900]. Carapace elongate (up to 2 cm.), with large "eye" node and short deep triangular groove behind it, dorsal margin behind groove with boss that may project over it; marginal groove commonly present; "chevron" typically tail-shaped, not V-shaped. Surface smooth, coarsely pitted, or pustulose. Interior of valves with 30 to 40 oval, narrowly aligned muscle scars. *L.Sil.(Llandov.)-M.Sil.(Wenlock.)*, N.Eu.(Baltic-Novaya Zemlya)-NE. Asia(E.Sib.).——FIG. 44,*1a,b*. *G. lenaica* ABUSHIK, L.Sil.(Llandov.), N.Zemlya; *1a,b*, LV lat., dors., ×1 (Mandelstam, 1958).——FIG. 44,*1c*. *G. jejuna* ABUSHIK, L.Sil.(Llandov.), W.Sib.; LV lat., ×3 (Mandelstam, 1958). [BOLD.]

Hermannina KEGEL, 1933 [*pro Hermannella* PAECKELMANN, 1922, *non* CANU, 1891] [**Herrmannella waldschmidti* PAECKELMANN, 1922] [=*Chevroleperditia* SWARTZ, 1949]. Like *Leperditia* but postdorsal swelling absent. *M.Sil.-M.Dev.* Eu.——FIG. 42,*1a-e*. **H. waldschmidti*, M.Dev., Ger.; *1a*, RV lat., ×10; *1b*, post. hinge, ×10; *1c-e*, carapace L, vent., post., ×7 (Kegel, 1933). ——FIG. 42,*1f*. *H. welleri* SWARTZ, RV lat., muscle scars, ×15 (Swartz, 1949).

Heterochilina POULSEN, 1937 [*H. *obliqua*]. Like *Leperditia* but RV with curved ridge near free margin in mid-ventral or anteroventral position

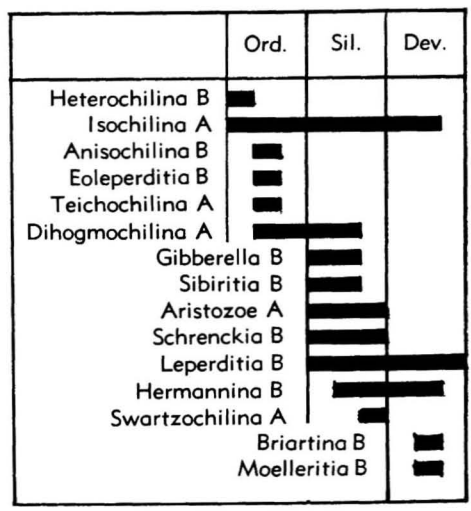

FIG. 41. Stratigraphic distribution of leperditicopid ostracodes (Moore, n). Classification of genera in families is indicated by letter symbols (A.—Isochilinidae, B.—Leperditiidae).

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and subparallel to it. *L.Ord.*, Greenl.——Fig. 45, *1. *H. obliqua; 1a,b,* both RV lat., ×7 (Poulsen, 1937).

Moellerítia Abushik in Mandelstam *et al.*, 1958 [**Leperditia mölleri* Schmidt, 1883]. Carapace large (1.5 to 8 cm.), with large "eye" node, behind which dorsal margin shows a projecting boss; marginal rim well developed, broad, long, usually well separated from ventral margin; overlap of valves not strong, longitudinal axis oblique; interior with large chevron-shaped or triangular muscle area containing more than 200 scars, ventral rim of area marked by elongate, triangular, closely spaced scars and its inside by scattered smaller scars of varying shape, usually very small near anterior side. Surface smooth or punctate. *M.Dev.*, E.Eu.(Urals-Novaya Zemlya).——Fig. 44, *3. *M. moelleri;* muscle-scar pattern, ×40 (Mandelstam, 1958). [Bold.]

Schrenckia Glebovskaia, 1949 [**Leperditia grandis*

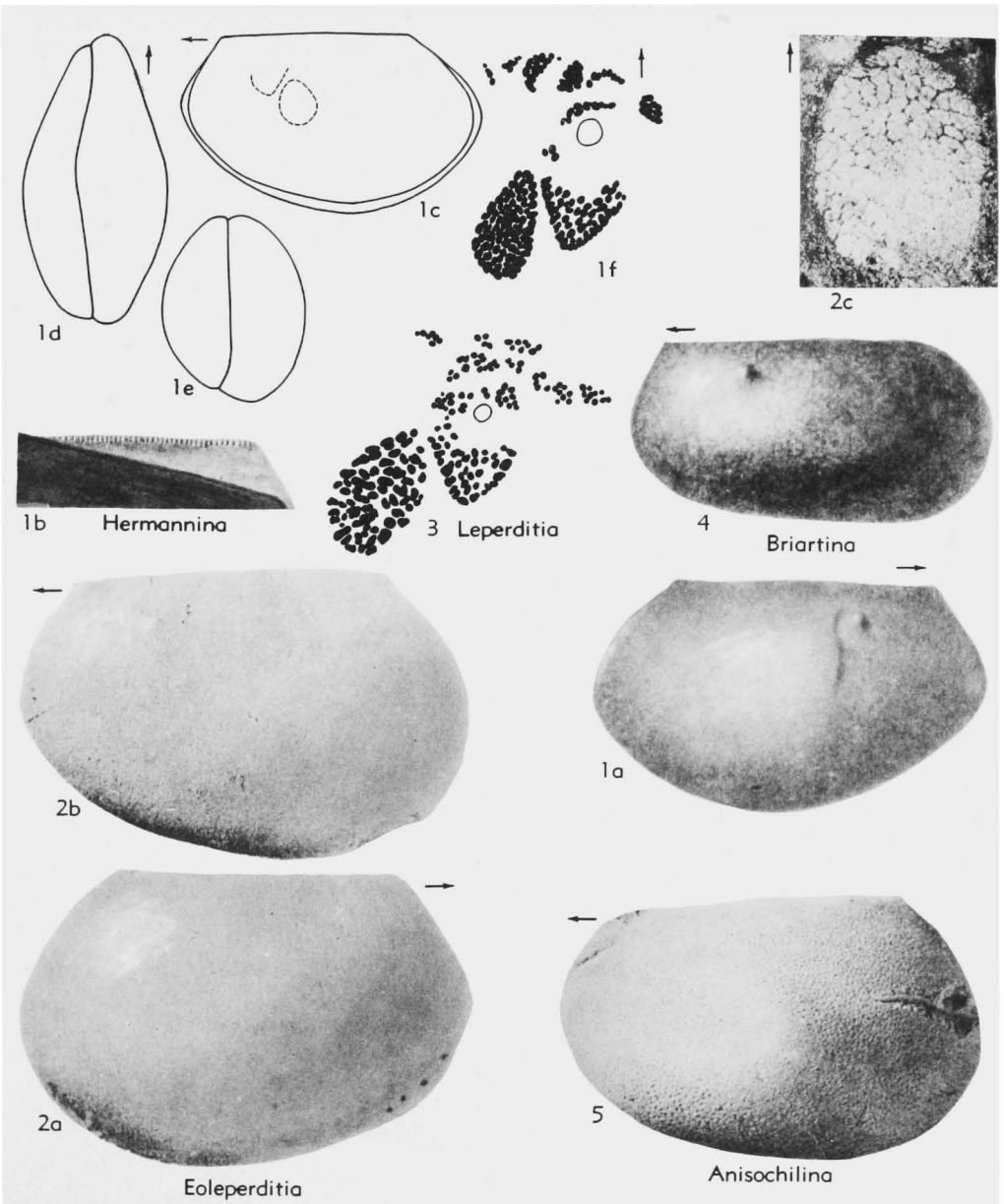

Fig. 42. Leperditiidae (p. Q106-Q107).

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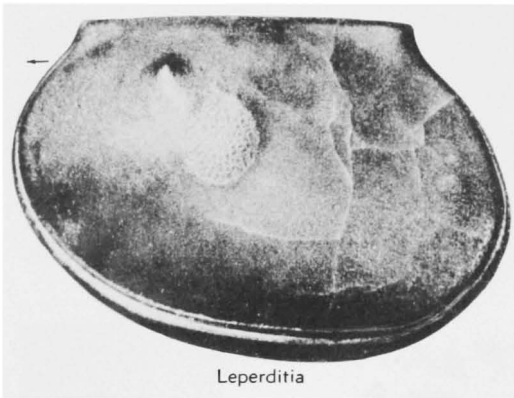

FIG. 43. Leperditiidae (p. Q108).

SCHRENCK, 1852]. Like *Leperditia* but differing in presence of 2 or more pitlike structures in ventral region of RV and in being most inflated in ventral half of carapace. *Sil.*, E.Eu.(USSR)-N. Asia(Sib.).——FIG. 44,*4*. *S. multa* ABUSHIK, U. Sil.(Ludlov.), E.Sib.; *4a-c*, 3 RV lat., ×2,×2,×3 (Mandelstam, 1958). [BOLD.]

Sibiritia ABUSHIK in MANDELSTAM *et al.*, 1958 [**Leperditia wiluiensis* SCHMIDT, 1873]. Carapace medium in size (0.7 to 1.7 cm.), valves very unequal, strongly overlapping, smooth; "eye" spot distinct; marginal ridge narrow, commonly absent; longitudinal axis oblique, anterior and posterior portions of RV with 2 to 5 deep pits corresponding in interior to nodes against which margin of LV closes but they may join to a narrow groove; front of middle part of rim commonly with 1 to 4 rounded shallow pits which in interior form oblique nodes, apparently contributing to closure of valves. Chevron-shaped muscle area weakly developed, with 5 to 28 small muscle scars grouped in shape of triangle with concave base near "eye" node, irregular angular shape and irregularly arranged but rather regular in each triangle. Resembles *Eoleperditia* SWARTZ in development of the ventral margin, but differs in its larger size, characters of the muscle "chevron," closure by pits, better development of "eye" node, and presence of a narrow marginal rim. *L. Sil.(Llandov.)-M.Sil.(Wenlock.)*, NE. Asia (E. Sib.).——FIG. 44,*2*. *S. ventriangularis* ABUSHIK, L.Sil.; *2a-d*, carapace R, L, ant., vent., ×3 (Mandelstam, 1958). [BOLD.]

Family ISOCHILINIDAE Swartz, 1949

[*nom. transl.* ABUSHIK, 1960 (*ex* Isochilininae SWARTZ, 1949)] [Materials for this family prepared by H. W. SCOTT, University of Illinois]

Subequivalved leperditiids with flattened borders along free margin. *L.Ord.-M.Dev.*

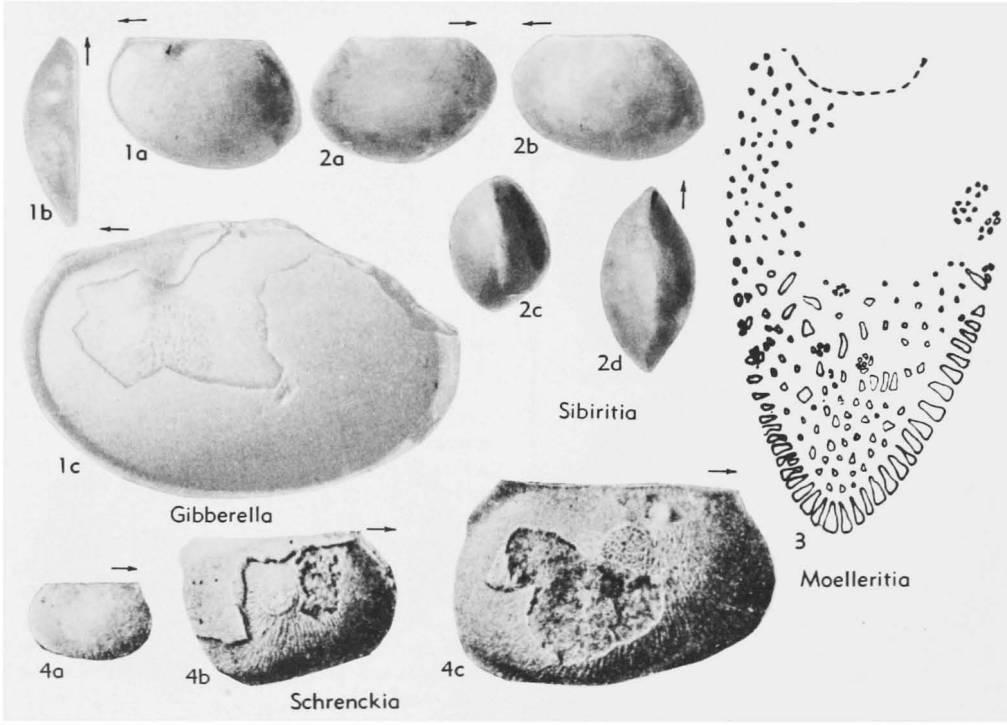

FIG. 44. Leperditiidae (p. Q106-Q108).

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Isochilina JONES, 1858 [**Leperditia (Isochilina) ottawa* JONES, 1858; SD BASSLER & KELLETT, 1934] [= *Hogmochilina, Holtedahlina, Paenaequina* SOLLE, 1935; *Holtedahlites* SOLLE, 1936 (*pro Holtedahlina* SOLLE, 1935, *non* FOERSTE, 1909)]. Valves subequal, flattened border extending along free margin but weak or absent mid-ventrally in some shells; small pits in some species distributed along ventral flat border of RV, reflecting inner nodes; faint to strong eye tubercle anterodorsal, reflected by internal pit; faint to strong depression or sulcus (S_2) dorsal to adductor scar. *L.Ord.-M.Dev.*, N.Am.——FIG. 46,*1*. **I. ottawa*, M.Ord., N.Am.; *1a*, RV lat., ×7; *1b*, LV lat., ×10; *1c*, RV int. (muscle scars), ×20; *1d*, LV lat., (muscle scars), ×20; *1e*, RV lat. (ventral border, with pits) ×20; *1f*, RV int., ×10 (Swartz, 1949).——FIG. 45,*3*. *I. ampla* ULRICH, M.Ord., Tenn.; RV (holotype) int., ×1.3 (Swain, 1957).——FIG. 31,*1*. *I.* sp.; thin sec. showing 2 shell layers, ×13 (Levinson, n.).

Aristozoe BARRANDE, 1868 [**A. amica*]. Like *Isochilina* but with one or more nodes in anterodorsal area; cardinal corners well defined to rounded. [*A. amica* is probably an early molt of the adult that BARRANDE described as *A. memoranda.*] *Sil.*, Bohemia.

Dihogmochilina TEICHERT, 1937 [**Isochilina grandis* var. *latimarginata* JONES, 1891] [=*Dihogmochilus* NEAVE, 1950]. Like *Isochilina* but with forked sulcus. *M.Ord.-M.Sil.*, Arct.——FIG. 45,*4*. **D. latimarginata*, Sil.; LV lat., ×4 (Teichert, 1937).

Swartzochilina SCOTT, 1956 [**Dihogmochilina straitcreekensis* SWARTZ, 1949]. Like *Isochilina* but sulcus splits adductor scar in two, and area anterodorsal to eye spot marked by one or more strong rounded pits; flattened border along entire free margins. *U.Sil.*——FIG. 46,*2*. **S. straitcreekensis*, USA(Va.); *2a,b*, LV lat., RV lat., ×7 (Swartz, 1949).

Teichochilina SWARTZ, 1949 [**Isochilina jonesi* WETHERBY, 1881]. Like *Isochilina* but RV overlapping LV, submarginal pits and corresponding inner nodes of RV lacking; flattened border along entire free margins. *M.Ord.*, N.Am.——FIG. 45,*2*. **T. jonesi* (WETHERBY), USA(Ky.); *2a,b*, carapace L, post., ×2 (Wetherby, 1881).

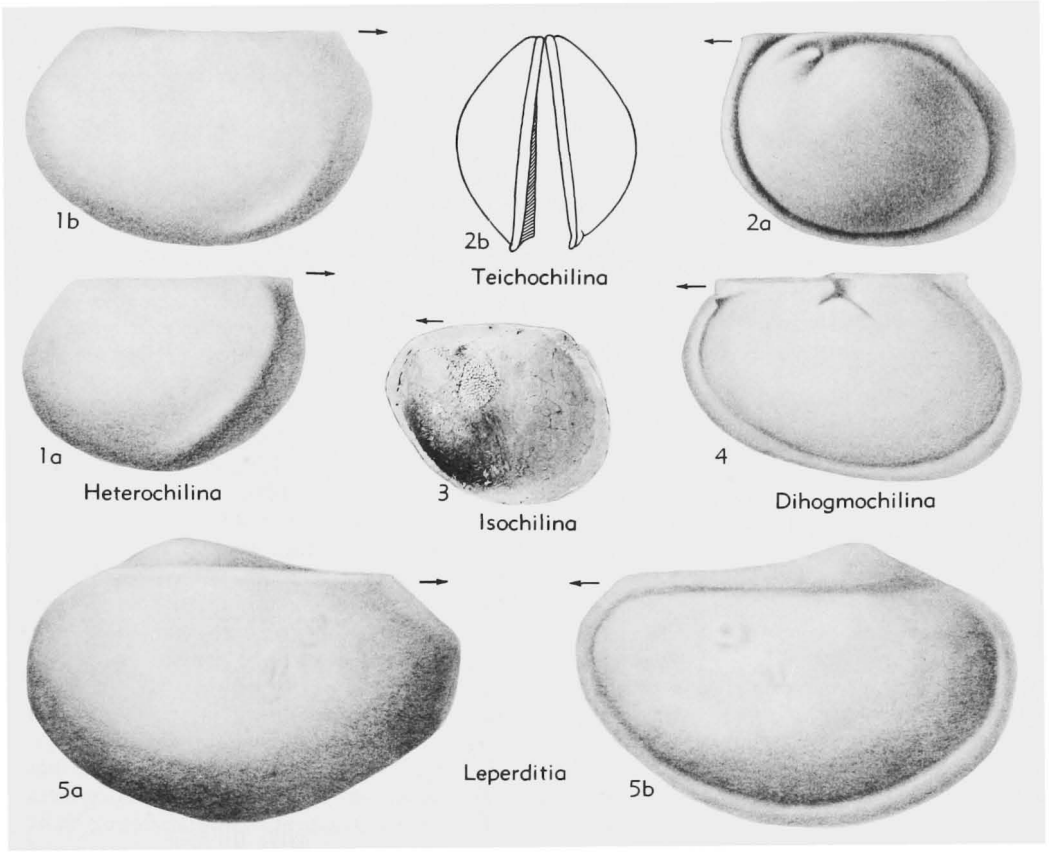

FIG. 45. Leperditiidae, Isochilinidae (p. Q106-Q109).

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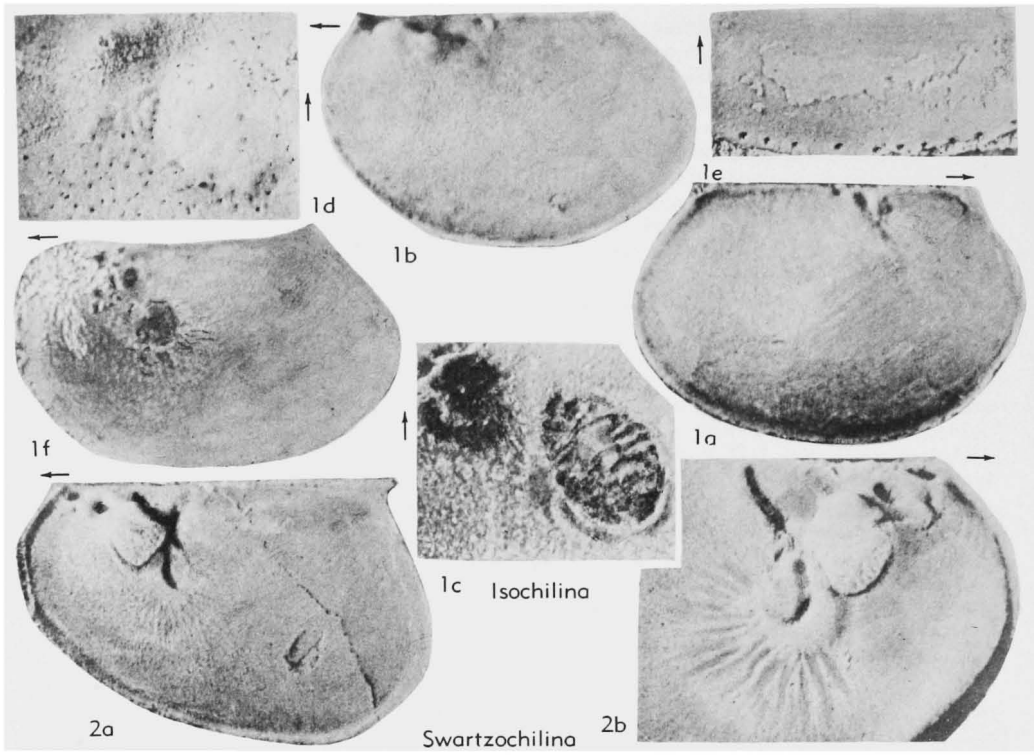

FIG. 46. Isochilinidae (p. Q109).

Order PALAEOCOPIDA Henningsmoen, 1953

[*nom. correct.* SCOTT, herein (*pro* Paleocopa HENNINGSMOEN, 1953)] [=Order Beyrichiida POKORNÝ, 1953 *(partim)*] [Type Genus—*Beyrichia;* SD SCOTT, herein [Diagnosis and discussion prepared by H. W. SCOTT, University of Illinois]

Dorsal margin long and straight; surface smooth to ornamented; lobes, sulci, ventral and adventral structures common; calcareous inner lamella absent; dimorphic or nondimorphic; soft parts unknown. *L.Ord.-M. Perm., ?Rec.*

The Palaeocopida have been one of the most misunderstood of all ostracode groups, even though they have been studied for over 100 years. Much of the confusion in earliest work resulted from poor illustrations. Later, genera and species were added in large number without due regard to criteria of classification. In particular, students of the palaeocopids disregarded information available on dimorphism and ontogeny of modern forms. As a result, new genera, species, and even families often were based on dimorphs or instar stages. To add to the confusion, ornamental features such as number of spines borne by the carapace were used as a basis of generic classification. Disregard for such morphological features as hingement, muscle-scar pattern, and dimorphism, accompanied by emphasis on lobation and ornamental characters, kept classification in a constant state of disorder. One of the main attempts in this *Treatise* is to bring order to classification of the great group of palaeocopid ostracodes.

To arrive at the most satisfactory classification we have had the opinions and constant help of many workers but do not claim to have resolved all problems. Some monogeneric families have been recognized; the muscle scars and hinge structures are unknown in some genera, and evidence pertaining to dimorphism is incomplete or lacking in others. Future studies will certainly fill many of the gaps. We hope that future creation of new families and genera will be based on adequate material, fully illustrated and studied, so that questions of orientation, ontogeny, dimorphism, hinge-

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ment, muscle scars, and marginal features will be known.

T. R. JONES and E. O. ULRICH were major early contributors to knowledge of Ordovician and Silurian ostracode classification. R. S. BASSLER joined ULRICH (1923) in attempting to make known many of the early Paleozoic groups and in presenting the first extensive classification. Prior to their work, the Leperditiidae, Beyrichiinae, Aparchitinae, Leperditellidae, Kirkbyidae, Kloedenellinae, and Glyptopleuridae had been proposed. These family-group taxa were based on lobation, sulcation, and overlap as main criteria of classification. Proposal of them laid the foundation for further extensive work. Other workers accepted these groups for many years and concepts of them were still dominant with appearance of the BASSLER & KELLETT "Bibliography" in 1934. This bibliography gave students an available source of information and many new workers were attracted to ostracode studies.

The appearance of SWARTZ's (1936) classification was the first major step toward recognition of the importance of ventral and adventral dimorphic features. SWARTZ made many emendations and additions to the classification of forms now assigned to the palaeocopids. HESSLAND (1949) recognized the importance of dimorphism and ontogeny in classification and of the muscle scars for use in orientation. HENNINGSMOEN (1953) first proposed that the straight-backed Paleozoic ostracodes, without frontal openings or calcareous inner lamella, be included in a new order, which he named Paleocopa. He included the Leperditiidae in this new order. HENNINGSMOEN also recognized the importance of dimorphism in classification and thus agreed with SWARTZ's concepts. His recognition of velar and carinal dimorphic structures (partly including those now termed as histial) was an important step in delineating major taxa. KESLING, in many papers published in the 1950's, added much to knowledge of the structure and classification of the palaeocopids. His monograph (1951) on *Cypridopsis,* though based on a nonpalaeocopid modern species, was a major contribution to understanding of ontogeny and the molting process. The observations made could be applied in part to the Paleozoic genera. New fields of research were opened and many students began to report on ostracode populations instead of single specimens. POKORNÝ (1953) separated the Leperditiida from the palaeocopids and postulated the existence of a heart in the leperditiids. His 1958 text was the first to give a comprehensive classification of all ostracodes.

Orientation of the palaeocopids has been a very troublesome problem for a long time, as discussed in a previous chapter. BONNEMA (1909, 1913, 1930) called attention to the anterior position of the muscle scars in some forms and the posterior dimorphic swelling in others; GEIS (1932) showed that posterior swelling is common in the females of many modern species, that the anterior end is the highest in many, and applied these observations to classification of Mississippian palaeocopids; SWARTZ (1936, 1949), TRIEBEL (1941), HESSLAND (1949), LEVINSON (1950), SCOTT (1951), KESLING (1951), HENNINGSMOEN (1953), and JAANUSSON (1957) contributed to knowledge of muscle scars, hingement, ventral and adventral structures, lobation, sulcation, and other elements in relation to orientation. The classification here adopted for palaeocopids is based primarily on dimorphism, relationship of valves along the free margin, and muscle scars; secondarily it takes account of outline or form. Lobation, sulcation, and ornamentation play a minor part.

Suborder BEYRICHICOPINA Scott, n. suborder

[=Beyrichiida POKORNÝ, 1953] [Diagnosis prepared by H. W. SCOTT, University of Illinois]

Ostracodes with a straight back and convex free margin; lobes and sulci common; valves subequal; duplicature lacking; marginal structures commonly present as velum, pseudovelum, histium, or carina; dimorphic or nondimorphic. *L.Ord.-M.Perm., ?Rec.*

The Beyrichicopina represent a natural group of palaeocopids characterized by the presence of one or more of the following features: dimorphic structures, lobes, sulci, and subequal valves. A velum or pseudovelum is commonly present. The Beyrichiacea show dimorphism by the development of a ventral to anteroventral lobe or "pouch"; the Hollinacea are dimorphic, as indicated by locular, histial, or velate structures (except for the Quadrijugatoridae and Bassler-

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atiidae, which are nondimorphic and may not belong to the superfamily); the Primitiopsacea are dimorphic, as shown by the development of a posteroventral dolon; the Oepikellacea are dimorphic in part. The Kirkbyacea are nondimorphic.

Superfamily BEYRICHIACEA Matthew, 1886

[*nom. transl.* Ulrich & Bassler, 1923 (*ex* Beyrichiidae Matthew, 1886, *nom. transl. et correct.* Ulrich, 1894, *ex* Beyrichinae Matthew, 1886)] [Diagnosis by S. A. Levinson, Humble Oil & Refining Company]

Straight-hinged ostracodes with subequal ends or forward swing, mostly with well-developed lobes and sulci and showing tendency to have carinal, velate, and marginal structures; dimorphism well defined in most families. *M.Ord.-L.Perm.*

The stratigraphic distribution of genera assigned to the Beyrichiacea is indicated graphically in Figure 47.

Family BEYRICHIIDAE Matthew, 1886

[*nom. transl. et correct.* Ulrich, 1894 (*ex* Beyrichinae Matthew, 1886)] [=Kloedeninae (*recte* Kloedeniinae) Ulrich & Bassler, 1923; Treposellinae Henningsmoen, 1954] [Materials for this family prepared by S. A. Levinson, Humble Oil & Refining Company, and R. C. Moore, University of Kansas, with contributions on some genera by Jean Berdan, United States Geological Survey]

Straight-hinged, nonsulcate to trisulcate, marginal ridge or frill commonly present; dimorphism well marked, females invariably with a cruminal pouch. *M.Ord.-U.Dev., ?L.Carb.-?L.Perm.*

Beyrichia M'Coy, 1846 [**B. klödeni* (ICZN pend.)] [*non Beyrichia* Boll, 1847] [=*Eobeyrichia, Mitrobeyrichia, Neobeyrichia, Nodibeyrichia, Velibeyrichia* Henningsmoen, 1954]. Trilobate, L_2 smallest lobe, rarely projecting above hinge line; marginal ridge or frill developed in some species; surface commonly granulose or pitted; female with globular to subovate anteroventral pouch. *L.Sil.-M.Dev.*, Eu.-N.Am.-Austral.——Fig. 48,*1a-c*. *B. tuberculata* (Klöden), U.Sil.(Ludlov.), Gotl.; *1a*, ♂ RV lat., ×14; *1b,c*, ♀ RV lat., vent., ×14 (Kesling, 1957).——Fig. 48,*1d-f*. *B. buchiana* Jones, U.Sil.(Ludlov.), Gotl. (type species of *Neobeyrichia; 1d*, ♂ RV lat., ×16; *1e,f*, ♀ RV lat., vent., ×14 (Kesling, 1957).——Fig. 48,*1g-i*. *B. salteriana* Jones, U.Sil.(Ludlov.), Gotl.; *1g*, ♂ RV lat., ×31; *1h,i*, ♀ RV lat., vent., ×26 (Kesling, 1957).——Fig. 48,*1j-l*. *B. fittsi* Roth, L.Dev., USA (Okla.); *1j*, ♂ RV lat., ×24; *1k,l*, ♀ RV lat., vent., ×24 (Kesling, 1957).——Fig. 48,*1m*. *B. jonesii* Boll, M.Sil.(Wenlock.), Gotl.; ♀ carapace transv. sec. showing cruminal pouches, ×24 (Kesling, 1957).——Figs. 27*C*, 28. *B. moodeyi* Ulrich & Bassler, M.Sil.(Clinton.), USA (N.Y.); type species of *Velibeyrichia*, 27*C*, transv. sec. ♀ LV, enlarged (Wainwright, 1959); 28, serial transv. secs. (Wainwright, 1959). [In the opinion of Berdan, the generic names published by Henningsmoen (1954) are desirably used for subgenera of *Beyrichia*. Possibly *Velibeyrichia*, which includes most North American species assigned to *Beyrichia*, should have the status of an independent genus. —Moore.]

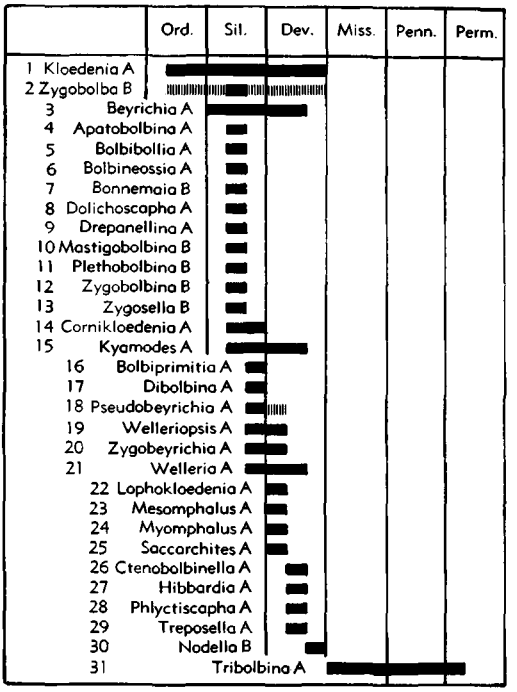

Fig. 47. Stratigraphic distribution of beyrichiacean ostracodes (Moore, n). Classification of genera in families is indicated by letter symbols: A—Beyrichiidae, B—Zygobolbidae. An alphabetical list of genera provides cross references to the serially numbered generic names on the diagram.

Generic Names with Index Numbers

Apatobolbina—4
Beyrichia—3
Bolbibollia—5
Bolbineossia—6
Bolbiprimitia—16
Bonnemaia—7
Cornikloedenia—14
Ctenobolbinella—26
Dibolbina—17
Dolichoscapha—8
Drepanellina—9
Hibbardia—27
Kloedenia—1
Kyamodes—15
Lophokloedenia—22
Mastigobolbina—10
Mesomphalus—23
Myomphalus—24
Nodella—30
Phlyctiscapha—28
Plethobolbina—11
Pseudobeyrichia—18
Saccarchites—25
Treposella—29
Tribolbina—31
Welleria—21
Welleriopsis—19
Zygobeyrichia—20
Zygobolba—2
Zygobolbina—12
Zygosella—13

Apatobolbina Ulrich & Bassler, 1923 [**A. granifera*]. Nonsulcate, frilled; female with pouch on anteroventral portion of frill, pouch extending

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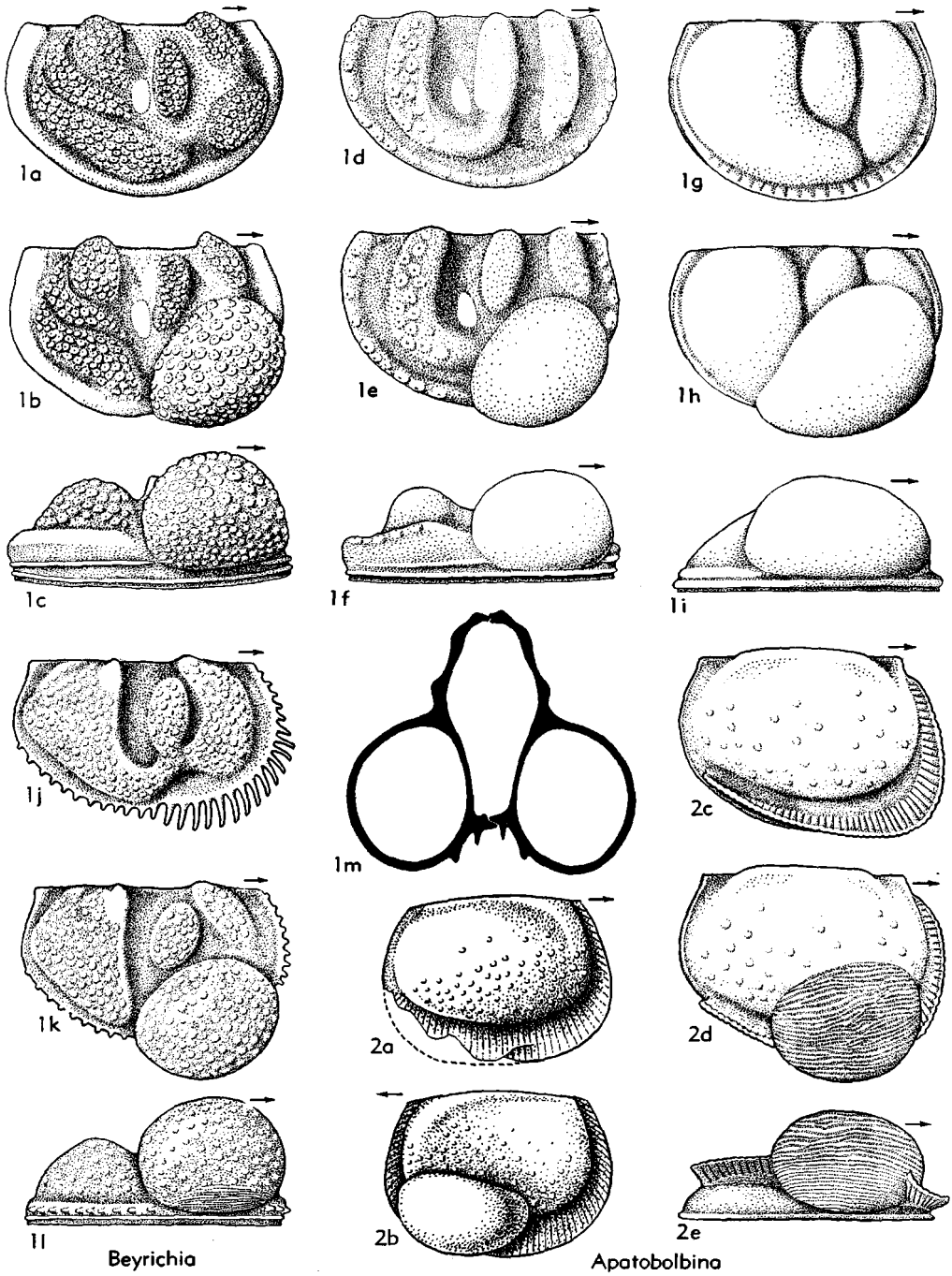

FIG. 48. Beyrichiidae (p. Q112-Q114).

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dorsally to about 0.3 height of valve. *M.Sil.*, N. Am.-Eu. (Ger.-Norway). —— FIG. 48,*2a,b*. **A. granifera*, Clinton., USA (Pa.); *2a,b*, ♂ RV lat., ♀ LV lat., ×16 (Kesling, 1951).——FIG. 48, *2c-e*. *A.* sp., Manistique F., USA (Mich.); *2c*, ♂ RV lat., ×22; *2d,e*, ♀ RV lat., vent., ×22 (Kesling, 1957).

Bolbibollia ULRICH & BASSLER, 1923 [*B. labrosa*]. Resembles *Bollia* in having small horseshoe-shaped ridge around moderately deep S_2; female with anteroventral pouch, monotypic. [Trend of the sulcus and bordering horseshoe-shaped ridge is slightly variable but mostly about normal to the dorsal margin—not strongly oblique, as represented in originally published figures.] *M.Sil.*, Can. (Anticosti).——FIG. 49,*1*. **B. labrosa: 1a,b*, ♂ LV lat., ♀ RV lat. (syntypes), ×40; *1c*, ♀ LV lat. (paratype), ×40; *1d-f*, ♂ RV lat., ♀ RV lat., vent., ×42, ×37, ×37 (*1a-c*, Sohn, n; *1d-f*, Kesling, 1957).

Bolbineossia KESLING, HEANY, KAUFMANN, & ODEN, 1958 [**B. didictyosa*]. Sulcation represented only by central pit (S_2), valves otherwise evenly convex, subovate in side view, surface of known species reticulate. Females with wide frill extending onto protuberant anteroventral brood pouch. *M.Sil.*, N.Am.——FIG. 49,*4*. **B. didictyosa*, Manistique Gr., USA (Mich.); *4a*, ♂ RV lat.; *4b,c*, ♀ RV lat., vent.; all ×25 (Kesling *et al.*, 1958).

Bolbiprimitia KAY, 1940 [**Halliella fissurella* ULRICH & BASSLER, 1923]. Resembling *Halliella* in form but with S_2 developed into thin, elongate deep sulcus, smooth ridge at free borders, surface reticulate; female with ventral-median pouch. *U. Sil.*, E.N.Am.——FIG. 49,*3*. **B. fissurella* (ULRICH & BASSLER), Tonoloway Ls., USA (W.Va.); *3a*, ♂ RV lat., ×40; *3b,c*, ♀ RV lat., vent., ×33 (Kesling, 1957).

Cornikloedenia HENNINGSMOEN, 1954 [**Drepanellina ventralis* ULRICH & BASSLER, 1923]. Trilobate, with a posteroventral alate projection. *M.Sil.-U. Sil.*, NE.N.Am.——FIG. 50,*5*. **C. ventralis*, M.Sil., USA(Md.); ♂ RV (holotype) lat., ×30 (Berdan, n). [BERDAN].

Ctenobolbinella KUMMEROW, 1953 [**C. carinata*]. Large prominent knob surrounded by furrow in dorsal half of valve, slightly in front of middle; female with lens-shaped, elongate pouch in anteroventral area. *M.Dev.*, Eu.(Ger.).——FIG. 52,*3*. **C. carinata*; ♀ RV lat., ×30 (Kummerow, 1953).

Dibolbina ULRICH & BASSLER, 1923 [**D. cristata*]. Somewhat like *Eurychilina* with wide frill around free margins but strongly dimorphic; small central node with adjoining arcuate sulcus, generally most prominent behind it; narrow ridge may be developed from near posterodorsal margin to median-ventral area parallel to proximal margin of frill; females with well-developed anteroventral pouch. *U.Sil.*, E.N.Am.-NW.Eu.——FIG. 49,*2a,b*. **D. cristata*, Tonoloway Ls., USA (W.Va.); *2a,b*, ♂ LV lat., ♀ LV lat., ×27 (Kesling, 1951).—— FIG. 49,*2c-e*. *D. steusloffi* (KRAUSE), Ludlov., Gotl.; *2c-e*, ♂ RV lat., ♀ RV lat., vent., ×30 (Kesling, 1957).

Dolichoscapha KESLING & EHLERS, 1958 [**D. escharota*]. Only female carapace known, hinge line long and straight; valves nonsulcate, velate ridge extending to each corner; surface reticulate except for central smooth spot. Brood pouch ventral, elongate. *M.Sil.*, N.Am.——FIG. 51,*3*. *D. escharota*, Schoolcraft Dol., USA (Mich.); ♀ LV (holotype) lat., ×57 (Kesling, 1958).

Drepanellina ULRICH & BASSLER, 1923 [**D. clarki*]. Carapace with submarginal, distinct ventral lobe parallel to free margins; L_2 and L_3 strongly developed into elongate lobes which may extend above dorsum; females with anteroventral portion of marginal ridge inflated and L_2 and L_3 tending to merge with marginal ridge. *M.Sil.*, E.N.Am.—— FIGS. 26, 50,*4*, 52,*5*. **D. clarki*, Clinton., USA (Md.-Pa.); 26, serial transv. secs., ♀ LV; 50,*4a,b*, ♂ LV (syntype) lat., ♀ RV (syntype) lat., ×15 (Berdan, n); 52, *5a,b*, ♀ RV lat., ♂ RV lat., ×15 (Ulrich & Bassler, 1923). [LEVINSON].

?Halliella ULRICH, 1891 [**H. retifera*; SD MILLER, 1892]. Straight-backed, with coarsely reticulate surface; S_2 prominent, posterior lobe larger than anterior; velate, dimorphic. [Characters poorly known; possibly the holotype is a male representative of *Beyrichia lyoni* ULRICH.] *M.Dev.*, USA(Ky.). [SCOTT.]

Hibbardia KESLING, 1953 [**Amphissites lacrimosus* SWARTZ & ORIEL, 1948]. Bilobate, with short frill around free border and marginal ridge around free edge; subcentral pit at ventral end of shallow sulcus (S_2); surface reticulate. Female with cruminal pouch in posteroventral portion of each valve. *M.Dev.*, E.N.Am.——FIG. 27*A*, 51,*1*. **H. lacrimosa* (SWARTZ & ORIEL), Ludlowville F., USA (N.Y.); 27*A*, transv. sec. ♀ carapace, enlarged; 51,*1a-c*, ♂ RV lat., ♀ RV lat., vent., ×21; 51,*1d*, ♀ carapace transv. sec. showing pouches, ×33 (Kesling, 1957).

Kloedenia JONES & HOLL, 1886 [**Beyrichia wilckensiana* JONES, 1855]. Trilobate, S_1 shorter than or equal to S_2, both well developed but usually restricted to dorsal half of valves; L_1 and L_3 smoothly rounded and united ventrally, without transverse furrows; L_2 small, globular or subovate; free border with narrow ridge; surface pustulose, reticulate or smooth. Females with large, well-defined pouch in anteroventral area but comprising extension of ventral lobe not distinctly separated from body of valve. *M.Ord.-U.Dev.*, N.Am.-Eu.——FIG. 53,*1a-f*. **K. wilckensiana*, U.Sil. (from Pleist. drift), Ger.; *1a,b*, ♂ LV (hypotype) lat., slightly inclined vent., ×20; *1c-f*, ♀ RV (hypotype) lat., dors., vent., post., ×20 (Kesling & Wagner, 1956). ——FIG. 53,*1g-i*. *K. sussexensis* (WELLER), U.Sil. (Decker Ls.), USA (N.J.); *1g*, ♂ LV lat.; *1h,i*,

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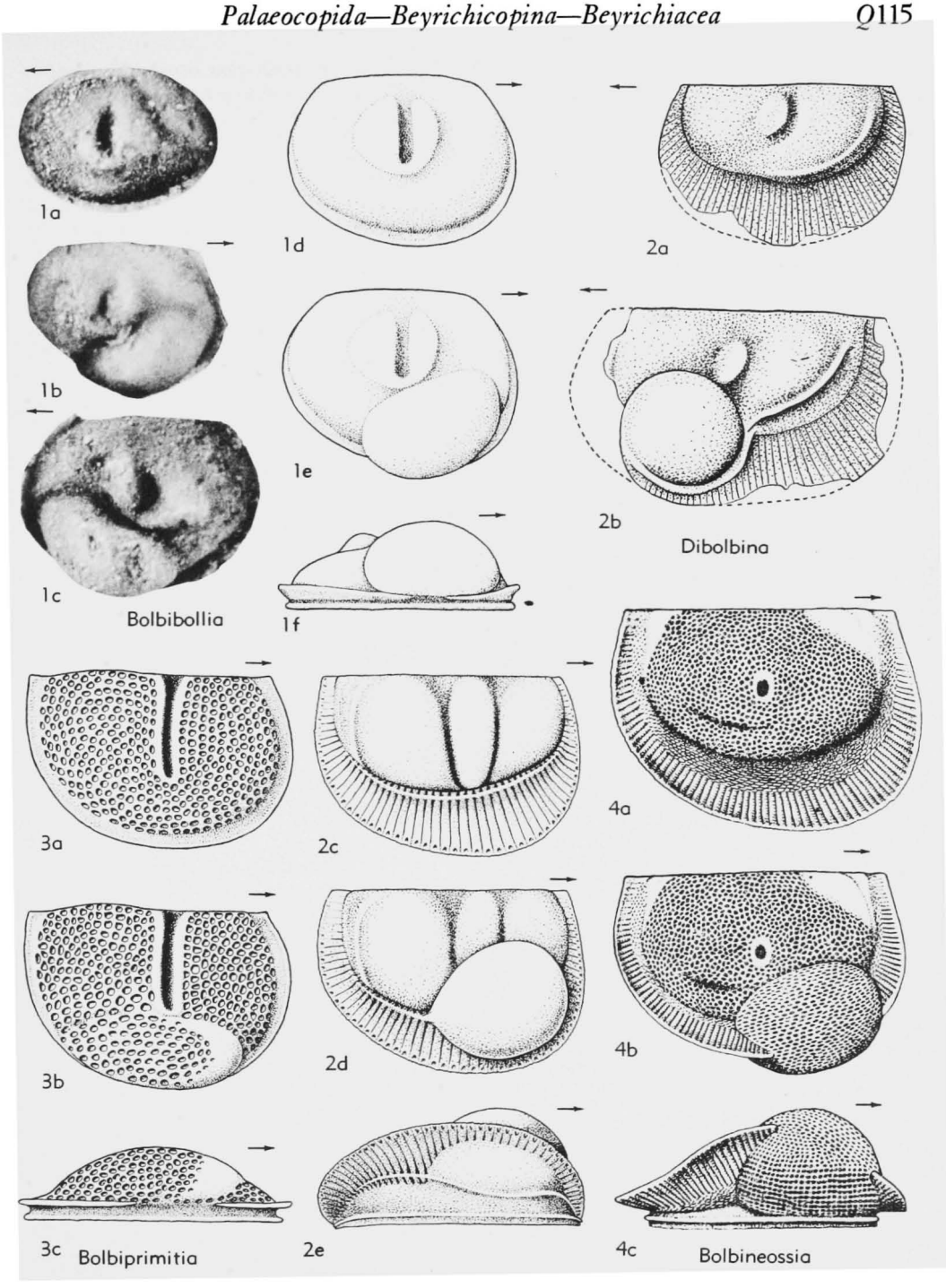

FIG. 49. Beyrichiidae (p. Q114).

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♀ RV lat., post.; all ×17 (Swartz & Whitmore, 1956].——Fig. 52,*1. K. normalis* Ulrich & Bassler, Sil., USA(Md.); *1a-c,* ♀ LV lat., ♀ LV lat., ♂ RV lat., ×30 (Ulrich & Bassler, 1923). [Levinson-Berdan].

Kyamodes Jones, 1888 [**K. whidbornei*] [=*Kyammodes* Ulrich & Bassler, 1908]. Quadrilobate or trilobate, L_2 may be small; lobes tend to project above hinge line; sulci confined to dorsal half of carapace; LV conspicuously overreaching RV on ventral margin; surface smooth. Female unknown in type species but in others assigned to genus large pouch observed in anteroventral area. *M.Sil.-M.Dev.,* Eu.-N.Am. —— Fig. 50,*2. *K. whidbornei,* Dev., Eng.; *2a-e,* ? ♂ carapace R, L, dors., vent., post., ×20 (Jones, 1888).——Fig. 51, *4. K. tricornis* (Ulrich & Bassler), U.Sil. (McKenzie F.), USA (Md.); *4a,b,* ♂ LV lat., ♀ LV lat., ×19 (Kesling, 1951).——Fig. 52,*4. K. kiesowi* (Krause), Sil. (from drift), Ger.; ♀ LV lat., ×20 (Ulrich & Bassler, 1923). [Levinson-Berdan.]

Lophokloedenia Swartz & Whitmore, 1956 [**Bey-*

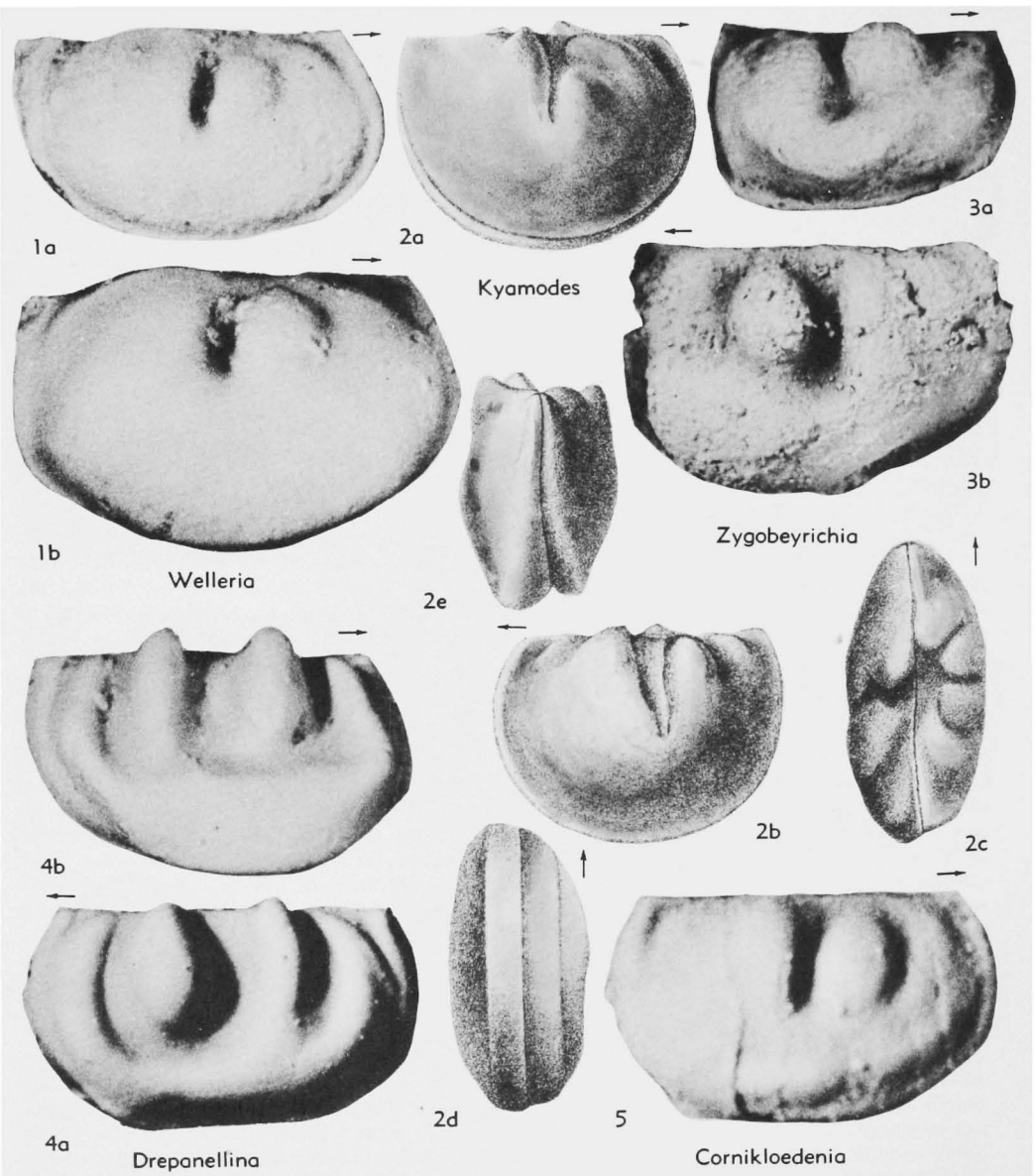

Fig. 50. Beyrichiidae (p. Q114-Q122).

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richia manliensis WELLER, 1903]. Like *Kloedenia* but L_1 extending backward along dorsal margin as indistinct crest that passes above L_2 and ends in low node at dorsal end of S_2; pouch well defined, anteroventral in position. Surface reticulate or pustulose. *L.Dev.*, N.Am.——FIG. 54,*2d-g*. **L. manliensis*, Manlius Ls., USA (N.J.); *2d,e*, ♂ LV (holotype) lat., dors., ×17, ×22; *2f*, ♂ RV lat., ×17; *2g*, ♀ LV lat., ×17 (SWARTZ & WHITMORE, 1956).——FIG. 54,*2a-c*. *L. kummeli* (WELLER), Manlius Ls., USA (N.J.); *2a*, ♂ LV lat., ×17; *2b,c*, ♀ RV lat., post., ×15 (Swartz & Whitmore, 1956). [BERDAN.]

Mesomphalus ULRICH & BASSLER, 1913 [**M. hart-*

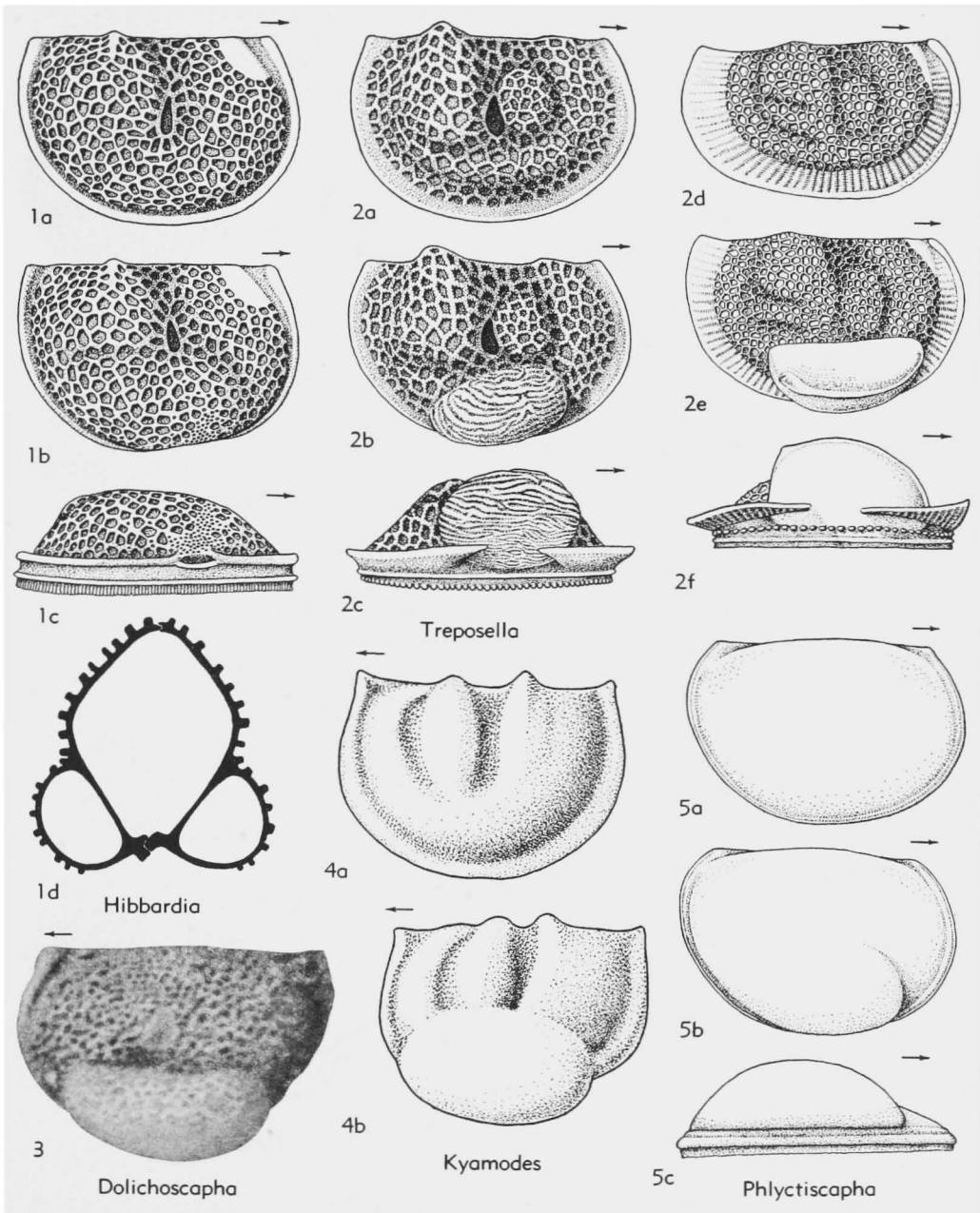

FIG. 51. Beyrichiidae (p. Q114-Q122).

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leyi.] [=*Mezomphalus* ZASPELOVA, 1952]. Subquadrate elongate; L_2 poorly defined, S_1 suppressed and S_2 confined to dorsal half of valve, arcuate; fissus on L_3 extending on ventral side of S_2; pouch elongate, occupying most of ventral border; surface granulose or punctate or both. *L.Dev.*, E.N.Am.—FIG. 52,7. **M. hartleyi*, USA(Md.); *7a,b*, ♀ LV lat., ♂ LV lat., ×20 (Ulrich & Bassler, 1923).

Myomphalus SWARTZ & WHITMORE, 1956 [**M. dorsinodosus* SWARTZ & WHITMORE, 1956]. Binodose, S_1 obsolete, L_2 a small node below dorsal margin, S_2 weak and narrow, L_3 broad, with small node or spine developed near dorsal end of S_2; surface smooth or obscurely granulose. Females with anteroventral pouch which is poorly defined dorsally. *L.Dev.*, N.Am.—FIG. 53,*3*. **M. dorsinodosus*, Manlius Ls., USA (N.J.-N.Y.); *3a*, ♂ LV (syntype) lat., ×25; *3b*, ♀ RV (syntype) lat., ×25 (Swartz & Whitmore, 1956). [BERDAN.]

Phlyctiscapha KESLING, 1953 [**P. rockportensis*]. Large, smooth, tumid, dorsal-median portion of each valve extending above hinge line as a hump;

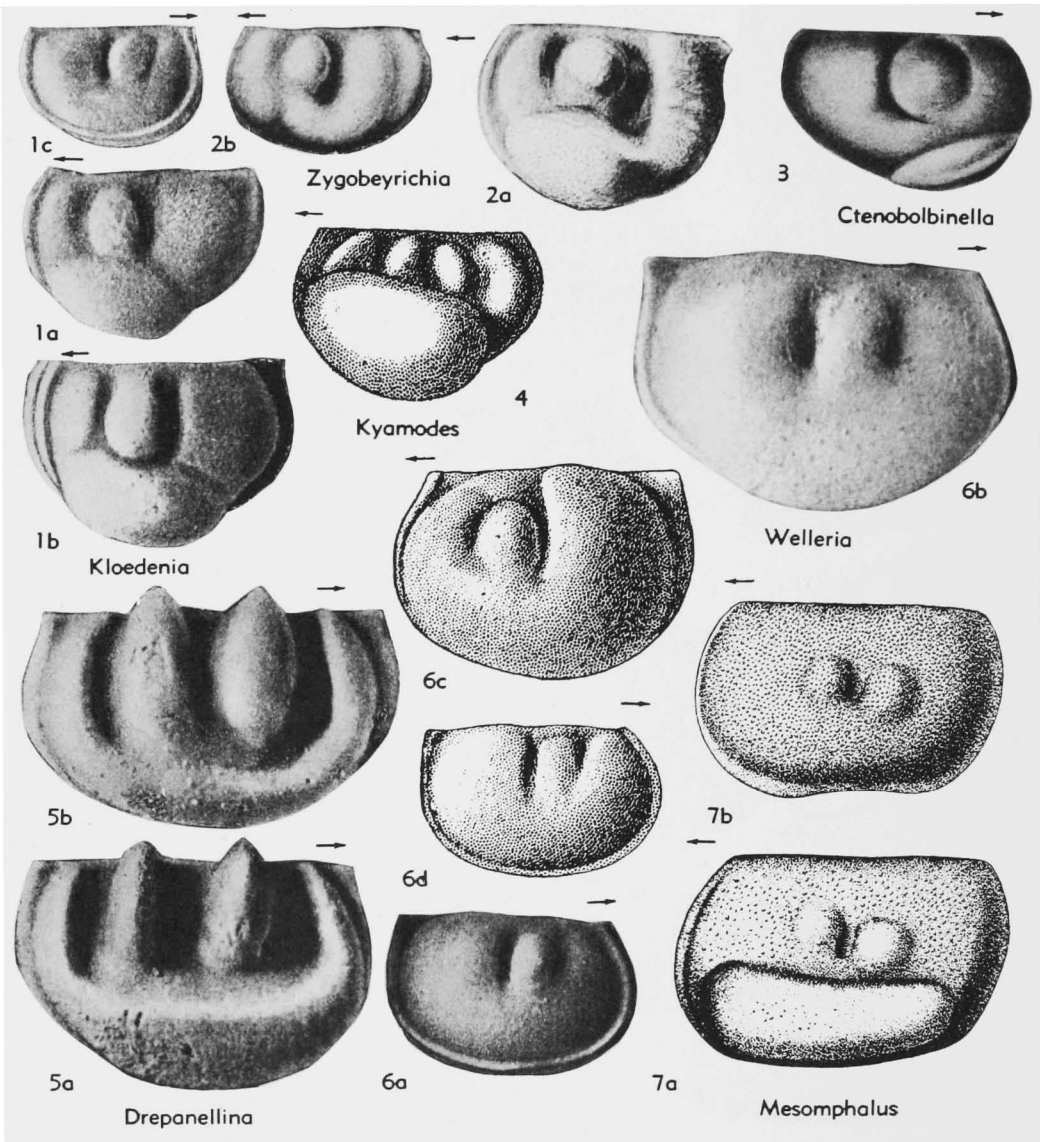

FIG. 52. Beyrichiidae (p. Q114-Q122).

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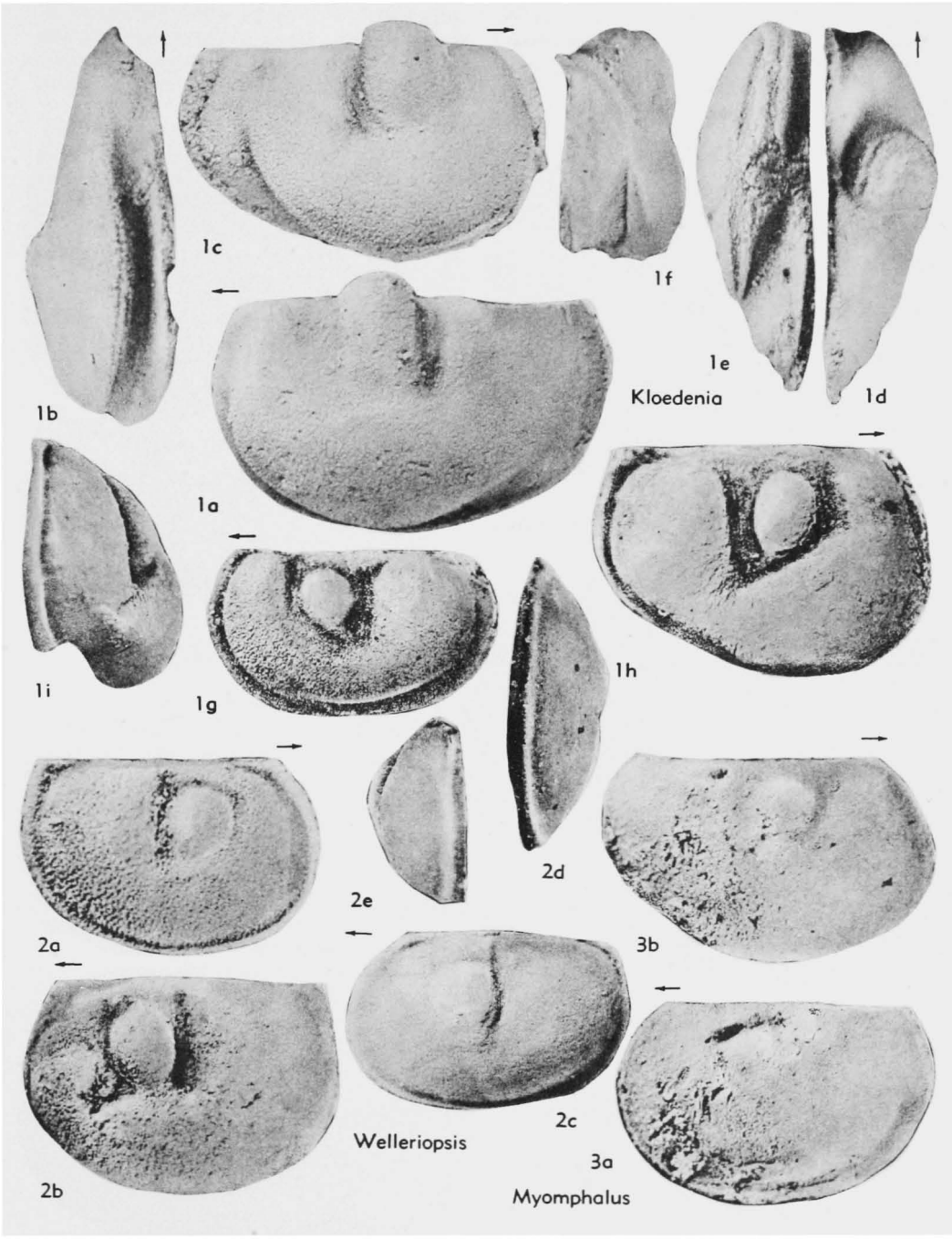

FIG. 53. Beyrichiidae (p. Q116-Q122).

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direction of overlap variable, marginal ridge around free edge, small velate ridge parallel to marginal ridge. Female with pouch in ventral or posteroventral area, posterior part of pouch confluent with rest of valve. *M.Dev.*, N.Am.——Figs. 27*B*, 51,*5*. **P. rockportensis*, USA (Mich.); 27*B*, ♀ carapace, transv. sec., enlarged (Kesling, 1953); 51,*5a-c*, ♂ RV lat., ♀ RV lat., vent., ×22 (Kesling, 1957).

Pseudobeyrichia Swartz & Whitmore, 1956 [**P. perornata*]. Trilobate, with L_2 large, elevated subglobular, subcentral; L_1 and L_3 lower and nearly

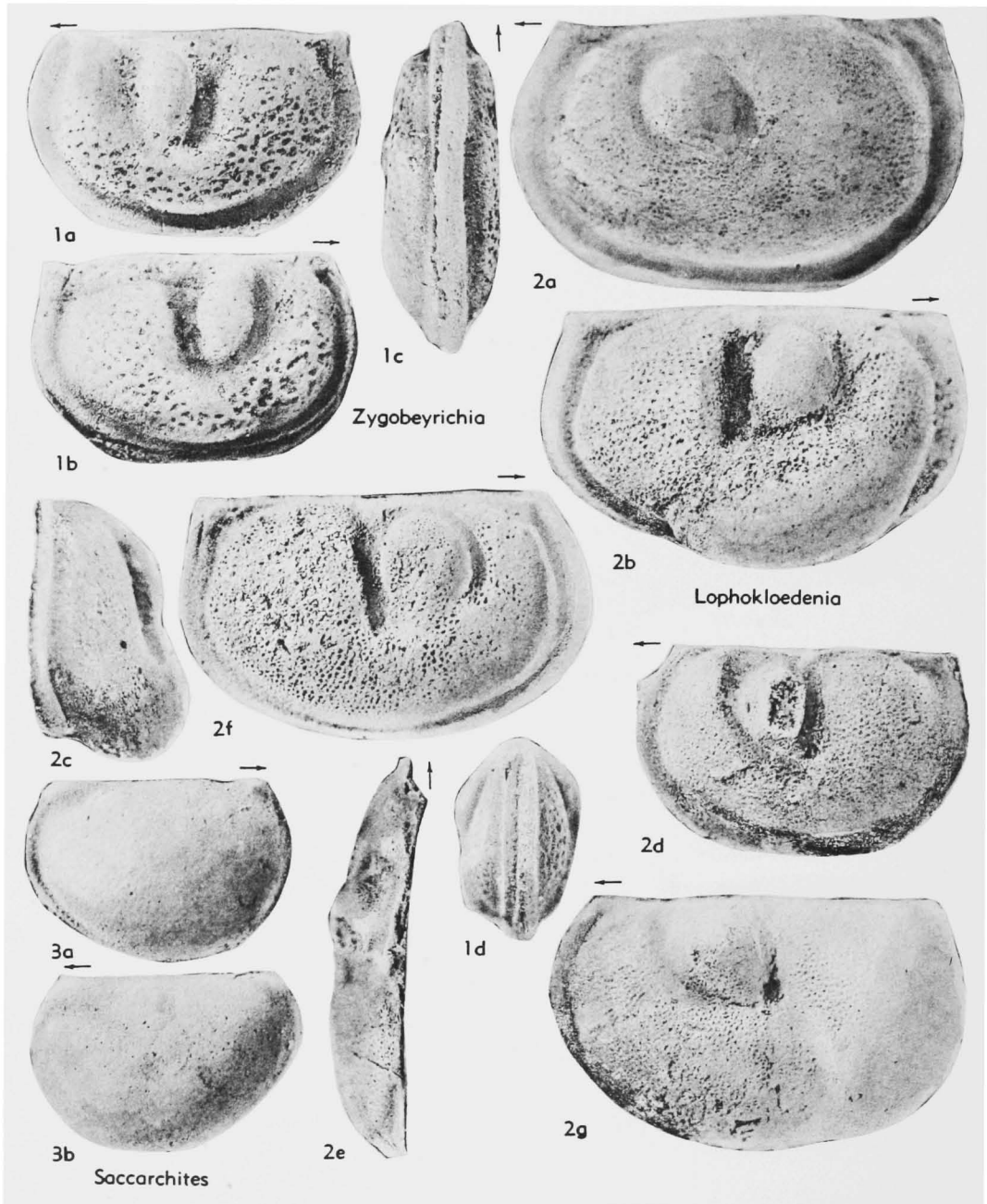

Fig. 54. Beyrichiidae (p. Q118-Q122).

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equal; S_1 shallow, S_2 well developed, fissus absent; pouch large, anteroventral, involving most of L_1 and not clearly separated from it; surface reticulate to pustulose. Hinge line intrenched, lateral surface separated from ventral region by angulation or elevated rim that is roughly parallel to free margin. *U.Sil., ?L.Dev.,* N.Am.——Fig. 56,2. **P. perornata,* ?L.Dev., USA (N.J.); *2a,b,* ♂ LV (holotype) lat., ♀ LV lat., ×45 (Swartz and Whitmore, 1956). [Berdan.]

?**Saccarchites** Swartz & Whitmore, 1956 [**S. saccularis*]. Lobes and sulci suppressed, surface smooth with scattered punctae. Females with poorly defined pouch in anteroventral position overhanging narrow brim. *L.Dev.,* N.Am.——Fig. 54,*3*. **S. saccularis,* Manlius Ls., USA (N.Y.); *3a,* ♂ RV (syntype) lat., *3b,* ♀ LV (syntype) lat., ×20 (Swartz & Whitmore, 1956). [Berdan.]

Treposella Ulrich & Bassler, 1908 [**Beyrichia lyoni* Ulrich, 1891]. Small rounded node in anteromedian area with elongate node in posteromedian area, nodes separated by distinct sulcus; low ventral ridge becoming obscure toward front and rear; with short frill on free margins; sur-

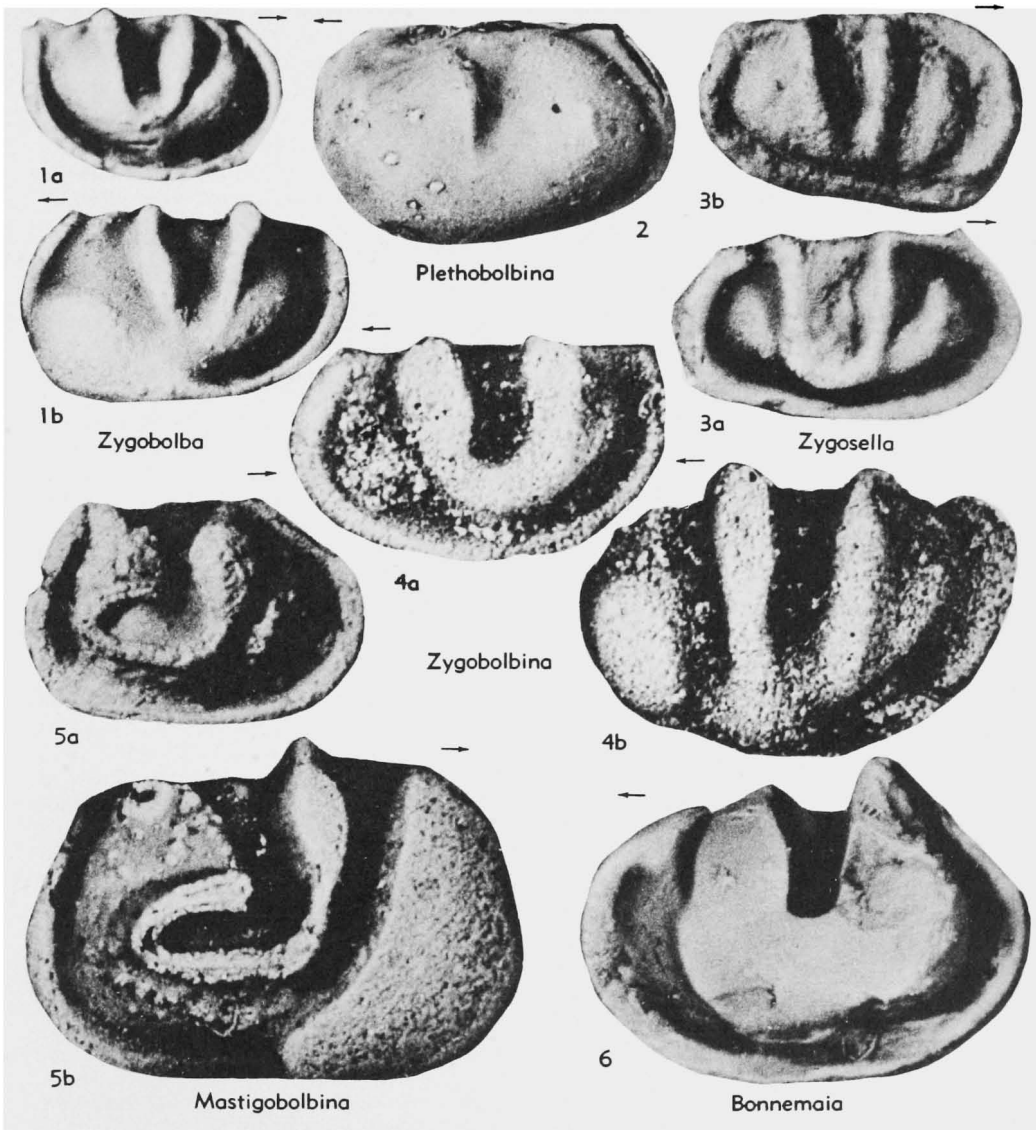

Fig. 55. Zygobolbidae (p. Q122-Q123).

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face coarsely reticulate. Female with ovate pouch centrally located on ventral border. *M.Dev.*, N.Am. ——Fig. 51,*2a-c*. **T. lyoni* (Ulrich), Jeffersonville Ls., USA (Ky.-Ind.); *2a-c*, ♂ RV lat., ♀ RV lat., vent., ×21 (Kesling, 1957).——Fig. 51,*2d-f*. *T. stellata* Kesling, Centerfield Ls., USA (N.Y.); *2d-f*, ♂ RV lat., ♀ RV lat., vent., ×20 (Kesling, 1957). [According to Berdan, *Kozlowskiella* Přibyl (1953), is closely related to *Treposella* and appropriately is assignable to the Beyrichiidae. It is here included in Palaeocopida of uncertain suborder and family.—Moore.]

?**Tribolbina** Latham, 1932 [**T. carnegiei*]. Large with 2 long sulci, one extending from anterodorsal margin almost to ventromedian border, other from slightly behind dorsomedian area to join first at ventromedian area, sulci together forming distinct "V"; knoblike lobe may be developed between the sulci near the anterodorsal margin. Female with elongate pouch in anteroventral area. *L.Carb.-L.Perm.*, N.Am.-Eu.

Welleria Ulrich & Bassler, 1923 [**W. obliqua*]. Trilobate, S_1 and S_2 shallow, short; lobes low; surface smooth in type species. Females with ill-defined pouch that consists merely of ventral swelling. *U.Sil-M.Dev.*, NE. N.Am.-?Eu.——Figs. 50,*1*, 52,*6*. **W. obliqua*, U.Sil.(Tonoloway F.), USA (W.Va.); 50,*1a,b*, ♂ and ♀ RV (syntypes) lat., ×15 (Berdan, n); 52,*6a,b*, ♂ RV lat., ♀ RV lat., ×15; 52,*6c,d*, ♀ LV lat., ♂ RV lat., ×15 (Ulrich & Bassler, 1923). [Berdan.]

Welleriopsis Swartz & Whitmore, 1956 [**W. diplocystulis*]. Trilobate, S_1 and S_2 tending to unite on dorsal side of L_2, which does not reach dorsal margin; marginal rim narrow; surface smooth, or finely punctate-reticulose. Dimorphic pouch extending from anteroventral to posteroventral part of valve, fairly well defined dorsally and indented below L_2. *U.Sil.-L.Dev.*, N.Am.——Fig. 53,*2a,b*. **W. diplocystulis*, L.Dev. (Manlius Ls.), USA (N.J.); *2a*, ♂ RV (syntype) lat., ×35; *2b*, ♀ LV (syntype) lat., ×30 (Sohn, n).——Fig. 53, *2c-e*. *W. jerseyensis* (Weller), U.Sil. (Decker Ls.), USA (N.J.); *2c-e*, LV (holotype) lat., vent., post., ×20 (Sohn, n). [Berdan.]

Zygobeyrichia Ulrich, 1916 [**Z. apicalis*]. Trilobate, L_1 separated from L_2 and L_3 by shallow ventral extension of S_1; surface reticulate. Pouch large, anteroventral. *U.Sil.-L.Dev.*, NE. N.Am.-Eu.—— Figs. 50,*3*, 52,*2*. **Z. apicalis*, L.Dev., USA (Me.); 50,*3a*, ♂ RV (topotype) lat., ×15; 50,*3b*, ♀ LV (topotype) lat., ×15 (Berdan, n); 52,*2a,b*, ♀ LV lat., ♂ LV lat., ×15 (Ulrich & Bassler, 1923).—— Fig. 54,*1*. *Z. barretti* (Weller), U.Sil. (Decker Ls.), USA (N.J.); *1a-d*, ♂ carapace (holotype) L, R, vent., post., ×25 (Swartz & Whitmore, 1956). [Berdan.]

Family ZYGOBOLBIDAE Ulrich & Bassler, 1923

[=Nodellinae Zaspelova, 1952] [Materials for this family prepared by Jean Berdan, United States Geological Survey]

Shape semielliptical, dorsum straight, cardinal angles distinct; median sulcus deep and conspicuous; L_1 suppressed or attenuate, L_2 and L_3 tending to unite ventrally, raised above other lobes so that general appearance of carapace is commonly bilobate, less commonly trilobate, or quadrilobate; free margins bordered by rim which is a ventrally directed flexure of shell. Dimorphism shown by anteroventral or ventral pouch. Hinge simple, muscle scar unknown. *?M.Ord.-?L. Sil., M.Sil., ?Dev.*

Zygobolba Ulrich & Bassler, 1923 [**Beyrichia decora* Billings, 1866]. L_2 and L_3 narrow, forming a prominent U- or V-shaped ridge; surface smooth, finely punctate, or reticulate. *?Ord., M. Sil., ?Dev.*

Z. (Zygobolba). Pouch large, oval, situated anteroventrally. *?Ord., M.Sil., ?Dev.*, N. N.Am.-N. Eu.——Fig. 55,*1*. **Z. (Z.) decora* (Billings), M.Sil., Can.; *1a*, ♂ RV (topotype) lat., ×15; *1b*, ♀ LV lat., ×15 (Berdan, n).

Z. (Zygobolbina) Ulrich & Bassler, 1923 [**Zygobolbina conradi* Ulrich & Bassler, 1923]. Pouch bilobed, anteroventral in position, anterior part subglobular, divided by shallow sulcus from posterior part, which is a low swelling. *M.Sil.*, NE. N.Am.——Fig. 55,*4*. **Z. (Z.) conradi* (Ulrich & Bassler), USA (Md.); *4a*, ♂ LV (syntype) lat., ×15; *4b*, ♀ LV (syntype) lat., ×15 (Berdan, n).

Z. (Zygosella) Ulrich & Bassler, 1923 [**Zygosella vallata* Ulrich & Bassler, 1923]. Pouch narrow and ridgelike, confined to anterior part of carapace. *M.Sil.*, NE. N.Am.——Fig. 55,*3*. **Z. (Z.) vallata*, USA(Md.-W.Va.); *3a*, ♂ RV (holotype) lat., ×15; *3b*, ♀ RV lat., ×15 (Berdan, n).

Bonnemaia Ulrich & Bassler, 1923 [**B. celsa*]. L_2 and L_3 broad, sharply set off from surface of valve by angular contact, L_1 narrow (if present), S_1 very narrow (if present); L_3 in most species with sigmoidally curved angular crest on its posterior side; anteroventral pouch ovate, poorly defined dorsally; surface smooth where known, ornamentation of most species unknown. *M.Sil.*, NE. N.Am.——Fig. 55,*6*. **B. celsa*, USA (Md.); ♂ LV lat., ×15 (Berdan, n).

?**Glymmatobolbina** Harris, 1957 [**G. quadrata*]. Subquadrate, valves equal; S_2 prominent, S_1 weak; posterior portion of carapace broadly swollen, connected ventrally below S_2 to anterior lobe. Monospecific. [Resembles *Plethobolbina*.] *M.Ord.*, USA (Okla.). [Scott.]

Mastigobolbina Ulrich & Bassler, 1923 [**M. typa*]. L_1 narrow, L_2 pyriform, typically produced ven-

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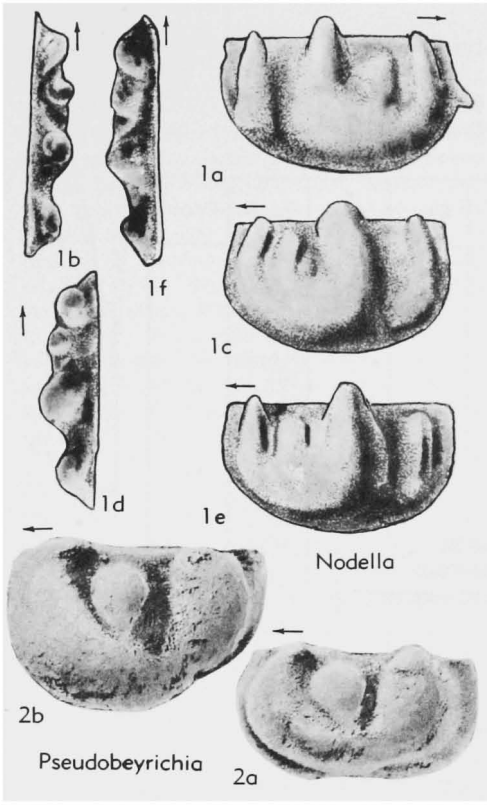

FIG. 56. Beyrichiidae, Drepanellidae (p. Q122-Q125).

trally and posteriorly as curved carina ("flagellum") that extends onto L_3, S_1 very narrow; pouch large, subovate, in anterior part of valve; surface smooth, reticulate, or pustulose. *M.Sil.*, NE. N.Am. ——FIGS. 27, 55,*5*. **M. typa*, USA (Md.); 55,*5a*, ♂ RV (syntype) lat., ×15; 55,*5b*, ♀ RV lat., ×15 (Berdan, n).

?**Plethobolbina** ULRICH & BASSLER, 1923 [**P. typicalis*]. L_1 suppressed, L_2 and L_3 very large and full, S_2 only sulcus present, rim narrow and flattened; pouch inconspicuous; anteroventral swelling. Surface smooth or reticulate. *M.Sil.*, NE. N.Am. ——FIG. 55,*2*. **P. typicalis*, USA (Pa.); ♂ LV (holotype) lat., ×15 (Berdan, n).

Family UNCERTAIN

?**Gillatia** ÖPIK, 1953 [**G. trinacria*]. Straight-backed, trilobate, with marginal rim, lobes not connected ventrally, but broad swelling of valves occurs on ventral side of sulci. *L.Sil.*, Austral.(Victoria). [SCOTT.]

Superfamily DREPANELLACEA Ulrich & Bassler, 1923

[*nom. transl.* POLENOVA and ZANINA, 1960 (*ex* Drepanellinae ULRICH & BASSLER, 1923)] [Diagnosis and discussion by H. W. SCOTT, University of Illinois]

Carapace subquadrate to subrectangular, with or without marginal rim; surface smooth, pitted, or reticulate; one or more nodes present, some species terminated by spines; nodes rarely lobate; S_2 poorly to well defined; hingement by tongue and groove; dimorphism unknown. *M.Ord.-M. Perm.*

The Drepanellacea include very diverse genera which upon first examination seem to be unrelated. The marginal rim which is so characteristic of *Bollia* and *Ulrichia* might appear to be of major importance, but when such forms as *Paraechmina* are studied, we note that the marginal rim is expressed in several ways. It may be complete and prominent (e.g., *P. spinosa* HALL), more or less lobate (e.g., *P. postica* ULRICH & BASSLER, or completely absent (e.g., many *Aechmina* and all Richinidae). Gradations in development of the marginal rim are such that they cannot be used as a key to the superfamily. The number and position of nodes varies from the single dorsomedial spinose node of *Aechmina* to the multinodose form of *Cornigella*. Comparison of a smooth binodose, marginally rimmed *Ulrichia* with multinodose *Cornigella* might lead to the conclusion that these forms were entirely unrelated, whereas all gradations actually may be found between number and position of the nodes, degree of ornamentation, and strength of the marginal rim. These gradations imply relationship, which, in addition to absence of typical lobation or any form of recognizable dimorphism, warrants the inclusion of all indicated families in a single superfamily, the Drepanellacea.

The stratigraphic distribution of drepanellacean genera is indicated graphically in Figure 57.

Family DREPANELLIDAE Ulrich & Bassler, 1923

[*nom. transl.* SWARTZ, 1936 (*ex* Drepanellinae ULRICH & BASSLER, 1923)] [=Neodrepanellinae, Nodellinae ZASPELOVA, 1952; Depranellidae HOWE, 1955] [Materials for this family prepared by H. W. SCOTT, University of Illinois, with additions from IVAR HESSLAND, University of Stockholm]

Carapace subquadrate to subrectangular; hinge long, dorsum straight, cardinal angles subequal and well defined; lateral surface lobate or with nodose lobes, nodes commonly terminating as spines with one or

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more overreaching dorsum; surface smooth, granular, pitted, or finely reticulate; marginal ridge or carina subparallel to free margin, poorly developed posteriorly; valves subequal. Hingement by simple tongue and groove but unknown in some forms. Dimorphism unknown. *M.Ord.-U.Dev.*

Drepanella ULRICH, 1890 [*pro Depranella* ULRICH,

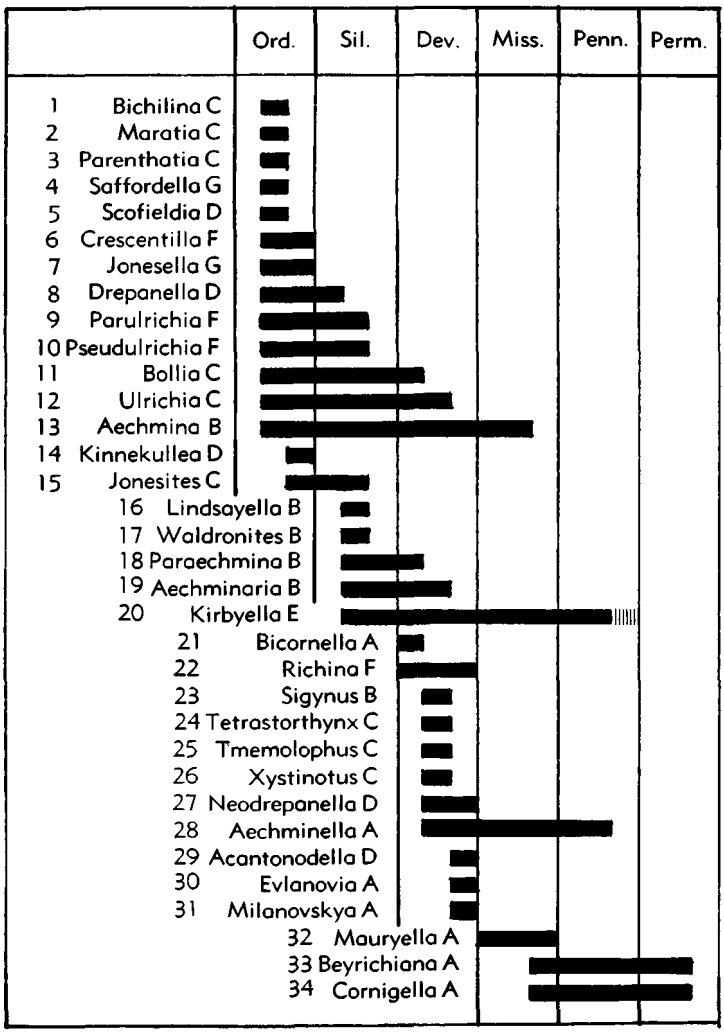

FIG. 57. Stratigraphic distribution of drepanellacean ostracode genera (Moore, n). Classification of the genera in families is indicated by letter symbols (A—Aechminellidae, B—Aechminidae, C—Bolliidae, D—Drepanellidae, E—Kirkbyellidae, F—Richinidae, G—Family Uncertain) and an accompanying alphabetical list furnishes a cross reference to the serially arranged numbers on the diagram.

Generic Names with Index Numbers

Acantonodella—29
Aechmina—13
Aechminaria—19
Aechminella—28
Beyrichiana—33
Bichilina—1
Bicornella—21
Bollia—11
Cornigella—34
Crescentilla—6
Drepanella—8
Evlanovia—30
Jonesella—7
Jonesites—15
Kinnekullea—14
Kirkbyella—20
Lindsayella—16
Maratia—2
Mauryella—32
Milanovskya—31
Neodrepanella—27
Paraechmina—18
Parenthatia—3
Parulrichia—9
Pseudulrichia—10
Richina—22
Saffordella—4
Scofieldia—5
Sigynus—23
Tetrastorthynx—24
Tmemolophus—25
Ulrichia—12
***Waldronites*—17**
Xystinotus—26

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1890 (ICZN pend.)] [**Drepanella crassinoda* ULRICH, 1890]. Subrectangular to subquadrate; dorsal border straight, cardinal angles subequal, well defined; carinate rib subparallel to anterior and ventral free margin, terminating anterodorsally as spine which overreaches dorsal margin, prominent spine at posterodorsal cardinal position; carinate ridge and posterodorsal spine representing external ornamental features not reflected internally; 2 prominent lobes in dorsomedial area separated by S_2, lobes smooth or marked by small secondary spines, which may terminate dorsally in a spine; surface smooth, granular, or pitted; valves subequal; no velum or subcarinate ridges known. Hingement in RV consisting of long straight groove, corresponding bar presumed to exist in LV; dimorphism unknown. *M.Ord.-L.Sil.*, N.Am.——FIG. 59,*1*. **D. crassinoda* (ULRICH), M.Ord.(Stones River F.), USA(Ky.); *1a,b*, RV lat., int., ×40 (Scott, n).

Acantonodella ZASPELOVA, 1952 [**A. terciocornuta*] [=*Acanthodella* HOWE, 1955]. Amplete or slightly postplete, with shallow sulcal depression between presulcal node and postsulcal oblique lengthened elevation, another dorsal elevation extending conformingly behind this one; adventral structure developed as ridge extending along entire free margin (anterior end may form knob dorsally). Dimorphism not reported. Surface pitted. Closely similar to *Drepanella, U.Dev.*, Eu. (USSR).——FIG. 58,*3*. **A. terciocornuta; 3a,b*, RV (holotype) lat., dors., ×50 (Zaspelova, 1952). [HESSLAND.]

?Kinnekullea HENNINGSMOEN, 1948 [**K. waerni*]. Straight dorsal margin; ends and ventral margin broadly rounded; arcuate ridge extending subparallel to anterior margin and in some specimens extending backward along ventral margin, ridge may project dorsally as spine or terminate in low node; rib tends to merge ventrally into smooth, reticulate, or pitted valve surface; no adventral structure; dimorphism unknown. [The sigmoid lobe is believed to be an external feature, not reflected interiorly. The genus cannot belong to the Bolliidae or Richinidae because in these families the lobes are reflected internally; also, it lacks the marginal rim of the bolliids. This form may represent an instar stage of some drepanellid.—SCOTT.] *U.Ord.*, Eu. (Swed.).——FIG. 58,*4*. **K. waerni;* LV lat., ×28 (Henningsmoen, 1948).

Neodrepanella ZASPELOVA, 1952 [**Drepanella tricornis* BATALINA, 1941] [=*Tetracornella* ZASPELOVA, 1952]. Anterodorsal quarter bearing 3 dorsally directed spines and rounded node; velate structure present, complete or incomplete posteriorly and merging or not merging with anterodorsal spine; no posteroventral spine. Surface reticulate. *M.Dev.-U.Dev.*, Eu.——FIG. 58,*2*. **N. tricornis* (BATALINA), U.Dev., Russia; *2a,b*, RV (neotype) lat., dors., ×50; *2c,d*, LV (paratype) lat., dors., ×50; *2e,f*, RV (paratype), lat., int., ×70 (Zaspelova, 1952).

?Nodella ZASPELOVA, 1952 [**N. svinordensis*]. Valves with 4 spinose dorsal lobes, anterior 3 being joined ventrally but posterior separated from others by sulcus; posteroventral spine may be present; velate structure present or absent. Muscle scar defined as small rounded node below median lobe. Surface smooth. *U.Dev.*, Eu.(Russia).——FIG. 56,*1*. **N. svinordensis; 1a,b*, RV (holotype), lat., dors., ×50; *1c,d*, LV (paratype) lat., dors.; *1e,f*, LV (paratype) lat., dors.; all ×50 (Zaspelova, 1952).

Scofieldia ULRICH & BASSLER, 1908 [**Drepanella bilateralis* ULRICH, 1894]. Like *Drepanella* but marginal ridge broader, dorsomedial node (L_2) smaller, and S_2 and S_3 merge at base of L_2. *M. Ord.*, N.Am.——FIG. 58,*1*. **S. bilateralis* (ULRICH), Decorah Sh., USA (Minn.); *1a,b*, LV lat., int., ×20 (J. R. Cornell, n).

Family AECHMINELLIDAE Sohn, n. fam.

[Materials for this family prepared by I. G. SOHN, United States Geological Survey]

Small, straight-backed, lobate or nodose, with some or all lobes terminating in spines; overlap slight; surface reticulate, pitted, or smooth; free margins smooth. Hinge ridge-and-groove type. *L.Dev.-M.Perm.*

Aechminella HARLTON, 1933 [**A. trispinosa*] [=*Balantoides* MOREY, 1935; *Boursella* TURNER, 1939]. Quadrilobed or trilobed with posterior spine, sulci vertical. *M.Dev.-L.Penn.*, N.Am.——FIG. 60,*1*. **A. trispinosa*, Penn., USA (Okla.); *1a,b*, LV (holotype) dors., lat., ×60 (Sohn, n).

Beyrichiana KELLETT, 1933 [**B. permiana*] [=*?Mammoides* BRADFIELD, 1935]. Bilobed in dorsal half, with posterolateral spine or node on each valve; differs from *Aechminella* in lack of distinct sulcus. *U.Miss.-L.Perm.*, N.Am.——FIG. 60,*5*. *B. ? mammilata*, Penn., Okla. (type species of *Mammoides*); RV (holotype) lat., ×30 (Sohn, n).

Bicornella CORYELL & CUSKLEY, 1934 [**B. tricornis*]. Differs from *Beyrichiana* in having 2 backwardly pointed spined lobes in dorsal half. *L.Dev.*, N.Am.——FIG. 60,*2*. **B. tricornis*, USA (Okla.); *2a,b*, LV lat., dors., ×120 (Sohn, n).

Cornigella WARTHIN, 1930 [**C. minuta* (=**Beyrichia tuberculospinosa* JONES & KIRKBY, 1886)]. Subhemicircular valves with single upward pointing large spine near dorsal margin, surface with scattered small nodes. *U.Miss.-M.Perm.*, Eu., USA.

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Evlanovia Egorov, 1950 [**E. tichonovitchi*]. Differs from *Beyrichiana* in absence of posterior spine and in having 2 nodes near ventral margin, one subcentral, other anteroventral. *U.Dev.*, Eu. (Russia).

——Fig. 60,*3*. **E. tichonovitchi; 3a*, ♂ RV lat.; *3b,c*, ♀ RV (holotype) lat., dors.; all ×45 (Egorov, 1950).

Mauryella Ulrich & Bassler, 1923 [**M. mam-*

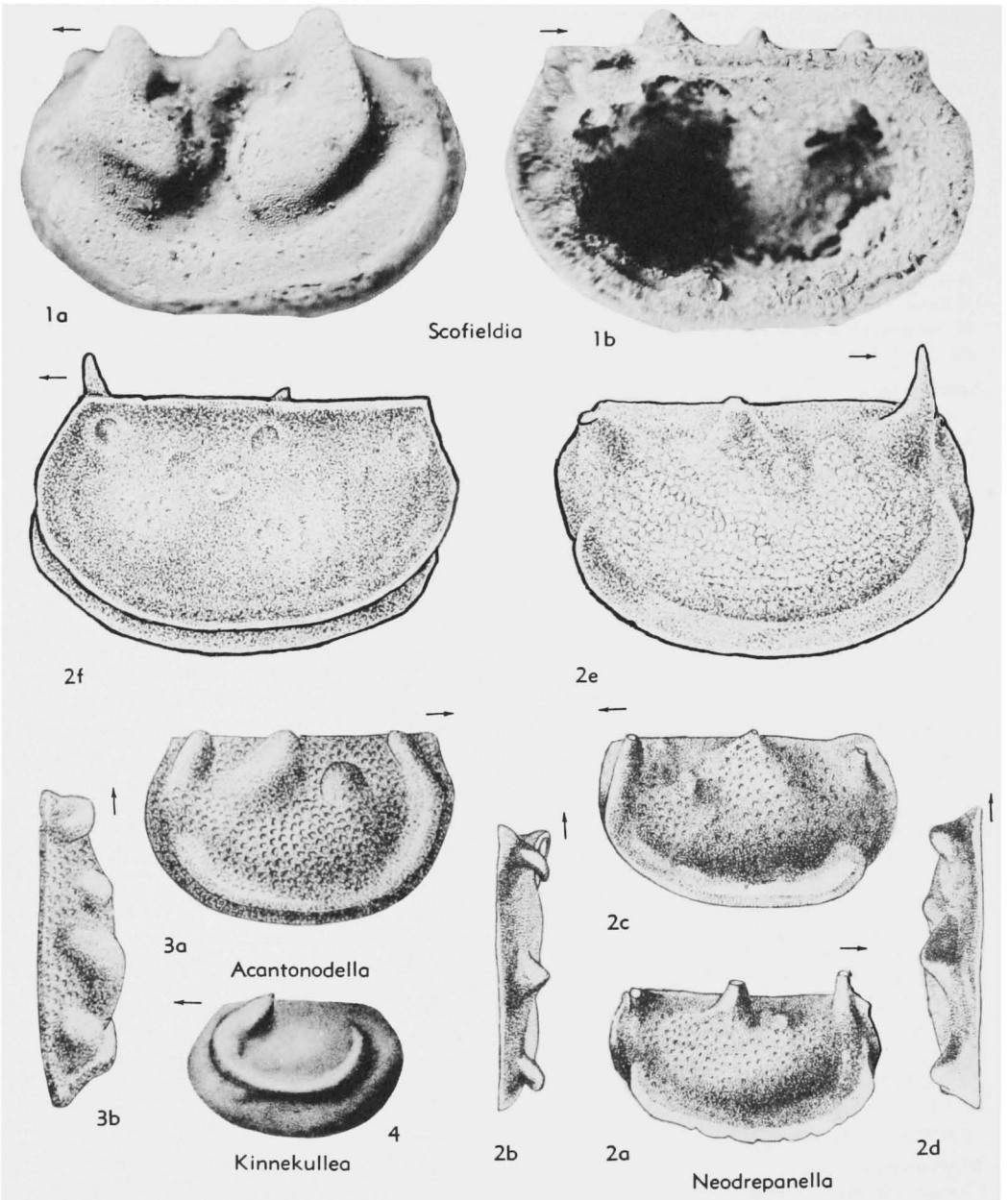

Fig. 58. Drepanellidae (p. *Q*125).

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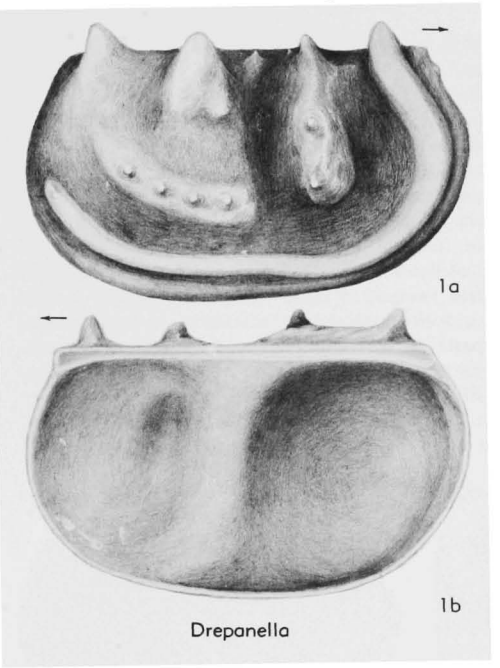

FIG. 59. Drepanellidae (p. Q125).

milata] [=*Verrucosella* CRONEIS & GALE, 1938; *Verrucolsella* NEAVE, 1950]. Rounded nodes superposed on reticulated valve. *Miss.*, N.Am.

?**Milanovskya** EGOROV, 1950 [**M. bicornis*]. Backward-pointing spines below dorsal margin near each end. *U.Dev.*, Eu. (Russia).——FIG. 60,*4*. **M. bicornis; 4a,b,* ♀ LV (holotype) lat., dors.; *4c,d,* ♂ LV lat., dors.; all ×45 (Egorov, 1950).

Family AECHMINIDAE Bouček, 1936

[*nom. transl.* SWARTZ, 1936 (Oct.) (*ex* Aechmininae BOUČEK, 1936) (July)] [Materials for this family prepared by S. A. LEVINSON, Humble Oil & Refining Company]

Straight-hinged with distinct spine; base of spine in dorsal-median area. Commonly with rounded pit variously located adjacent to base of spine; marginal ridge or marginal spines or papillae present in some species. *M.Ord.-M.Miss.*

Aechmina JONES & HOLL, 1869 [**A. cuspidata*]. Simple, with distinct dorsal-median spine, commonly with marginal spines or papillae. *M.Ord.-M.Miss.*, N.Am.-NW.Eu.-Austral.——FIG. 61,*1*. **A. cuspidata,* Sil.(Wenlock.), Eng.; LV lat., ×25 (Jones & Holl).——FIG. 61,*4*. *A.* sp. cf. *A. cuspidata,* Dev.(Helderberg.), USA (Md.); RV lat., ×60 (Bouček, 1936).

Aechminaria CORYELL & WILLIAMSON, 1936 [**A. nodosa*]. Like *Aechmina* but with distinct rounded pit at anteroventral side of base of spine. *M.Sil.-M.Dev.*, N.Am.——FIG. 61,*5*. *A. robusta,* M.Sil. (Waldron), USA (Ind.); RV lat., ×25 (Coryell & Williamson, 1936).

Lindsayella CORYELL & WILLIAMSON, 1936 [**L. rugosa*]. Like *Waldronites* but without submarginal ridge. *M.Sil.*, N.Am.——FIG. 61,*2*. **L. rugosa,* Waldron Sh., USA (Ind.); RV lat., ×40 (Coryell & Williamson, 1936).

Paraechmina ULRICH & BASSLER, 1923 [**Cytherina spinosa* HALL, 1852 (*non* REUSS, 1846; ICZN pend.)]. Like *Aechminaria* but with well-defined marginal ridge. *M.Sil.-L.Dev.*, N.Am.——FIG. 61, *7*. **P. spinosa* (HALL), M.Sil., USA (N.Y.); LV lat., ×45 (Hall, 1852).

Sigynus KESLING, 1953 [**S. dictyotus*]. Small pit ventral to base of dorsomedian spine, surface reticulate. *M.Dev.*, N.Am.——FIG. 61,*6*. **S. dictyotus,* Arkona, Can. (Ont.); RV lat., ×60 (Kesling, 1953).

Waldronites CORYELL & WILLIAMSON, 1942 [*pro Cornulina* CORYELL & WILLIAMSON, 1936 (*non* CONRAD, 1853)] [**Cornulina bispinosa* CORYELL & WILLIAMSON, 1936]. Like *Aechmina* but with submarginal ridge from mid-posterior to anterior cardinal angle where it terminates in small spine; irregular crescent-shaped ridge connecting major spine with anterodorsal spine. *M.Sil.*, N.Am.——FIG. 61,*3*. **W. bispinosa* (CORYELL & WILLIAMSON), Waldron Sh., USA (Ind.); RV lat., ×25 (Coryell & Williamson, 1936).

Family BOLLIIDAE Bouček, 1936

[*nom. transl.* SCOTT & WAINWRIGHT, herein (*ex* Bolliinae BOUČEK, 1936)] [=Ulrichiinae SCHMIDT, 1941] [Materials for this family prepared by H. W. SCOTT, University of Illinois, and JOHN WAINWRIGHT, Shell Oil Co., with some additions by IVAR HESSLAND, University of Stockholm, as recorded]

Carapace subquadrate to subrectangular; hinge long, cardinal angles subequal and well defined; lateral surface distinguished by presence of 2 dorsomedial nodes which are separate or joined ventrally to form U-shaped lobe, area between nodes representing S_2; distinct marginal rim (pseudovelum) extending around all or a portion of free margin; lateral surface of valves (other than lobes and marginal rim) flat to inflated and smooth to coarsely reticulate, pitted or granulose; valves subequal. Hingement by tongue and groove. Dimorphism unknown (except in *Bichilina*). [Distinguished from the Richinidae mainly by presence of a marginal rim.] *M.Ord.-M.Dev.*

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Bollia JONES & HOLL, 1886 [**B. uniflexa;* SD S.A. MILLER, 1892 (*fide* WARTHIN, 1948)]. Dorsal margin straight, long; cardinal angles distinct, subequal; marginal rim well defined, extending around entire free margin, rarely inconspicuous in posterodorsal area; 2 dorsomedial lobes connected ventrally to form a U-shaped lobe surrounding S_2, surface within marginal ridge and exclusive of lobes nearly flat or gently convex and ornamented with pits, puncta, or reticula. *M.Ord.-L.Dev.*, Eu.-N.Am.——FIG. 62,*1*. **B. uniflexa,* M.Sil., Eng.; *1a,b,* carapace R, dors., ×15 (Jones & Holl, 1886).——FIG. 62,*2*. *B. ungula* JONES, L.Dev. (Onondaga F.), USA (Pa.); LV lat., ×25 (SWARTZ & SWAIN, 1941).——FIG. 62,*3*. *B. subaequata* ULRICH, M.Ord. (Decorah Sh.), USA (Minn.); *3a,b,* LV lat., RV lat., ×45 (J. R. Cornell, n.).

?Bichilina SARV, 1959 [recorded by SARV as *Bichilina* NECKAJA, in coll.] [**B. prima* SARV, 1959 (described as *B. prima* NECKAJA, in coll.)]. Amplete or preplete, equivalved, monosulcate; sulcus deep and subcircular in outline, surrounded by horseshoe-shaped ridge; dorsal plica present, surface smooth or tuberculate. Dimorphic, adventral structure developed as more or less wide flange along entire free margin, of equal width and slightly concave or wider and somewhat convex in anteroventral part. *M.Ord.*, NW.Eu.——FIG. 62,*9*. **B. prima,* Est.; *9a,b,* RV (holotype) (tecnomorph) lat., and RV (heteromorph) int., ×33 (Sarv, 1959). [HESSLAND] [Classed by SCOTT in Bolliidae but in opin-

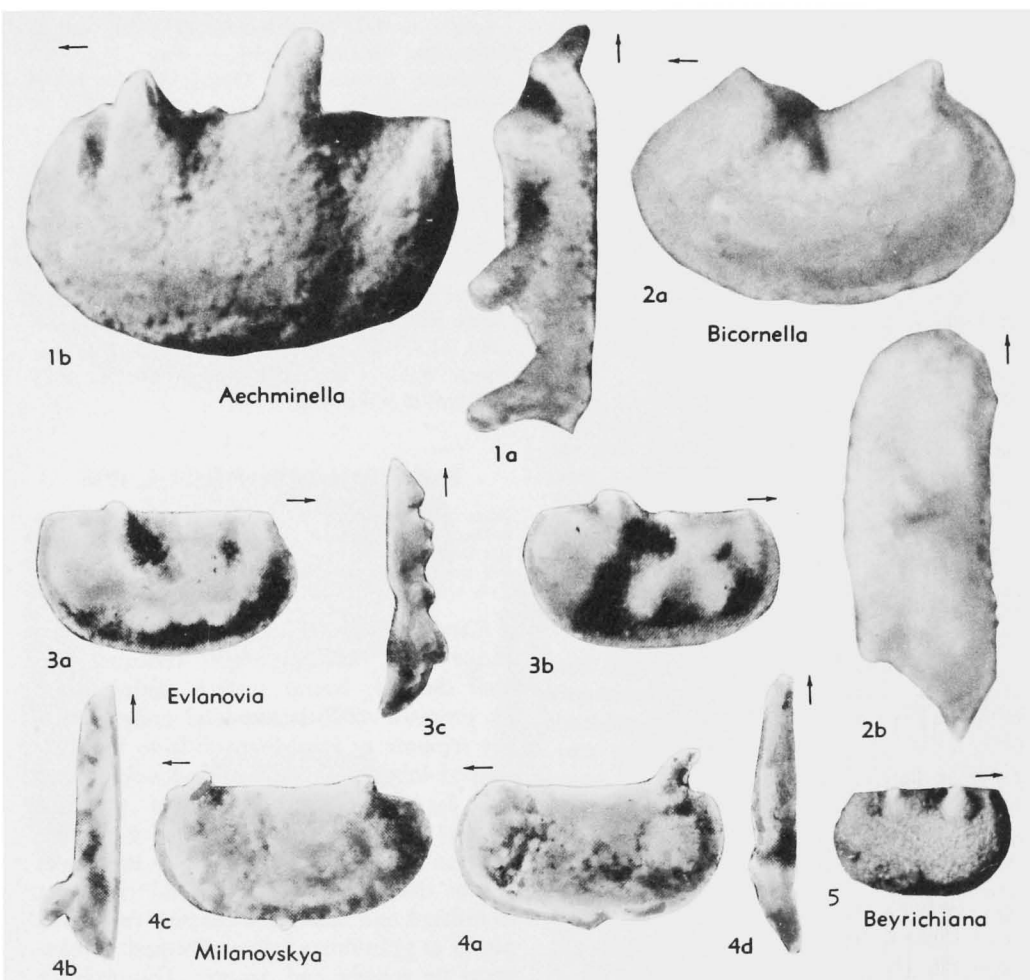

FIG. 60. Aechminellidae (p. Q126-Q127).

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ion of HESSLAND probably belongs in Tvaerenellidae.]

?**Jonesites** CORYELL, 1930 [*pro Placentula* JONES & HOLL, 1886 (*non* LAMARCK, 1822)] [**Primitia excavata* JONES & HOLL, 1869] [=?*Placentella* WILSON, 1935]. Subovate, cardinal angles obtuse; dorsal margin straight or in some specimens convex, marginal ridge parallel to free margin and continuing around dorsal border; thickened dorsal rim may rise above hinge line; S_2 defined by a raised U-shaped ridge that is continuous with marginal rim; anterior arm of ridge may be thickened to form a node but in some species ventral part of this ridge may be missing. Surface within marginal ridge (except ridge bounding S_2) depressed, reticulate. *U.Ord.-M.Sil.*, Eu.-N.Am.—— FIG. 62,*14*. **Jonesites primitia excavata* (JONES & HOLL), M.Sil. (Woolhope Ls.), Eng.; LV, ×44 (H. N. Coryell, 1930).

Maratia KAY, 1940 [**M. mara*]. Small, subovate, valves subequal; dorsal margin straight, ventral broadly convex; S_1, S_2, S_3 present, all confined to dorsal half of valves, L_1, L_2, L_3, and L_4 distinguished, L_1 and L_4 tending to fade ventrally into general shell surface, L_2 smaller than L_3, adventral bend *(Umbiegungskante)* sharp, forming broad venter; surface coarsely pitted to punctate; S_2, L_2, and L_3 reflected internally more strongly than other sulci and lobes. [Like *Ulrichia* but lacks sharp marginal rim and sulci, and lobes more numerous.] *M.Ord.*, N.Am.——FIG. 62,*7*. **M. mara*, M.Ord. (Decorah Sh.), USA (Minn.); *7a-c*, RV lat., LV lat., int., ×50 (J. R. Cornell, n).

?**Parenthatia** KAY, 1940 [**Moorea punctata* ULRICH

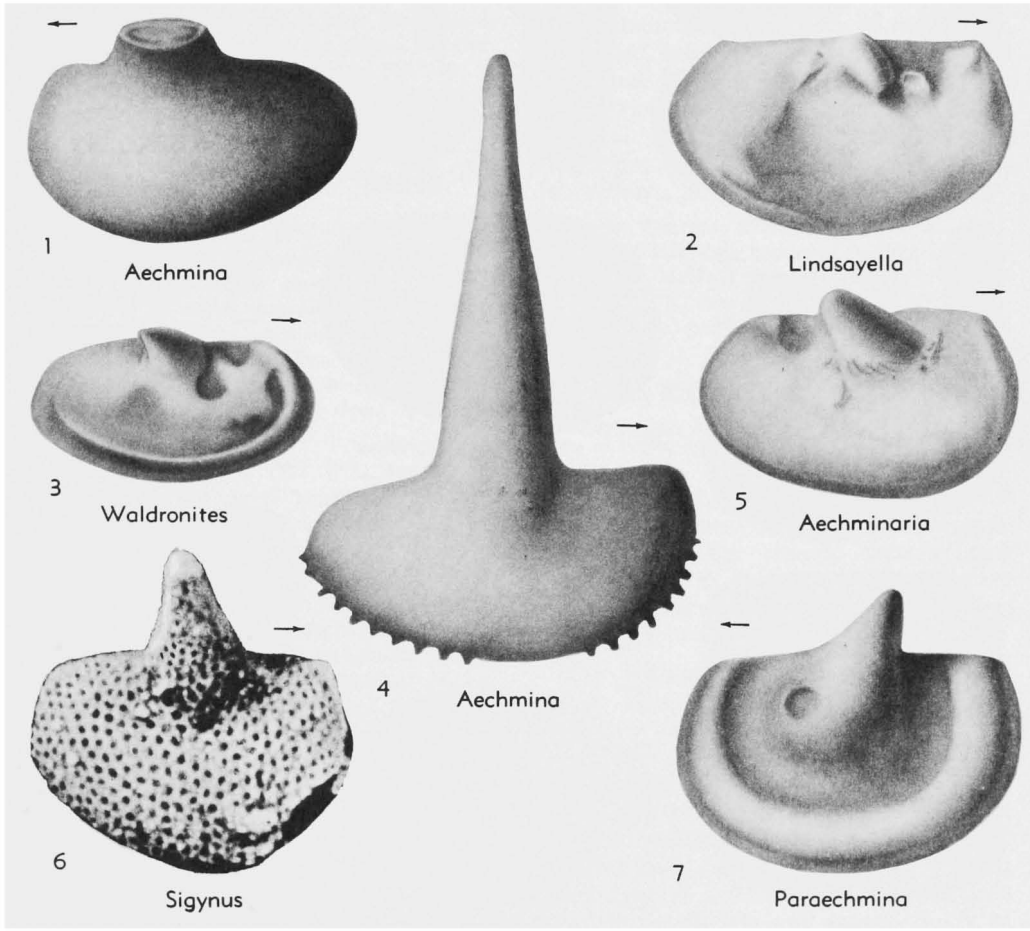

FIG. 61. Aechminidae (p. Q127).

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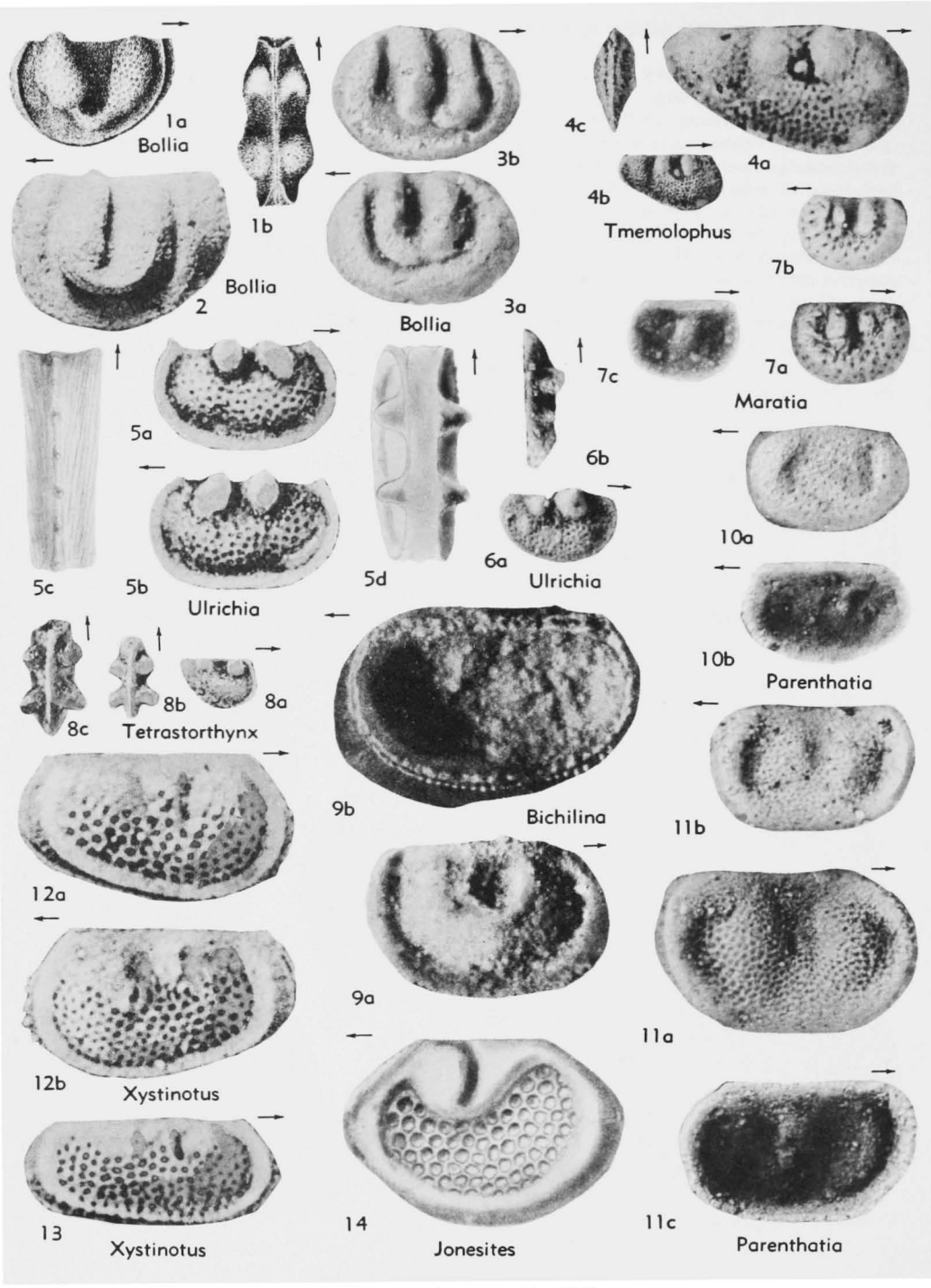

FIG. 62. Bolliidae (p. Q128-Q131).

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1894]. Small, valves subequal, hinge long and straight; cardinal angles poorly defined, anterior commonly more obtuse; marginal rim sharply defined along anterior and posterior margins, less well developed at mid-venter; S_2 indistinct or well defined, when present dividing valve into 2 gently swollen lobes which merge ventrally into general surface of shell, lobes joined to form broad "U" poorly defined at base; lobes separated from anterior and posterior marginal rims by shallow depressions; surface finely reticulate. [*P. punctata* probably represents a young instar, S_2 and the "U"-lobe being undeveloped. Specimens of *P. camerata* found associated with *P. punctata* seem to represent adults. *Parenthatia* may belong to the *Leperditellidae*, but the presence of a marginal rim and the subequality of the valves are closer to the Bolliidae. In ventral view the marginal rim produces the typical wide, flat to gently concave, surface common to the bolliids.] *M.Ord.*, N.Am.——Fig. 62,*10*. **P. punctata* (Ulrich), M. Ord. (Decorah Sh.), USA (Minn.); *10a,b*, LV lat., RV int., ×50 (J. R. Cornell, n).——Fig. 62, *11*. *P. camerata* Kay, M.Ord. (Decorah Sh.), USA (Minn.); *11a-c*, RV lat., LV lat., int., ×50 (J. R. Cornell, n.).

Tetrastorthynx Kesling, 1953 [**T. diabolicus*]. Like *Tmemolophus* but dorsomedial nodes widely spaced and considerably more distinct; surface reported to be highly granulose; original surface may have been finely reticulate. Dimorphism unknown, *M.Dev.*, N.Am.——Fig. 62,*8*. **T. diabolicus*, Arkona Sh., Can. (Ont.); *8a-c*, RV lat., carapace dors., carapace (holotype) dors., ×42 (Kesling, 1953).

Tmemolophus Kesling, 1953 [**T. margarotus*]. Like *Ulrichia* but dorsal nodes more lobelike, with distinct intervening sulcus; velate structure paralleling ventral free margin only, marginal costa sometimes present in some species; posteroventral margin more truncate; like *Bollia* but lacks ventral connection to dorsal nodes. [The subequal size of the nodes and their dorsomedial position exclude this genus from the Hollinidae.] *M.Dev.*, N.Am.——Fig. 62,*4*. **T. margarotus*, Arkona Sh., Can. (Ont.); *4a*, carapace (holotype) R, ×68; *4b,c*, carapace R, vent., ×30 (Kesling, 1953).

Ulrichia Jones, 1890 [**U. conradi*] [=*?Warthinia* Spivey, 1939; *?Limbatula* Zaspelova, 1952]. Small, surface reticulate; with 2 prominent dorsomedial nodes; marginal rim distinct. [Like *Bollia* except that dorsomedial lobes are not united ventrally; they may extend slightly above the dorsal margin.] *M.Ord.-M.Dev.*, cosmop.——Fig. 62,*5*. **U. conradi*, M.Dev.(Bell Sh.), USA (Mich.); *5a,b*, RV lat., LV lat., ×40 (Kesling, 1952); M. Dev.(Hamilton Gr.), USA (N.Y.), *5c,d*, vent. dors., ×40 (Scott, n.).——Fig. 62,*6*. *U. nodosa* (Ulrich), (type species of *Warthinia*), U.Ord. (Maquoketa F.), USA (Iowa); *6a,b*, RV lat., dors., ×35 (J. H. Burr, Jr., n).

Xystinotus Kesling, 1953 [**X. wrightorum*]. Like *Ulrichia* but without pronounced nodes; lateral surface reticulate, dorsal part of each valve smooth; with marginal costa or row of minute tubercles. *M.Dev.*, N.Am.——Fig. 62,*12*. **X. wrightorum*, Arkona Sh., Can. (Ont.); *12a,b*, carapace (holotype) R, carapace (paratype) L, ×68 (Kesling, 1953).——Fig. 62,*13*. *X. subnodatus* (Turner), Arkona Sh., Can. (Ont.); carapace R, ×68 (Kesling, 1953).

Family KIRKBYELLIDAE Sohn, n. fam.

[Materials for this family prepared by I. G. Sohn, United States Geological Survey]

Subquadrate, small essentially equivalved, reticulated, sulcate, with distinct to subdued subventral horizontal lobe that terminates in posterior spine, and with or without one marginal rim. Narrow ridge-and-groove hingement with minute terminal teeth. *M. Sil.-M.Penn., ?U.Penn.*

Kirkbyella Coryell & Booth, 1933 [**K. typa*]. Horizontal lobe with backward-pointing spine below sulcus. *M.Sil.-M.Penn., ?U.Penn.*, N.Am.——Fig. 63,*1*. **K. typa*, ?Penn., USA (Tex.); *1a-c*, RV (holotype) lat., int., dors., ×60 (Sohn, n).

Family RICHINIDAE Scott, n. fam.

[Materials for this family prepared by H. W. Scott, University of Illinois, with additions by Ivar Hessland, University of Stockholm]

Subovate, with 2 well-defined to somewhat obscure dorsomedial nodes, S_2 separating nodes; hinge shorter than greatest length, cardinal angles indistinct; surface smooth to reticulate; marginal rim lacking; dimorphism unknown. *M.Ord.-U.Dev.*

The Richinidae represent a rare and poorly known group of Ordovician to Devonian ostracodes. They differ from other families of the Drepanellacea in lack of a marginal rim and the ill-defined nature of the cardinal corners. The surface of most described species is recorded as smooth, but this may be a matter of preservation. Faint sculpturing of a reticulate nature has been reported on *Richina* and others. Study of more material may show that this group definitely belongs to the Bolliidae but until the presence of a marginal rim can be demonstrated they should be placed in a separate family. It is not certain that all de-

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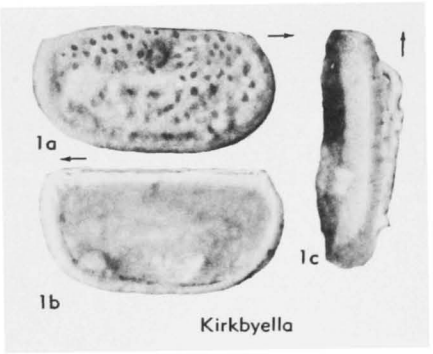

FIG. 63. Kirkbyellidae (p. Q131).

scribed forms are represented by original shell material; some may be steinkerns and need restudy. Several species have been described from Bohemia, Canada, and the United States.

Richina CORYELL & MALKIN, 1936 [**R. truncata*]. Subovate, ends rounded, cardinal angles indistinct; 2 dorsomedial nodes separated by S_2; sides slightly convex rather than nearly flat, as in *Ulrichia;* marginal rim lacking; surface smooth to finely reticulate. [This description is based on examination of topotype material with original shell preserved. SWARTZ & WHITMORE (1956) believe that *Richina* is more closely related to *Bollia* than to *Ulrichia,* as indicated by the yoke-ridge of *R. zygalis,* Silurian. *Richina* is believed to be closely related to the Bollidae, differing primarily in lack of a marginal rim.] *L.Dev.-U.Dev.,* N.Am. ——FIG. 64,*1*. **R. truncata,* M.Dev.(Hamilton), USA (N.Y.); LV lat., ×40 (Coryell & Malkin, 1936).

Crescentilla BARRANDE, 1872 [**C. pugnax*]. Small; dorsal border straight, hinge short, ends broadly rounded; with 2 conical and somewhat rounded protuberances overreaching dorsal border near each cardinal extremity; S_2 with broad flat floor. [This genus differs from *Parulrichia* in the dorsal extension of the 2 protuberances beyond the dorsal margin.] *M.Ord.-U.Ord.,* Eu. (Czech.-Eng.). ——FIG. 64,*5*. **C. pugnax,* RV lat., ×30 (Schmidt, 1941).

Parulrichia SCHMIDT, 1941 [**Primitia diversa* JONES & HOLL, 1886]. Small, valves equal, dorsal margin straight; 2 conical nodes on lateral surface near dorsal margin, may be terminated by spines; nodes separated by wide S_2; surface smooth or weakly sculptured. [This genus differs from *Pseudulrichia* in wider spacing of the nodes and broader sulcus; otherwise, they are very similar.] *M.Ord.-M.Sil.,* Eu. (Czech.-Eng.). —— FIG. 64, *4a-c*. **P. diversa* (JONES & HOLL), M.Sil.(Wenlock.), Eng.; *4a,* RV (lectotype, SCHMIDT, 1941) lat., ×30; *4b,c,* RV (another specimen), vent., dors., ×30 (Jones & Holl, 1866).——FIG. 64,*4d,e*. *P. diversa antiqua* SCHMIDT, M.Ord.(Caradoc.), Boh.; *4d,e,* carapace L, dors., ×50 (Schmidt, 1941). [SCOTT-HESSLAND.]

Pseudulrichia SCHMIDT, 1941 [**Leperditia bivertex* ULRICH, 1879]. Subovate, ends broadly rounded; hinge shorter than greatest length; valves equal; marginal rim lacking; with 2 low and indistinct to well-defined dorsomedial nodes, separated by S_2; surface smooth to slightly sculptured. [Differs from *Richina* in slightly sharper cardinal angles and nodes that merge more gently into shell.] *M.Ord.-M.Sil.,* Eu.-N.Am.——FIG. 64,*3a-d*. **P. bivertex* (ULRICH), M.Ord.(Trenton.), USA(Ky.); *3a,b,* LV (lectotype) lat., dors., ×14 (*3a,* Schmidt, 1941; *3b,* Ulrich, 1879); *3c,d,* carapace, L, dors., ×50 (Schmidt, 1941).——FIG. 64,*3e,f*. *P. simplex* (KAY), M.Ord.(Decorah Sh.), USA(Minn.); *3e,f,* LV lat., int., ×50, ×45 (J. R. Cornell, n). [SCOTT-HESSLAND.]

Family UNCERTAIN

Jonesella ULRICH, 1890 [**Leperditia crepidiformis* ULRICH, 1879] [=*Vogdesella* BAKER, 1924 (*pro Melanella* WADE, 1911, *non* MOREY, 1924)]. Subovate, with U-shaped lobe in anterior half and prominent S_2 inside this lobe; valves subequal, without marginal structures or rim; interior marked by U-channel reflecting exterior lobe; hingement by bar and groove. Dimorphism unknown. [This genus lacks the marginal rim of either Bollidae or Drepanellidae. The U-lobe is reflected interiorly by a corresponding channel which is situated much farther anteriorly than the same feature in *Bollia.* It differs from features of the Richinidae in the ventral connection of the 2 dorsal lobes to form the U-lobe. Very similar to specimens of *Dilobella (Ctenobolbina) fulcrata* (ULRICH) here interpreted to be ?males. *M.Ord.-U.Ord.,* N.Am.-Eu.——FIG. 64,*2*. **J. crepidiformis* (ULRICH), U.Ord.(Eden.), USA(Ky.); LV lat., ×18 (Ulrich & Bassler, 1923).

Saffordellina BASSLER & KELLETT, 1934 [**Saffordellina muralis* (ULRICH & BASSLER, 1923)] [*pro Saffordella* ULRICH & BASSLER, 1923 (*non* DUNBAR, 1920)]. Large, straight-backed ostracodes; lateral surface marked with several nodes in medial and anterodorsal quarter, prominent sigmoid ridge subparallel to ventral and anterior margins; venose-like lines radiating from nodes. Proper disposal of this genus cannot be made until the type is restudied. Hinge, marginal, and interior structures are unknown. It may belong to the Drepanellidae. *M.Ord.,* N.Am.——FIG. 64,*6*. **S. muralis* (ULRICH & BASSLER), USA(Tenn.); RV lat., ×? (Ulrich & Bassler, 1923).

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Superfamily HOLLINACEA Swartz, 1936

[*nom. transl.* Kesling, herein (*ex* Hollinidae Swartz, 1936)] [Diagram and discussion by H. W. Scott, University of Illinois, and R. C. Moore, University of Kansas]

Carapace straight-backed, nearly equivalved, sulcate, lobate, velate; velar dimorphism except in Quadrijugatoridae and Bassleratiidae, which nondimorphic families may not belong to the superfamily. *L.Ord.-M.Perm.*

The Hollinacea are a large assemblage of dimorphic straight-hinged palaeocopids that chiefly characterize lower Paleozoic marine strata, especially those of Ordovician age. Only a few forms occur in post-Devonian rocks, among which the long-ranging *Hollinella* extends into Middle Permian formations. The stratigraphic distribution of hollinacean ostracode genera is summarized graphically in Figure 65.

Family HOLLINIDAE Swartz, 1936

[=Ctenoloculininae Jaanusson & Martinsson, 1956] [Materials for this family prepared by R. V. Kesling, University of Michigan, with contribution from Jean Berdan, United States Geological Survey]

Carapace slightly inequivalved, with overlap of LV on RV, mostly with strongly developed lobation, including bi-, tri-, and quadrilobate types. L_3 large and bulbous in many genera; velar structures more or less prominent, restricted to anterior and ventral parts of free border. Hinge line straight, hingement consisting of subtriangular pits or furrows at ends of LV hinge for reception of corners of RV. Dimorphism distinct, shown primarily by form of velar structures. Surface commonly papillate (Kesling, 1952; Swartz, 1936). *M.Ord.-M. Perm.*

Ctenobolbina, included in the family with question, is the only Ordovician genus other than *Grammolomatella* and, possibly, *Eohol-*

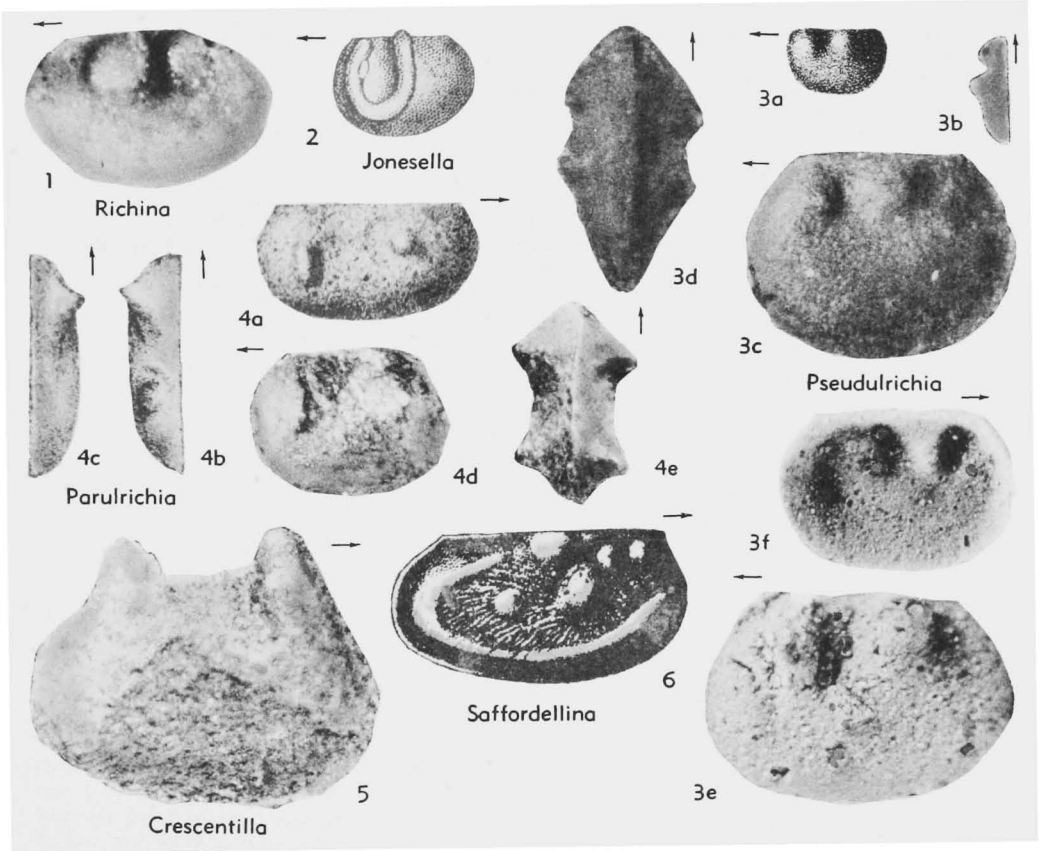

Fig. 64. Richinidae (p. Q132).
(Note: Fig. 64 also includes 2 genera of "Family Uncertain.")

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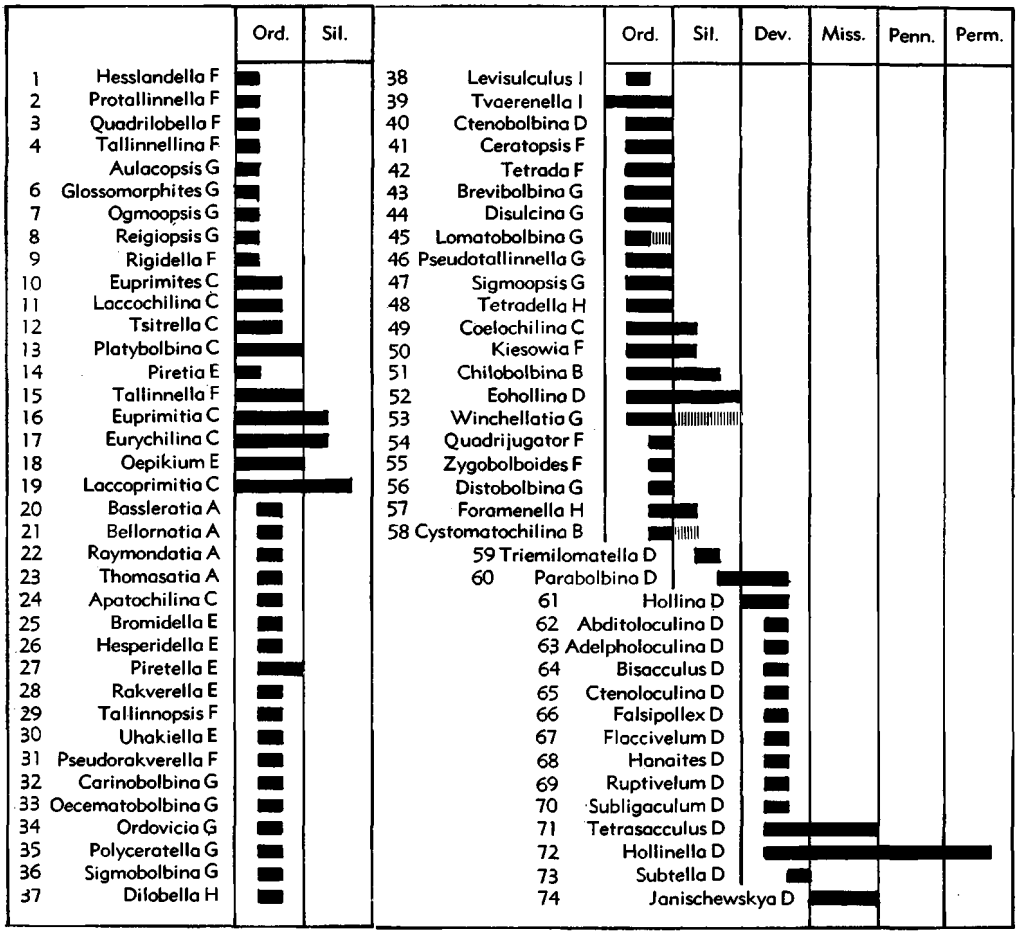

FIG. 65. Stratigraphic distribution of hollinacean ostracode genera (Moore, n). Classification of the genera in families is indicated by letter symbols (A—Bassleratiidae, B—Chilobolbinidae, C—Eurychilinidae, D—Hollinidae, E—Piretellidae, F—Quadrijugatoridae, G—Sigmoopsidae, H—Tetradellidae, I—Tvaerenellidae) and an accompanying alphabetical list furnishes a cross reference to the serially arranged numbers on the diagram.

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Triemilomatella—59
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Tvaerenella—39
Uhakiella—30
Winchellatia—53
Zygobolboides—55

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lina. It differs from typical hollinid genera in 3 significant ways: in lacking discernible dimorphism in the type species, in showing L_3 no more emphasized than other lobes, and in having S_3 developed as a distinct sulcus. In the type species, *C. ciliata*, however, the restricted frill, configuration of S_2, papillate surface, and general outline strongly suggest that it may have been ancestral to the typical hollinids.

Eohollina appears to have lobation and dimorphism similar to that of *Hollina*. There remains some question of its position, however, because the incurved frill of the female also resembles that in *Bromidella*. On the basis of carapace lobation, *Eohollina* is tentatively included in the Hollinidae.

Other new Ordovician genera created by HARRIS (1957) and assigned to Hollinidae lack dimorphism, and their relationships are even more doubtful. They are *Acanthobolbina, Ballardina,* and *Haplobolbina*. Possibly, as their author suggests, they are related to *Ctenobolbina,* but it is equally possible that they are sigmoopsids, in which the existence of dimorphism has not yet been established. They are placed in Palaeocopida of uncertain position.

Hollina ULRICH & BASSLER, 1908 [**Ctenobolbina insolens* ULRICH, 1908]. Distinguished by lobation, L_1 being a distinct lobe, L_2 a node, L_3 a large bulb, and L_4 commonly indistinct (but in some species comparable to L_1), with ventral lobes present below L_1 and L_3; female with large strongly incurved frill in anterior and ventral parts of each valve; male with 2 hollow, blunt ventral projections of ventral lobes in each valve (Kesling, 1952; Ulrich, 1908). *L.Dev.-M.Dev.*, N.Am.——FIG. 66,*1*. **H. insolens* (ULRICH), M. Dev., USA(Ind., Falls of Ohio); *1a,b*, ♂ RV lat., int,. ×30; *1c,d*, ♀ LV lat., int., ×30 (Kesling, 1952).

Abditoloculina KESLING, 1952 [**A. insolita*]. Lobation as in *Hollinella*, with large spurlike lateral projections in each sex of known species; female with frill and several loculi, male with narrow interrupted frill or velar ridge in each valve. M.Dev., N.Am.——FIG. 66,*2*. **A. insolita*, M.Dev., USA(Ind., Falls of Ohio); *2a-c*, ♂ RV lat., vent., int., ×30; *2d-f*, ♀ LV lat., vent., int., ×30 (Kesling, 1952).

Adelphobolbina STOVER, 1956 [**Ctenobolbina papillosa* ULRICH, 1891]. Valves with large inflated lobes for L_1 and L_3, L_2 completely fused with L_1, L_4 low and forming posterior 0.2 of valve, separated from L_3 by a long curved semisulcus; S_2 deep, geniculate, long; in some species L_1 and L_3 connected by a ventral lobe, in others separated by a ventral extension of S_2; surface papillose. Dimorphism not pronounced, primarily in form of the frill, which in females is broader and incurved in anteroventral part, but in males is narrow and flared out; in some species, females have a wide carapace and papillae in channels between the frills and submarginal or marginal ridges, whereas males have narrow carapace and lack ornamentation in the channels. *M.Dev.*, N.Am.——FIG. 66, *3e,f*. **A. papillosa* (ULRICH), USA(Ind., Falls of Ohio); *3e,f*. ♂ RV lat., vent., ×30 (Kesling & Peterson, 1958).——FIG. 66,*3a-d*. *A. megalia* (KESLING & TABOR), Hamilton, USA(Mich.); *3a,b*, ♂ carapace R, vent., ×35; *3c,d*, ♀ carapace R, vent., ×25 (Kesling & Tabor, 1953).

Bisacculus STEWART & HENDRIX, 1945 [**B. bilobus*]. Valves bilobed, with long curved S_2 in each valve extending from dorsal border entirely or nearly to ventral border; female with 2 loculi in each valve, male with very little velar development. *M.Dev.*, N.Am.——FIG. 66,*5*. **B. bilobus*, Hamilton, USA(Ohio); *5a,b*, ♀ carapace L, vent., ×50; *5c*, ♂ carapace L, ×50 (Stewart & Hendrix, 1945).

?Ctenobolbina ULRICH, 1890 [**Beyrichia ciliata* EMMONS, 1855]. Valves distinctly trilobate, with long S_2 and S_3 concave toward front, nearly reaching ventral border; L_3 not swollen, not extending above hinge line; long (but restricted) velar ridge or narrow frill. Dimorphism obscure or absent. [Genus formerly included Devonian species now assigned to *Adelphobolbina*.] *M.Ord.-U.Ord.*, N. Am.——FIG. 66,*4d*. **C. ciliata* (EMMONS), U.Ord., USA(Ohio); RV lat., ×18 (Ulrich, 1890).——FIG. 66,*4a-c*. *C. alata* ULRICH, U.Ord., USA(Ohio); *4a-c*, carapace R, dors., vent., ×22 (Kesling, 1951).——FIG. 67,*1*. *C. obliqua* ULRICH, M.Ord.(Edinburg F.), USA(Va.); *1a-d*, ♂ RV lat., dors., vent., int., ×20; *1e,f*, ♀ LV lat., RV int., ×20 (J.C.Kraft, n).

Ctenoloculina BASSLER, 1941 [**Tetradella cicatricosa* WARTHIN, 1934]. Carapace with L_1, L_2, and L_3 appearing as vertically elongate flat-topped ridges, L_4 being shield-shaped and elevated less than other lobes, in known species with lobes highly ornamented in contrast to smooth remainder of valves; female with frill and loculi, male with spurs at ventral ends of L_1, L_2, and L_3, those of L_2 and L_3 being large and recurved in most species. *M.Dev.*, N.Am.-Eu.——FIG. 68,*1*. **C. cicatricosa* (WARTHIN), Hamilton, USA(Mich.); *1a,b*, ♀ LV lat., vent., ×40; *1c*, ♂ LV lat., ×40 (Kesling); *1d,e*, ♀ carapace L, vent., ×37 (Kesling, 1951).

?Eohollina HARRIS, 1957 [**Beyrichia irregularis* SPIVEY, 1939]. Trilobate, L_1 lobate and continuous with ventral lobe in some species, L_2 appearing as a small node adjacent to the deep S_2, and L_3 large and bulbous in some species but forming only a small knob in others. Dimorphism in form

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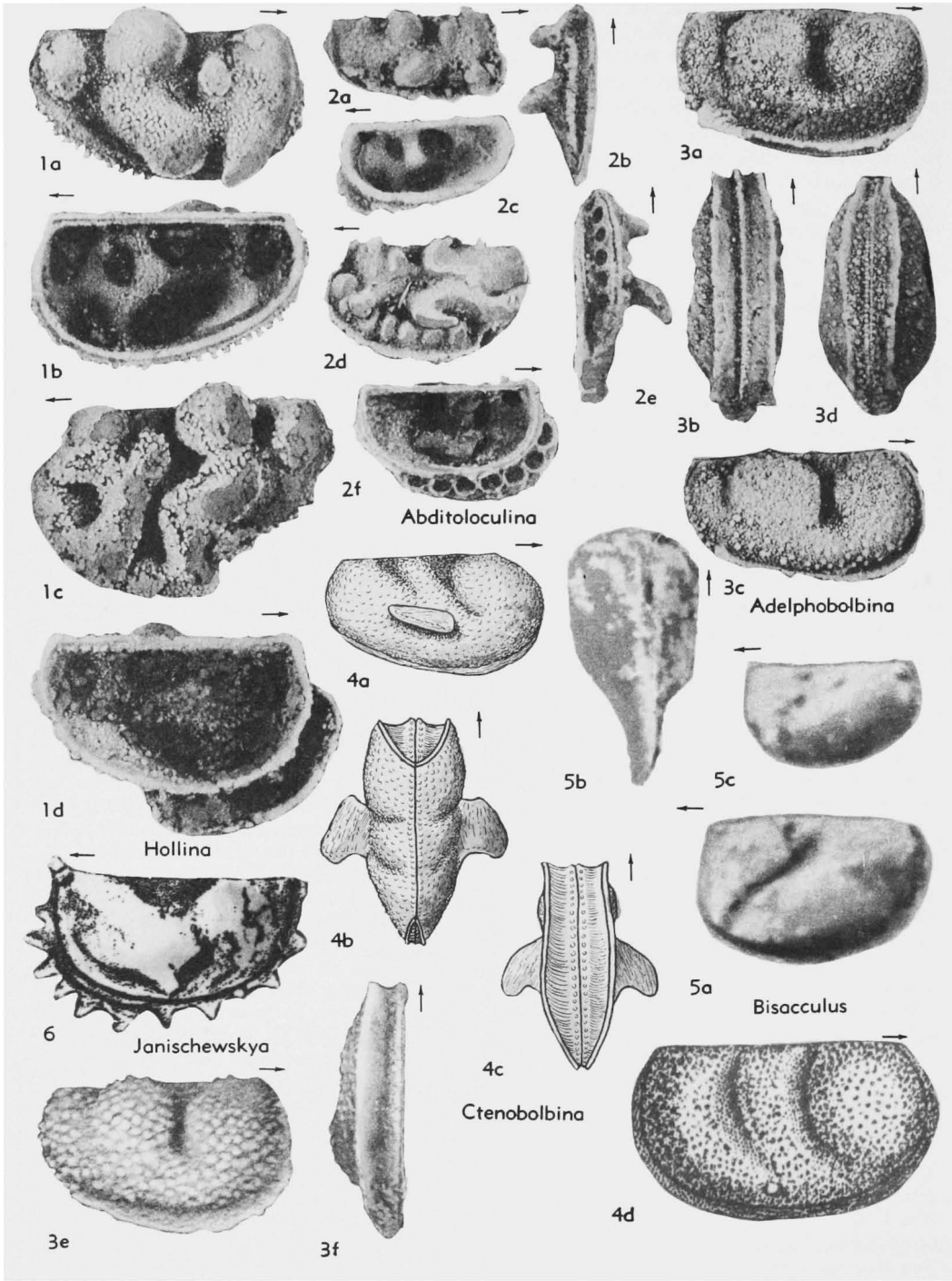

FIG. 66. Hollinidae (p. Q135-Q137).

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of velar structure, which is a ridge in males and an incurved frill in females. [Generic boundaries not distinctly drawn, and certain species assigned here seem closely allied to *Bromidella*.] *M.Ord.-U.Sil.*, N.Am.——Fig. 68,*2a*. **E. irregularis* (Spivey), U.Ord., USA(Iowa); LV lat., ×25 (Spivey, 1939).——Fig. 68,*2b-d*. *E. depressa* (Kay), M.Ord., USA(N.Car.); *2b*, ♂ RV lat.; *2c,d*, ♀ LV lat., int.; all ×30 (Kay, 1940).

Falsipollex Kesling & McMillan, 1951 [**F. altituberculatus*]. Lobation as in *Hollinella*, L_1 and L_4 vertically elongate, low, and inconspicuous in many species, L_2 a node set below hinge line, L_3 large and bulbous; S_1 distinct but shallow, S_2 deep, well defined; female with frill, male with 2 velar spurs in each valve (Kesling, 1951). *M.Dev.*, N.Am.——Fig. 68,*3n,o*. **F. altituberculatus*, Hamilton, USA(Mich.); *3n*, ♀ RV lat.; *3o*, ♂ LV lat.; ×50 (Kesling & McMillan, 1951).——Fig. 68,*3a-e*. **F. valgus* Kesling, Hamilton, USA (Mich.); *3a,b*, ♀ LV lat., int.; *3c-e*, ♂ carapace L, dors., vent.; all ×30 (Kesling, 1952).——Fig. 68,*3f,g*. *F. equipapillatus* Kesling & Weiss, Hamilton, USA(Mich.); *3f,g*, ♀ RV lat, ♂ RV lat, ×30 (Kesling & Weiss, 1953).——Fig. 68,*3h-m*. *F. laxivelatus* Kesling, USA(Mich.); *3h-j*, ♀ carapace R, vent., ant., ×30; *3k-m*, ♂ carapace L, vent., ant.; ×30 (Kesling, 1951).

Flaccivelum Kesling & Peterson, 1958 [**Winchellatia teleutaea* Kesling & Tabor, 1952]. Each valve with distinctive lobation, L_2 inconspicuous and partly fused with L_1, L_3 swollen but not bulbous, and posterior region low and convex; S_2, the only prominent sulcus, long and sinuous, deeper in dorsal part but reaching to velar structure in some species; female with a broad incurved frill continuous with lateral surface, in no way demarked at its proximal junction with rest of valve; male with small velar ridge, scarcely more than a crest, lying along bend between lateral and marginal surfaces. Surface smooth to finely granulose in known species. *M.Dev.*, N.Am.——Fig. 69,*1*. **F. teleutaea* (Kesling & Tabor), USA (Mich.); *1a,b*, ♂ RV lat., vent.; *1c,d*, ♀ RV lat., vent.; all ×30 (Kesling & Tabor, 1952).——Fig. 69,*1e-h*. *F. informis* (Ulrich), USA(Ind., Falls of Ohio); *1e,f*, ♂ RV lat., ant., ×30; *1g,h*, ♀ LV lat., ant., ×30 (Kesling & Peterson, 1958).

Grammolomatella Jaanusson, 1957 [**Biflabellum vestrogothicum* Henningsmoen, 1948]. Unisulcate, S_2 long, geniculate, sigmoidal, extending to frill in female valves; L_3 not delineated; L_1 and L_2 fused to form an anterior lobe; female with restricted, radially striate frill; male with 2 spurs in each valve, which in some species are pointed and connected by a narrow flange, but in others terminate bluntly. *M.Ord.-Sil.*, Eu.(Scand.-Eng.-Aus.).——Fig. 69,*2*. **G. vestrogothicum* (Henningsmoen), M.Ord., Swed.; *2a,b*, ♂ and ♀ LV lat., ×30 (Jaanusson, 1957).

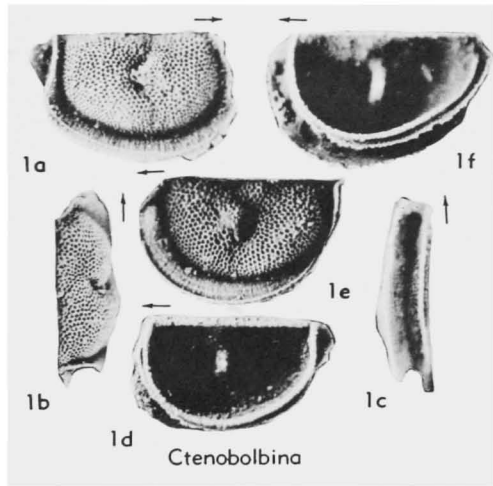

Fig. 67. Hollinidae (p. Q135).

Hanaites Pokorný, 1950 [**Halliella (Hanaites) givetiana*] [=*Proplectrum* Kesling & McMillan, 1951]. Valves showing L_1 as distinct lobe, L_2 obscure or lacking, and L_3 as prominent small node or knob; S_2 broad, with slight swelling in posterior part; velate ridge long and curved; anterior or anteroventral part of each valve bearing palmate or spurlike projection; known species with reticulate surface. Dimorphism in shape of velar ridge (Stover, 1956). *M.Dev.*, N.Am.-Eu.——Fig. 69, *3. H. platus* (Kesling & McMillan), Hamilton, USA(Mich.) (type species of *Proplectrum*); *3a,b*, ♀ carapace L, vent., *3c*, ♂ carapace L; all ×25 (Stover, 1956); *3d*, RV lat. (immature), ×50 (Kesling).

Hollinella Coryell, 1928 [**H. dentata*] [=*Basslerina* Moore, 1929; *Hollites* Coryell & Sample, 1932]. Lobes consisting of low gently arched L_1 confluent in most species with ventral lobe, L_2 distinctly nodelike (in some forms partly confluent with L_1) and set below dorsal border, L_3 large and bulbous, L_4 ill defined, ventral lobe (prominent in many species) connecting L_1 and L_4 and located between frill and ventral end of wide S_2; female with somewhat incurved long frill extending from anterior corner of valves to posteroventral part; male with outward-flaring frill that in most forms is narrower than frill of female. Dimorphism distinct to very indistinct. *M. Dev.-M.Perm.*, N.Am.-Eu.——Fig. 69,*4a,b*. **H. dentata*, Penn., N.Am.; *4a,b*, ♂ RV lat., ♀ LV lat., ×30 (Kesling, 1957).——Fig. 69,*4c-g*. *H. oklahomaensis* (Harlton), Penn., USA(Okla.); *4c-e*, ♂ carapace R, vent., post.; *4f,g*, ♀ carapace R, post.; all ×30 (Kesling, 1957).

?**Janischewskya** Batalina, 1924 [**J. digitata*]. Poorly known; type species with long S_2 and spinose frill. *L.Carb.*, Eu.——Fig. 66,*6*. **J. digitata*, USSR.; LV lat., ×? (Swartz, 1936).

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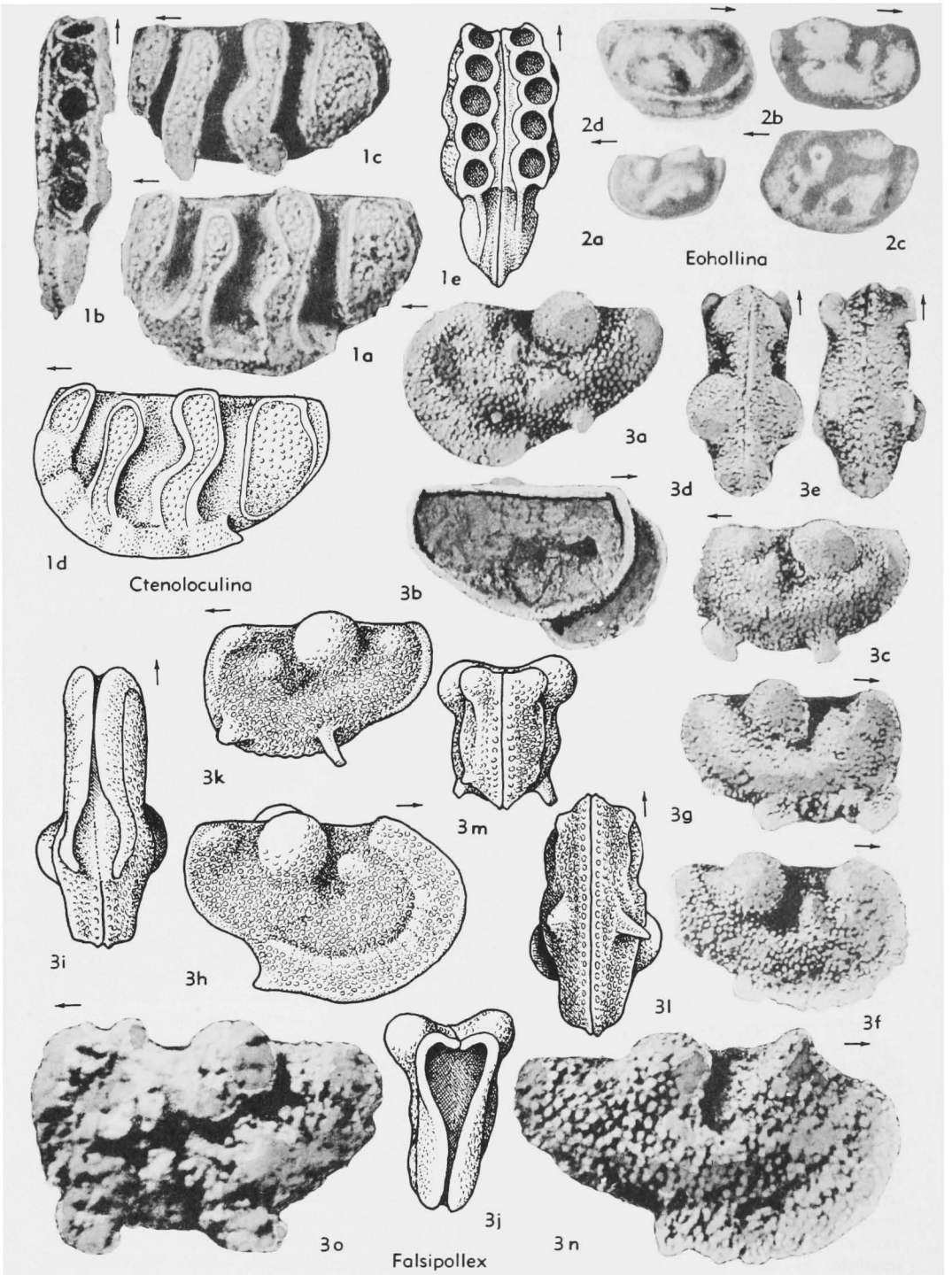

FIG. 68. Hollinidae (p. Q135-Q137).

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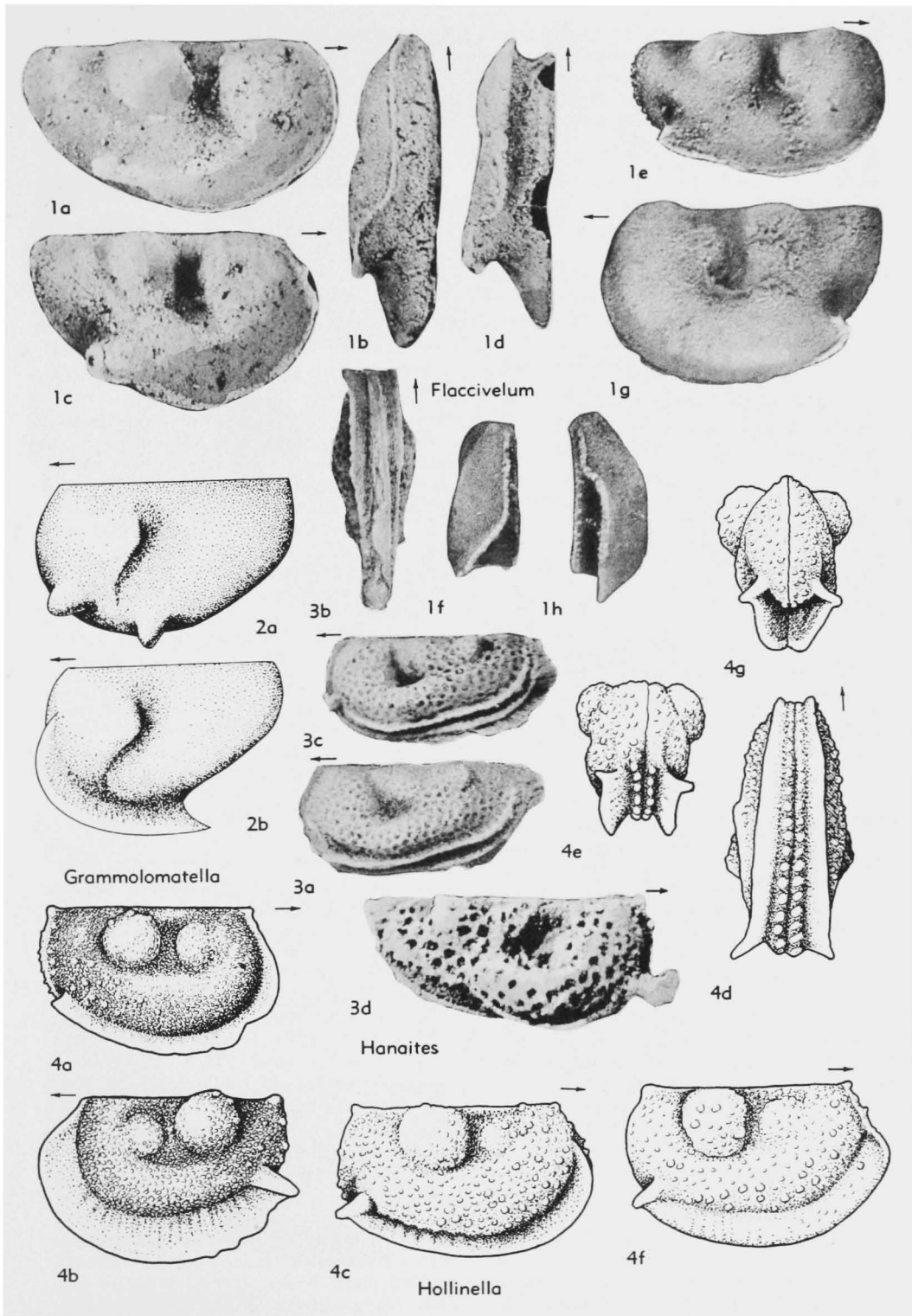

FIG. 69. Hollinidae (p. Q137).

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Parabolbina SWARTZ, 1936 [**Ctenobolbina granosa* ULRICH, 1900]. Only distinguishable sulcus consisting of prominent S_2, which extends from hinge about halfway to ventral border; female with incurved, scalloped frill; male with 2 velar spurs on each valve. *M.Sil.-M.Dev.*, N.Am.-Eu.——FIG. 70, *1a.* **P. granosa* (ULRICH), L.Dev., USA(N.Y.); *1a*, ♀ RV lat., ×34 (Ulrich, 1900).——FIG. 70,*1b,c.* *P. limbata* SWARTZ, L.Dev., USA (Pa.); *1b,c*, ♀ RV lat., ♂ LV lat., ×40 (Swartz, 1936).

Ruptivelum KESLING & WEISS, 1953 [**R. bacculatum*]. Lobation as in *Hollinella;* female with uninterrupted frill; male with frill divided into 2 segments (KESLING, 1953). *M.Dev.*, N.Am.——FIG. 70,*3.* **R. bacculatum*, Hamilton, USA(Mich.); *3a,b*, ♀ LV lat., vent., ×30; *3c,d*, ♂ LV lat., vent., ×30 (Kesling & Weiss, 1953).

Subligaculum KESLING & MCMILLAN, 1951 [**S. scrobiculatum*]. Lobation resembling that of *Parabolbina* but with sulcate extensions from ventral end of S_2; female with incurved, scalloped frill; male with short anteroventral frill and posteroventral spur (Kesling, 1951). *M.Dev.*, N.Am.——FIG. 70,*2.* **S. scrobiculatum*, Hamilton, USA (Mich.); *2a,b*, ♀ RV lat., int., ×50; *2c,d*, ♂ LV lat., int., ×50 (Kesling & McMillan, 1951).

?**Subtella** ZASPELOVA, 1952 [**S. prima*]. Valves with 2 dorsal tubercles or nodes; posterior third of shell flattened; velate structure prominent ventrally but reduced toward cardinal angles. Surface smooth. *U.Dev.*, Eu.(Russia).——FIG. 71,*1a,b.* **S. prima; 1a,b*, LV (holotype), lat., dors., ×50 (Zaspelova, 1952).——FIG. 71,*1c,d.* *S. latimarginata* ZASPELOVA; *1c,d*, RV (holotype) lat., dors., ×50 (Zaspelova, 1952). [BERDAN.]

Tetrasacculus STEWART, 1936 [**T. bilobus*] [=*Pterocodella, Workmanella* CRONEIS & GALE, 1938]. Valves bilobed, with long curved S_2; female with posterior loculus incomplete in some Devonian species; male with small projection on ventral end of front lobe or bearing small velar ridge. *M.Dev.-U.Miss.*, N.Am., *L.Carb.*, USSR. FIG. 70,*4a-c.* **T. bilobus*, M.Dev.(Hamilton), USA (Mich.-Ohio); *4a,b*, ♀ carapace R, vent., ×50; *4c*, ♂ carapace R (Kesling & McMillan, 1951).——FIG. 70,*4d-h.* *T. mirabilis* (CRONEIS & GALE), Miss., Ill.; *4d,e*, ♂ carapace L, vent., ×50; *4f-h*, ♀ carapace L, vent., ant., ×50 (Kesling, 1951).

Triemilomatella JAANUSSON & MARTINSSON, 1956 [**T. prisca*]. Unisulcate, S_2 deep and extending at least down to midheight; L_1 and L_2 confluent, L_3 not delimited from L_4, ventral lobe joining anterior with posterior lobes; surface papillose. Frill of each female valve terminating posteroventrally in a spine, separated from marginal or submarginal structure by a broad channel marked by several shallow depressions resembling loculi; frill of male like that of female but separated into 2 parts, a short anteroventral and long ventral, without a spine, separated from marginal or submarginal loculi-like pits on marginal surface. *M.Sil.*, NW.Eu. (Gotl.-Eng.).——FIG. 70,*5.* **T. prisca*, M.Sil., Gotl.; *5a-c*, ♂ carapace L, vent., ant.; *5d-f*, ♀ carapace L, vent., ant.; all ×45 (Jaanusson & Martinsson, 1956).

Family BASSLERATIIDAE E.A. Schmidt, 1941

[*nom. transl.* LEVINSON, herein (*ex* Bassleratinae SCHMIDT, 1941] [Materials for this family prepared mainly by S. A. LEVINSON, Humble Oil & Refining Company, and R. C. MOORE, University of Kansas]

Small, subovate to subrectangular with one or more marginal ridges and anterocentral node; other ridges and nodes commonly within marginal ridges. *?L.Ord., M.Ord.*

Bassleratia KAY, 1934 [**B. typa*] [=*?Laddella* SPIVEY, 1939]. Prominent 2 marginal ridges and anterocentral node, outer ridge parallel to free border, inner ridge more elevated; central vertical ridge commonly present. *M.Ord.*, N.Am.——FIG. 72,*1.* **B. typa*, Can.(Ont.); *1a-d*, RV (holotype) lat., dors., vent., ant., ×45 (Bradfield, 1935). [*Hilseweckella* HARRIS, 1957 (**H. rugulosa*) is added as ?junior synonym of *Bassleratia* on basis of study by H. W. SCOTT (1960) of type specimen.——FIG. 134A,*2.* *?B. rugulosa* (HARRIS), M.Ord., USA(Okla.); *2a,b*, LV lat., ant., ×35 (161).—MOORE.]

Bellornatia KAY, 1934 [**B. tricollis*]. Single marginal ridge parallel to dorsal and free borders, inner oval ridge located in posterodorsal part of valve, 3 nodes inclosed by inner ridge. *M.Ord.*, N.Am.——FIG. 72,*2.* **B. tricollis*, USA(Iowa-Minn.); *2a*, RV (holotype) lat., ×60 (Bradfield, 1935); *2b-d*, LV lat., RV lat., vent., ×50 (J. R. Cornell, n) (*2a*, Iowa; *2b-d*, Minn.).

Lennukella JAANUSSON, 1957 [**Drepanella europaea* ÖPIK, 1937]. Straight-backed, equivalved, unisulcate, with large preadductorial knob behind S_1; dorsal ridge strong, continued forward as ornamental ridge in front of knob; prominent ventral and anteroventral carinal ridge; velar structure developed as narrow ridge that in side view conceals subvelar field. *M.Ord.(Llandeil.-Caradoc.)*, NW. Eu.(Est.-Swed.).——FIG. 72A,*5.* **L. europaea* (ÖPIK), Swed.; *5a,b*, RV lat., carapace vent., ×30 (36).

Raymondatia KAY, 1934 [**R. goniglypta*]. Small, with single marginal ridge parallel to dorsal and free borders; prominent inner posterior ridge extending vertically from middle third of posterodorsal border; at mid-height of valve turning abruptly backward at a right or slightly obtuse angle; anterocentral node commonly inflated; reaching dorsal border. *M.Ord.*, N.Am.——FIG. 72,*3.* **R. goniglypta*, USA(Iowa-Minn.); *3a,b*, RV (holotype) lat., dors., ×60; *3c-e*, LV lat.,

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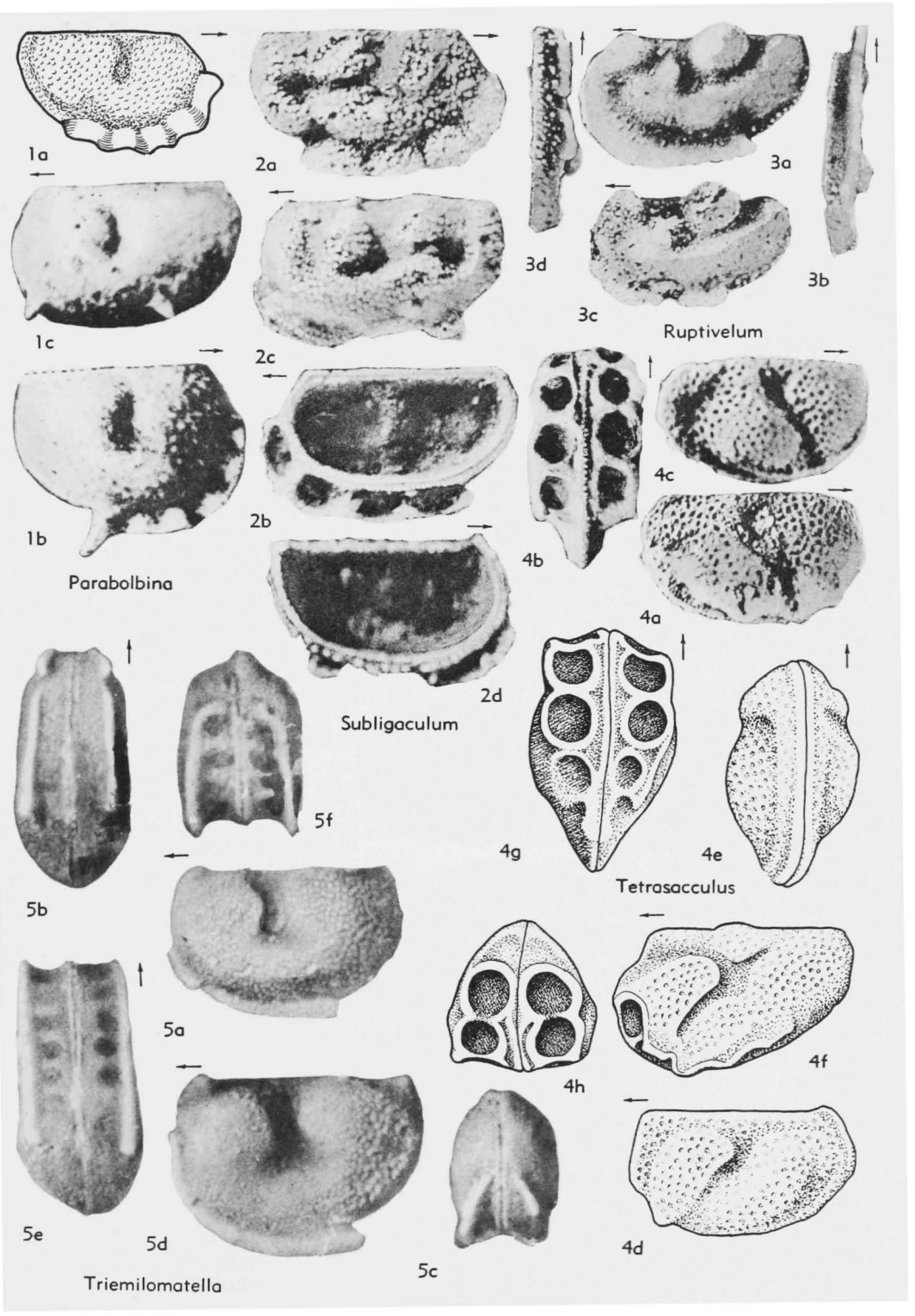

FIG. 70. Hollinidae (p. Q140).

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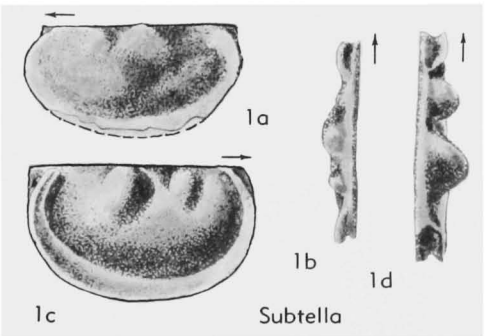

FIG. 71. Hollinidae (p. Q140).

RV lat., int., ×50 (J.R. Cornell, n) (*3a,b,* Iowa; *3c-e,* Decorah Sh., S.Minn.).

?Steusloffia ULRICH & BASSLER, 1908 [**Strepula linnarssoni* KRAUSE, 1889; SD ULRICH & BASSLER, 1923]. Straight-backed, subovate in outline, with single long, broad sulcus (S_2) located behind large knob (L_2) in anterodorsal region and with distinct posteroventral lobe (L_3); adults bearing narrow crests on and in front of presulcal lobe, and on and behind posteroventral lobe; velar structure moderately broad, becoming ridgelike or obsolete before reaching posterior cardinal corner; dimorphism known. *L.Ord.-M.Ord.,* NW.Eu.——FIG. 72A, *1. *S. linnarssoni* (KRAUSE), ?M.Ord.(boulder in glacial drift), N.Ger.; LV lat.(reconstr.), ×35(36).——FIG. 72A,*2. S. costata* (LINNARSSON), M.Ord., Swed.; LV lat.(reconstr.), ×35(36).——FIG. 72A, *3. S. multimarginata* ÖPIK, M.Ord., Est.; LV lat. (reconstr.), ×35(36).——FIG. 72A,*4. S. rigida* ÖPIK, M.Ord., Est.; LV lat., ×20(58).

Thomasatia KAY, 1934 [**T. falcicosta*]. Like *Bassleratia* in having 2 marginal ridges and anterocentral node but with outer ridge distinctly developed only at anterior and ventral borders, obscure at rear; inner ridge parallel to anterior border and commonly bifurcating in ventrocentral area, may curve dorsally in anterocentral area with development of arcuate ridge from posterior cardinal angle ending abruptly near outer marginal ridge at ventral border. *M.Ord.,* N.Am.——FIG. 72,*4a-f. *T. falcicosta,* Can.(Ont.) USA(Minn.); *4a-d,* RV (holotype) lat., dors., vent., ant., ×40; *4e-f,* LV lat., int., ×50 (J. R. Cornell, n) (*4a-d,* Ont.; *4e,f,* Decorah Sh., S. Minn.).——FIG. 72, *4g-l. T.* sp., Edinburg F., USA(Va.); *4g-k,* RV lat., LV lat., int., dors., vent., ×30; *4l,* LV hinge, ×60 (J.C. Kraft, n).

Family CHILOBOLBINIDAE Jaanusson, 1957

[*nom. transl.* LEVINSON, herein (*ex* Chilobolbininae JAANUSSON, 1957] [Materials for this family prepared by S. A. LEVINSON, Humble Oil & Refining Company, and R. C. MOORE, University of Kansas, with additions by IVAR HESSLAND, University of Stockholm]

Carapace straight-hinged, moderately and rather evenly convex, with centrally located pit or short sulcus; velate frill well developed; dimorphism distinct, females with prominent ventral pouch. *M.Ord.-M.Sil.*

Chilobolbina ULRICH & BASSLER, 1923 [**Primitia dentifera* BONNEMA, 1909] [=*Chilobolba* BONNEMA, 1938]. Wide striate frill; very short median furrow or pit; females with long ovate brood pouch located mid-ventrally or anteroventrally. *M.Ord.-M.Sil.,* N.Am.-Eu.——FIG. 73,*2. C. hartfordensis* ULRICH & BASSLER, M.Sil., USA(Md.); LV lat. ×? (Levinson, 1951).——FIGS. 73,*1,* 74. *C.* sp., M.Ord.(Edinburg F.), USA(Va.); 73,*1a-d,* LV lat., int., dors., vent., ×20; 73,*1e,* RV int., ×20; 74, LV transv. sec., ×40 (Kraft, n).——FIG. 75,*1. C. dentifera* (BONNEMA), ?U.-M.Sil., USA (Md.); *1a,* ♂ RV lat.; *1b-d,* ♀ RV lat., int., vent.; all ×20 (Kesling, *et al.,* 1958).

Cystomatochilina JAANUSSON, 1957 [**Primitia (Ulrichia?) umbonata* KRAUSE, 1892]. Nonsulcate or with small shallow sulcal pit at or below mid-height, predominant knoblike presulcal node; dimorphic, with very wide frill extending along entire free margin, concave anteriorly and ventrally or convex anteroventrally and ventrally. *U. Ord., ?L.Sil.,* Eu.(Baltoscandia).——FIG. 76,*1. *C. umbonata* (KRAUSE), U.Ord.(Ashgill.) erratics from S. Bothnian area, Swed.; *1a,* LV lat., (heteromorph with partly convex frill, reconstr.), ×30; *1b,* LV lat. (tecnomorph, reconstr.), ×35 (36). [HESSLAND.]

?Family EURYCHILINIDAE Ulrich & Bassler, 1923

[*nom. transl.* HENNINGSMOEN, 1953 (*ex* Eurychilininae ULRICH & BASSLER, 1923)] [=Euprimitiinae HESSLAND, 1949] [Materials for this family prepared by S. A. LEVINSON, Humble Oil & Refining Company, and R. C. MOORE, University of Kansas, with additions by others as recorded]

Straight-hinged, unisulcate or with pit, marginal frill or velate structure, commonly showing dimorphic variations but females lacking domiciliar pouch. *L.Ord.-U. Dev.*

Eurychilina ULRICH, 1889 [**E. reticulata*] [=*Actinochilina* JAANUSSON, 1957]. Hinge long; S_2 wide and deep, anterior edge raised to form a node; frill wide, curved, and radiate, in females of some species sausage-shaped in section. *L.Ord.-L.Sil.,* N.Am.-Eu.——FIG. 77,*3. *E. reticulata,* M.Ord. (Trenton.), USA(Minn.); *3a,* LV lat., ×18 (Jones & Brady, 1874); *3b,c,* ♀ LV lat., ♀ LV int., ×17, ×20 (J.R. Cornell, n).——FIG. 77,*2. E. sp.* M.Ord.(Edinburg F.), USA(Va.); *2a,b,* ♀ LV lat., ♀ RV int., ×20 (J.C. Kraft, n).——FIG. 77, *1. E.* sp., M.Ord. (Edinburg F.), USA(Va.); *1a,b,* ♀ LV lat., ♂ LV lat., ×20; *1c,* ♀ LV transv. sec. through sulcus showing flange on inner side of frill, ×45 (J.C. Kraft, n).

Apatochilina ULRICH & BASSLER, 1923 [**Eurychilina*

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obesa ULRICH, 1890]. Like *Coelochilina,* with narrow radiate frill, S_2 faint near dorsal border. *M.Ord.,* E.N.Am.-Eu.——FIG. 77,*4*. **A. obesa* (ULRICH), M.Ord., USA(Ky.); ?LV lat., ×18 (Kesling, 1953).——FIG. 78,*1*. *A.* sp., M.Ord. (Edinburg F.), USA(Va.); *1a-d,* RV lat., RV lat., RV int., LV lat., ×20; *1e,* RV transv. sec. through midpoint, ×45 (J.C. Kraft, n).

Bicornellina ZASPELOVA, 1952 [**B. bolchovitinovae*]. Valves with prominent upwardly directed spine

FIG. 72. Bassleratiidae (p. Q140-Q142).

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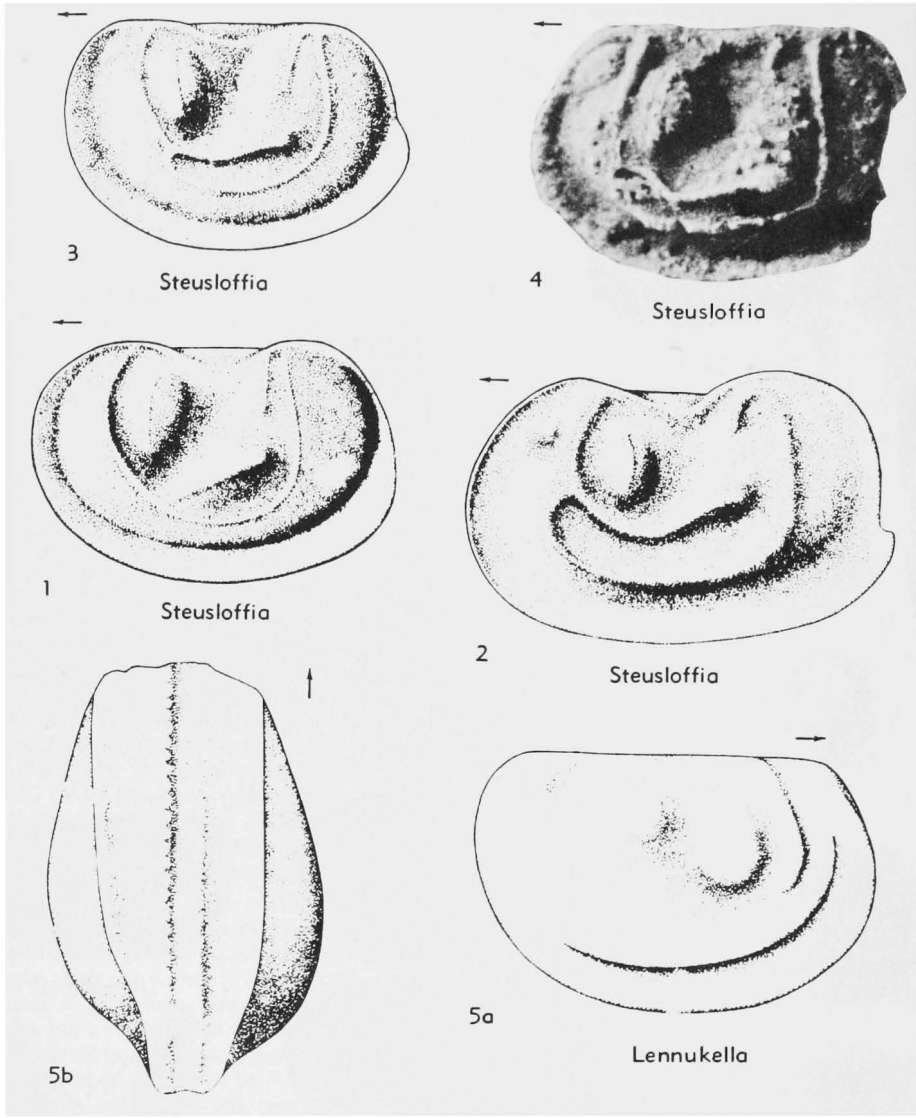

FIG. 72A. Bassleratiidae (p. Q140-Q142).

in antero- and posterodorsal regions, united to frill or disconnected; frill complete, striated; no anterodorsal node. Muscle scar obscure on exterior but forming distinct node on interior of valve. Surface smooth. *U.Dev.*, Eu.(Russia).——FIG. 77, *5*. **B. bolchovitinovae; 5a,b,* LV (holotype) lat., dors.; *5c,* RV (paratype) lat., all ×70 (ZASPELOVA, 1952). [BERDAN.]

Coelochilina ULRICH & BASSLER, 1923 [**Eurychilina aequalis* ULRICH, 1890]. S_2 narrow and shallow, node absent, frill sausage-shaped in section. *M. Ord.-L.Sil.*, N.Am.-Eu.——FIG. 78,*3*. **C. aequalis* (ULRICH), M.Ord., USA(Ky.); ?LV lat., ×18 (Kesling, 1953).

Euprimites HESSLAND, 1949 [**E. recticulogranulata*]. Like *Euprimitia* but with horseshoe-shaped ridge enclosing ventral part of sulcus. *L.Ord.-M. Ord.*, Eu.——FIG. 78,*2*. **E. recticulogranulata,* L. Ord., Swed.; *2a-c,* RV (holotype) lat., vent., ant., ×30 (Hessland, 1949).

Euprimitia ULRICH & BASSLER, 1923 [**Primitia sanctipauli* ULRICH, 1894]. S_2 straight, narrow, deepest at ventral end; with presulcate node and narrow frill or velate ridge; surface reticulate. *L. Ord.-L.Sil.*, N.Am.-Eu.——FIG. 78,*4*. **E. sanctipauli* (ULRICH), M.Ord. (Decorah sh.), USA (Minn.); *4a,b,* RV lat., RV lat., ×20, ×50 (*4a,* Ulrich, 1894; *4b,* J.R. Cornell, n).——FIG. 78,*9*. *E. labiosa* ULRICH, M.Ord.(Edinburg F.), USA(Va.); *9a-c,* LV lat., RV lat., RV int., ×40; *9d-e,* RV

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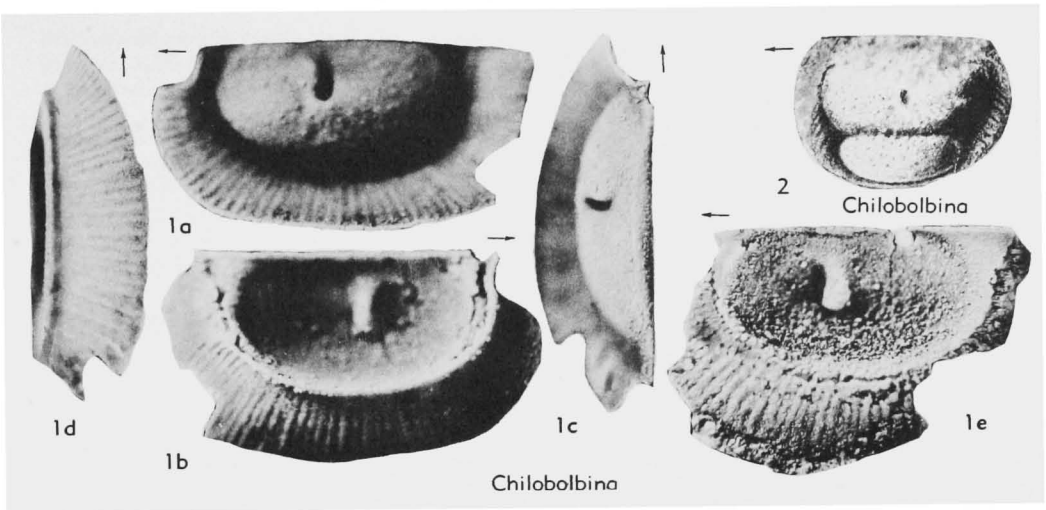

FIG. 73. Chilobolbinidae (p. Q142).

transv. sec. through sulcus, RV hinge, ×60 (J.C. Kraft, n).

Laccochilina HESSLAND, 1949 [**Eurychilina estonula* ÖPIK, 1935] [=*Eobromidella* HARRIS, 1957; *Prochilina* JAANUSSON, 1957]. Like *Eurychilina* but S_2 a pit and presulcate node prominent; frill sausage-shaped. *L.Ord.-M.Ord.,* Eu.-E.N.Am.——FIG. 78, *11. L. dorsoplicata* HESSLAND, L.Ord., Swed.; RV (holotype) lat., ×30 (Hessland, 1949).

Laccoprimitia ULRICH & BASSLER, 1923 [**Primitia centralis* ULRICH, 1890]. S_2 round and pitlike, usually located centrally, narrow depressed zone occurring along free margin or with narrow flange; presulcate node may be present. *L.Ord.-M.Sil.,* E. N.Am.-Eu.——FIG. 78,*8. *L. centralis* (ULRICH), U.Ord., USA(Ky.); LV lat., ×14 (Hessland, 1949).——FIG. 78,*7. L. ventroturgida* HESSLAND, L.Ord., Swed.; *7a-c,* RV (holotype) lat., dors., ant., ×30 (Hessland, 1949).

Platybolbina HENNINGSMOEN, 1953 [*nom. subst. pro Platychilina* THORSLAND, 1940 (*non* KOKEN, 1892)] [**Primitia distans* KRAUSE, 1889]. Like *Chilobolbina* except S_2 very faint to absent, with prominent subcentral muscle spot. *L.Ord.-U.Ord.,* Eu.-E.N.Am.——FIG. 78,*10. P. tiara* HESSLAND, U.Ord., Norway; ♀ LV lat., ×24 (ÖPIK, 1937). ——FIG. 78,*6. P. umbonata* (KRAUSE), U.Ord., Norway; LV lat. (presulcal node broken off), ×22 (Henningsmoen, 1953).

?Tsitrella SARV, 1959 [**T. lamina*]. Preplete, lengthened, ventral margin mainly parallel to dorsal, flattened, equivalved; nonlobate, with very short dorsal sulcus; low adventral ridge developed in some shells; surface reticulate. Dimorphism not reported. *L.Ord.-M.Ord.,* NW.Eu.——FIG. 78, *5. *T. lamina,* L.Ord., Est.; RV (holotype) lat., ×37 (Sarv, 1959). [HESSLAND.]

Family PIRETELLIDAE Öpik, 1937

[=Oepikiumidae JAANUSSON, 1957] [Materials for this family prepared by IVAR HESSLAND, University of Stockholm]

Amplete or preplete, cardinal angles well defined, S_2 permanently distinct (other sulci may be indicated), L_2 in most genera developed as prominent presulcate knob (other lobes generally not present), dorsal plica and lobal crests present in most genera, generally C_1 and C_3, which may be united ventrally and, dorsally, with dorsal plica; as a rule scattered tubercles on surface, in some species seemingly forming indistinct linear patterns; dimorphic, velar ridge or flange in

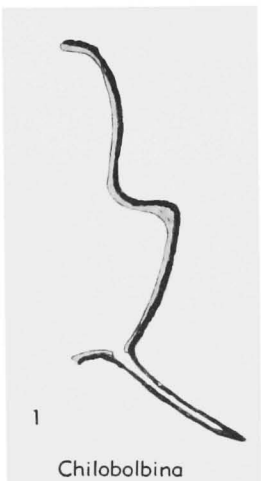

FIG. 74. Chilobolbinidae (p. Q142).

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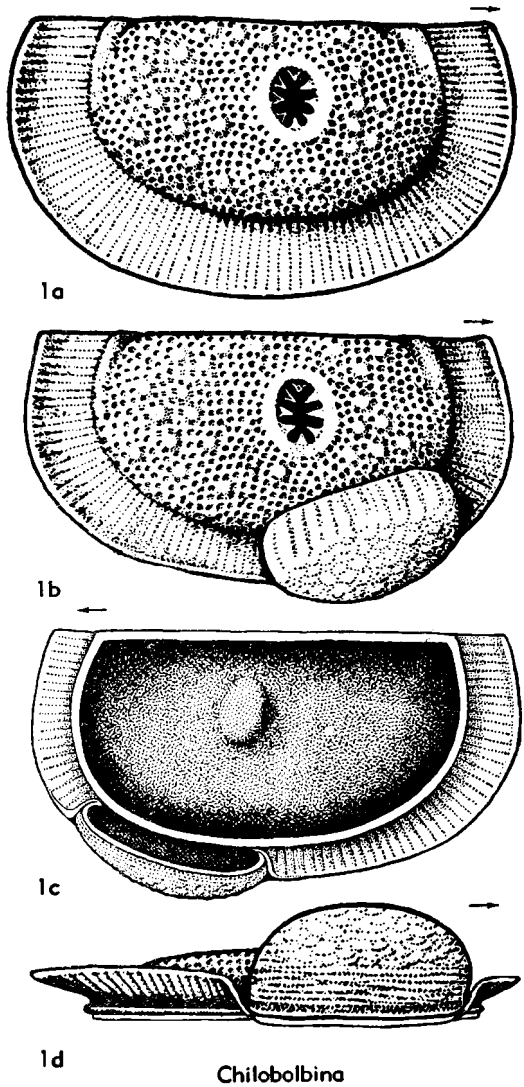

FIG. 75. Chilobolbinidae (p. Q142).

tecnomorphs and incurved frill forming anteroventral closed or almost closed chamber in heteromorphs (frill may be continued posteriorly by isolated spines). *L.Ord.-U.Ord.*

Piretella ÖPIK, 1937 [**P. acmaea*] [=*Duhmbergia* SCHMIDT, 1941 (holotype seemingly late instar of *Piretella*)]. Unisulcate, L_2 forming a large semiglobal swelling; C_1-C_3 form approximately a semicircle, ends united dorsally in adult and late larval specimens by crest or row of tubercles generally continuing backward (=dorsal plica), free end declining adventrally; velar structure wide, entire or extending along anterior border and mainly anterior half of ventral border, incurved type composed of large spines with rounded ends, distinctly separated from each other, continued posteriorly by similar spines at greater distance. *M.Ord.-U.Ord.*, NW.Eu.(Baltoscandia).——FIG. 79,*1*. **P. acmaea*, U.Ord., Est.; *1a*, tecnomorph RV (holotype) lat., ×20; *1b-e*, heteromorph carapace, R, dors., vent., ant., ×20 (58).——FIG. 81,*1*. *P. margaritata* ÖPIK, U.Ord., Est.; *1a,b*, tecnomorph and heteromorph LV lat., ×25 (Kesling, 1951).

Bolbina HENNINGSMOEN, 1953 [**Bollia ornata* KRAUSE, 1896]. Straight-backed, subelliptical, ends rather evenly rounded; S_2 well marked, medium in length, L_2 forming swollen area joined ventrally to posteroventral lobe, which may terminate in conical spurlike process (possibly dimorphic); velate structure short, ridgelike. *Ord.* (from glacial drift), Ger. [HESSLAND refers to *Piretellidae*.]

Bromidella HARRIS, 1931 [**B. reticulata*]. Sinuous sulcus in the dorsal part of each valve, passing around the upper ends of L_2 and L_3, separating an attenuated M-shaped dorsal ridge from the rest of the valve. Surface spinose in type species. Female with frill incurved to form a false pouch. *M.Ord.*, N.Am.——FIG. 80,*1g,h*. **B. reticulata*, M.Ord., Okla.; *1g,h*, ♀ RV lat., int., ×25 (Swartz, 1936).——FIG. 80,*1a,b*. *B. rhomboides*

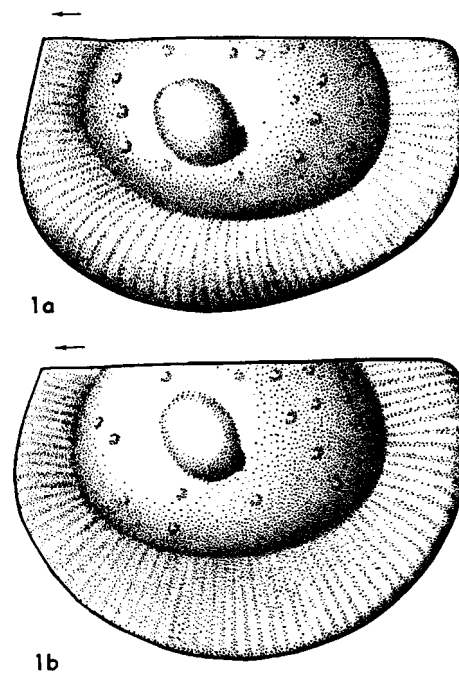

FIG. 76. Chilobolbinidae (p. Q142).

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KAY, M.Ord., USA(Minn.); *1a,b,* ♂ LV lat., ♀ RV int., ×50 (J.R. Cornell).——FIG. 80,*1c-f. B. depressa* KAY, M.Ord., USA(Minn.); *1c,d,* ♂ LV lat., RV lat., ×50; *1e,f,* ♀ RV lat., int., ×50 (J.R. Cornell).

?**Hesperidella** ÖPIK, 1937 [**P. esthonica* BONNEMA,

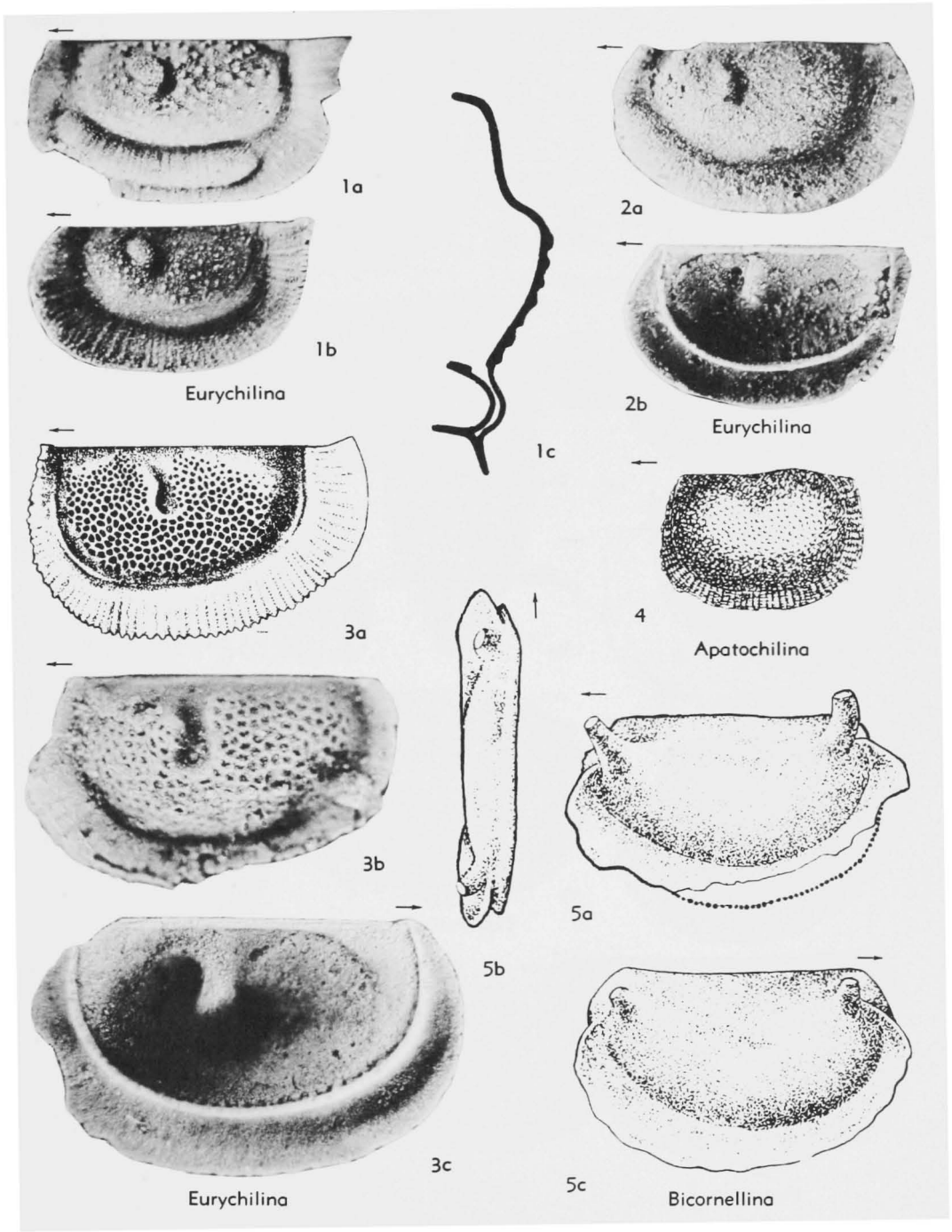

FIG. 77. Eurychilinidae (p. Q142-Q144).

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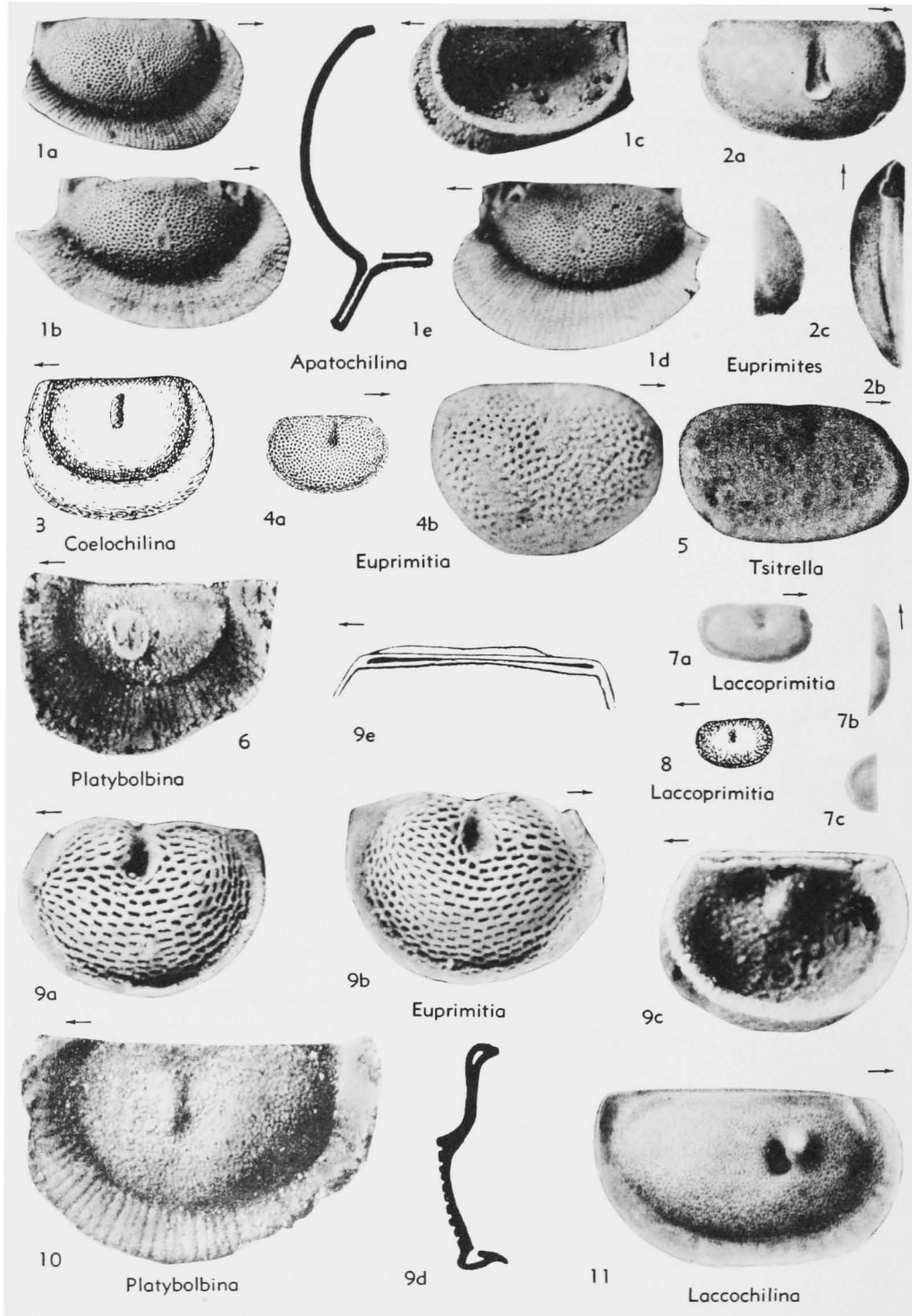

FIG. 78. Eurychilinidae (p. Q143-Q145).

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1909]. Unisulcate, sulcus deep and crescent-shaped; L_1 developed as large rounded node; sulcus and node surrounded by crest ($?C_1$-C_3), with part of dorsal crest (plica) forming approximate circle, which may be incomplete if dorsal section of $?C_1$ is lacking; scattered tubercles tending locally toward linear arrangement; velar structure confluent with dorsal plica; dimorphic, velar flange straight and moderately wide in tecnomorphs, widened anteroventrally in heteromorphs, slightly convex, undulating radially; subvelar field slightly concave. *M.Ord.* NW.Eu.(Baltoscandia).——FIG. 79,*2*. **H. esthonica* (BONNEMA), Est.; *2a*, RV tecnomorph, lat., ×40 (Öpik, 1937); *2b*, RV heteromorph, lat. (Swed.), ×36 (Jaanusson, 1957).

Oepikium AGNEW, 1942 [**Biflabellum tenerum* ÖPIK, 1935] [=*Biflabellum* ÖPIK, 1935 (*non* DÖDERLEIN, 1913); *Öpikium* AGNEW, 1942; *Öpikum* HENNINGSMOEN, 1953 *(nom. null.)*]. S_2 prominent but not deep, extending from the dorsal border to the frill. L_2 nodelike, not clearly separated from L_1. Female with frill incurved. Male with broad flat or flaring frill; frill in type species broadest among known ostracodes. *L.Ord.-U.Ord.*, Eu.——FIG. 81,*3*. **O. tenerum*, Est.; *3a,b*, ♀ and ♂ LV lat. (reconstr.), ×20 (Kesling, n).

Piretia JAANUSSON, 1957 [**P. geniculata*]. Distinctly unisulcate, with poorly developed presulcal node and no ornamental crests or dorsal plica; dimorphic; velar structure not reaching postero-

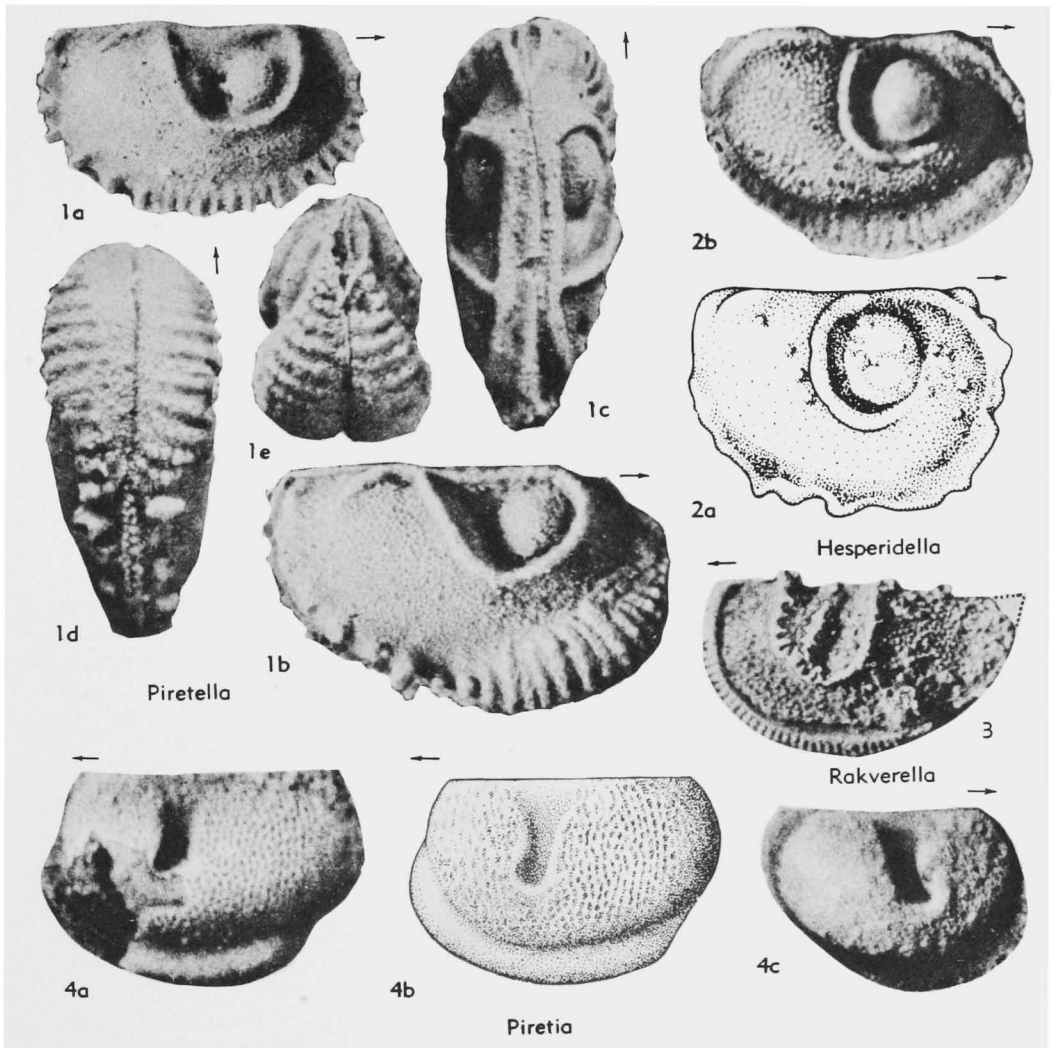

FIG. 79. Piretellidae (p. Q146-Q150).

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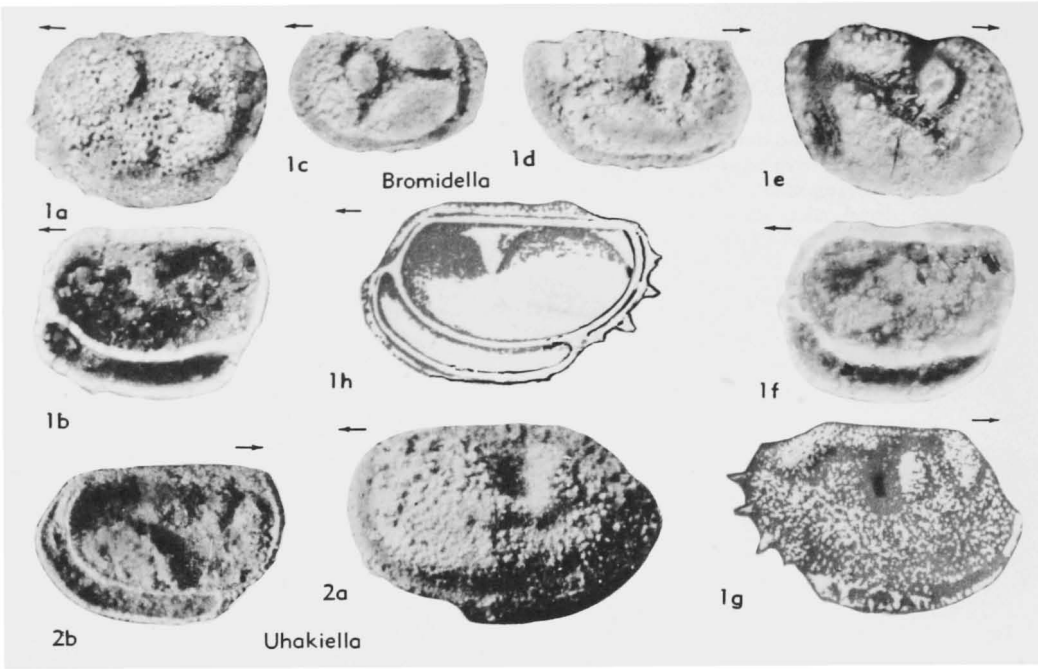

FIG. 80. Piretellidae (p. Q146-Q150).

dorsal corner, forming ridge to slightly concave flange *or* flange that is strongly convex ventrally and anteroventrally. *L.Ord.*, NW.Eu.(Baltoscandia).——FIG. 79,*4*. **P. geniculata*, Swed.; *4a*, LV heteromorph (holotype) lat., *4b*, same (reconstr.); *4c*, RV (tecnomorph) lat.; all ×35 (Jaanusson, 1957).

Rakverella ÖPIK, 1937 [**R. spinosa*]. Preplete, posterodorsal angle acute; dorsal ends of C_1-C_3 generally extending beyond hinge line, dorsal extensions corresponding to C_2 and C_4 may occur, crest sides may be spiny; velar structure dimorphic, extending along anterior margin and generally entire ventral margin, narrow in tecnomorphic specimens, wide and convex in heteromorphs, ends of velar spines may be free and protruding so as to give velar structure a crenulate or spiny appearance; subvelar area not well known. *M.Ord.*, NW.Eu.(Baltoscandia).——FIGS. 79,*3*; 81,*2b*. **R. spinosa*, Est.; 79,*3*, LV (holotype) lat., ×20 (Öpik, 1937); 81,*2b*, same (reconstr.), ×33 (Öpik; Kesling, n).——FIG. 81,*2a*. *R. bonnemai* ÖPIK, Est.; RV (holotype) lat. (reconstr.), ×33 (Kesling, n).

Uhakiella ÖPIK, 1937 [**U. coelodesma*]. L_1 a prominent node; L_2 a distinct node ventrally connected to a low ridge leading to L_3; L_3 a prominent lobe, ventrally nearly confluent with a long ventral ridge. Frill of female incurved to form a false pouch. This genus is closely related to *Bromidella* of the same age in N.Am. *M.Ord.*, Eu.——FIG. 80,*2a*. **U. coelodesma*, Est.; ♀ LV lat., ×20 (Öpik, 1937).——FIG. 80,*2b*. *U. kohtlensis* ÖPIK, Est.; ♀ LV int., ×20 (Öpik, 1937).

Family QUADRIJUGATORIDAE Kesling & Hussey, 1953

[*nom. correct.* JAANUSSON, 1957 (*pro* Quadrijugatidae KESLING & HUSSEY, 1953)] [=Ceratopsinae NECKAJA, 1958] [Materials for this family prepared by R. V. KESLING, University of Michigan, with contributions by IVAR HESSLAND, University of Stockholm, and others as recorded]

Carapace nearly equivalved, subquadrate, subelliptical, or subovate in side view, more or less subquadrate in ventral and end views, dorsal border long; each valve quadrilobate, lobes in some genera composed of 4 equal distinct elongate ridges, in others with L_1 partly confluent with L_2 and L_3 with L_4; S_2 invariably present, long; S_1 and S_3 restricted ventrally by confluence of lobes in some genera but otherwise appearing as long sulci; marginal and velate structures invariably present, but variously developed. [In most genera, lobes joined ventrally to ridge in position of histium as in Sigmoopsidae, but without ventral edge to form a histial structure; in the aberrant *Kiesowia*, however, this ridge, like the lobes, dissected and discontinuous, scarcely recognizable in some species. Most genera nondimorphic but a few (e.g., *Tallinnella*) with velate

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structure of females wider anteroventrally than corresponding part of males. As additional species are studied, it is possible that the dimorphic genera may be segregated in another family, but at present dimorphic features of several genera are not well understood. The family is closely related to the Sigmoopsidae, differing mainly in lack of histium and associated dimorphism.] *L. Ord.-U.Ord.*

Quadrijugator KESLING & HUSSEY, 1953 [**Bollia permarginata* FOERSTE, 1917]. Quadrilobate, with 4 nearly equal strongly elevated ridges, some or all joined to a ventral ridge, valves with low velate and marginal ridges close together. RV with hinge consisting of ridge highest at ends and indistinct at center; LV hinge with long groove, deepest at ends and shallow medially, with long shallow groove in central part. *U.Ord.*, N.Am.—— FIG. 82,*1*. **Q. permarginatus*, USA(Mich.); *1a,b*, carapace R, dors., ×60; *1c,d*, RV lat., vent., ×60 (Kesling & Hussey, 1953).

Ceratopsis ULRICH, 1894 [**Beyrichia chambersi*

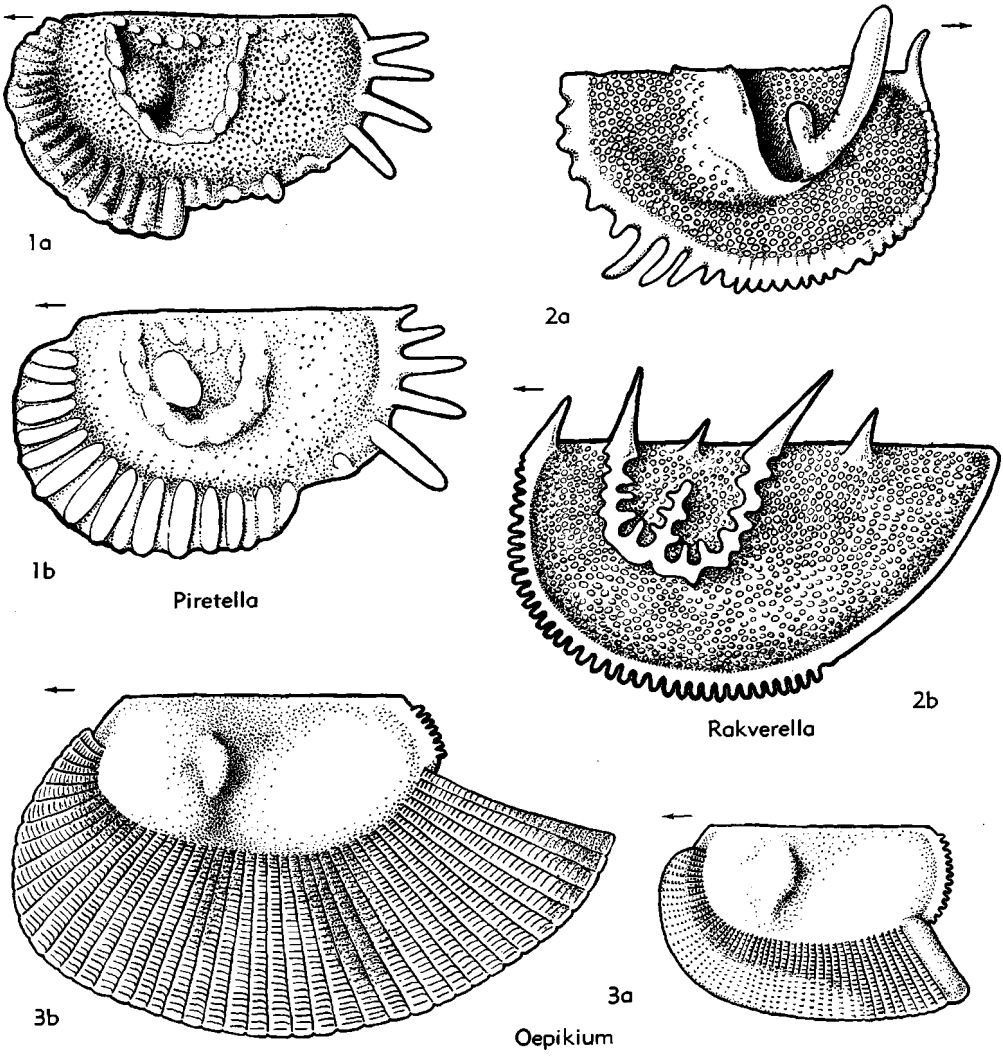

FIG. 81. Piretellidae (p. Q146-Q150).

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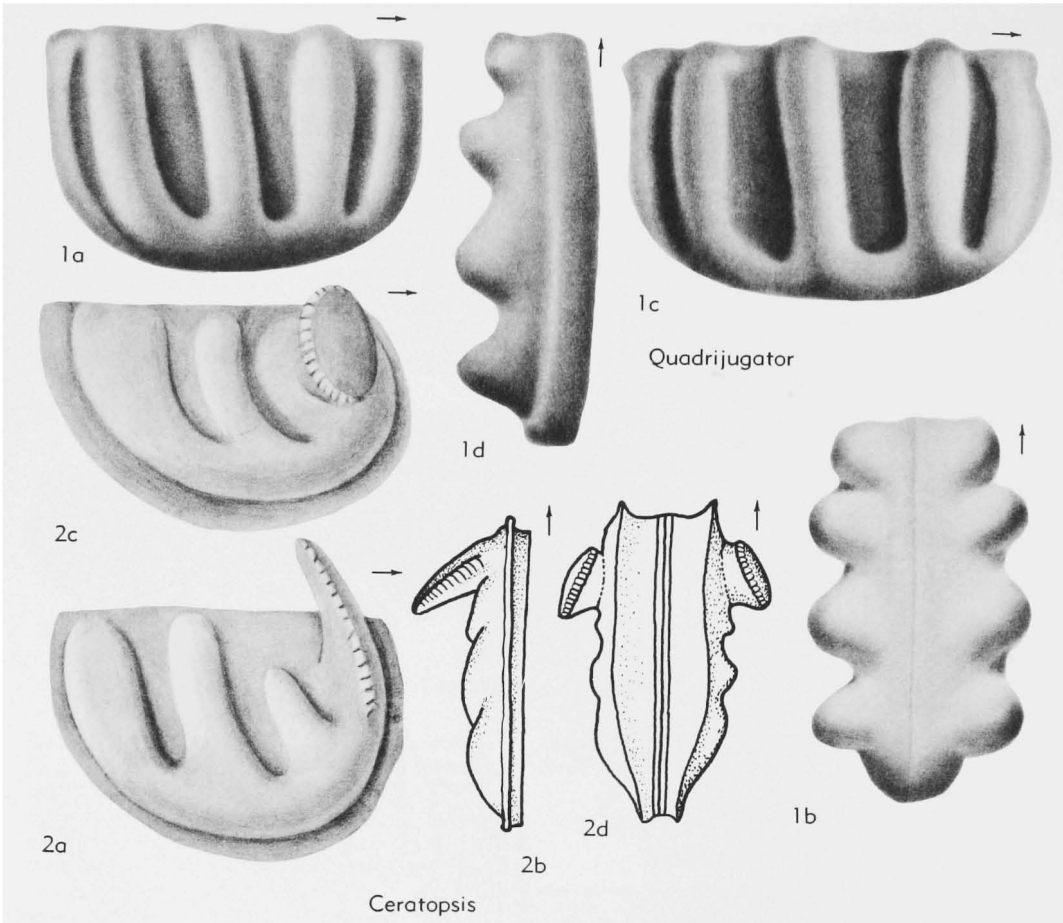

FIG. 82. Quadrijugatoridae (p. Q151-Q152).

MILLER, 1875] [=*Ceratella* ULRICH, 1890 (*non* GRAY, 1869) (*nom. nud.*)]. Valves quadrilobate but lobes unequal, L_1 being large and ornate (in different species extending well above hinge line, produced as long spine, or developed as mushroom-shaped process), L_2 short, not reaching hinge line, L_3 with form of long ridge, and L_4 an elongate lobe or ridge; in most species S_1 narrower than S_2 or S_3, ventral lobe prominent and ridgelike in some species, nearly indistinguishable in others. *M.Ord.-U.Ord.*, N.Am.-Eu.——FIG. 82, *2a,b*. **C. chambersi* (MILLER), M.Ord., USA (Minn.); *2a*, RV lat., ×30; *2b*, vent., ×27.5 (Ulrich, 1894).——FIG. 82,*2c,d*. *C. oculifera* (HALL), U.Ord., USA(Ohio); *2c,d*, carapace R, dors., ×25, ×20 (Kesling, 1951).

Hesslandella HENNINGSMOEN, 1953 [**Ctenentoma macroreticulata* HESSLAND, 1949]. Unisulcate, with long sulcus which may be geniculated, traces of S_1 and S_3 may be seen; presulcal node distinct; adventral structure developed as velar ridge, entire; subvelar area channeled; dimorphism not observed. *L.Ord.*, Eu.——FIG. 85,*1*. **H. macroreticulata*, Swed.; *1a*, LV lat.; *1b*, RV (holotype) ant., both ×30 (Hessland, 1949). [HESSLAND.]

Kiesowia ULRICH & BASSLER, 1908 [**Beyrichia dissecta* KRAUSE, 1892]. Quadrilobate but with each lobe reduced to a node or to 2 or more nodes in a group, boundaries of sulci poorly defined; velar structure present as a ridge resembling that of *Quadrijugator* or a broad frill as in some *Tetradella* species; ventral region dissected into nodelike areas rather than forming a connecting ridge as in other genera. *M.Ord.-L.Sil.*, Eu.——FIG. 83,*1a*. **K. dissecta* (KRAUSE), M.Ord., Ger. (drift); RV lat., ×15 (Kesling, 1951).——FIG. 83,*1b*. *K. radians* (KRAUSE), M.Ord., Ger. (drift); RV lat., ×17 (Kesling, 1951).

Protallinnella JAANUSSON, 1957 [**Beyrichia grewingki* BOCK, 1867]. Seemingly equivalved; quadri-

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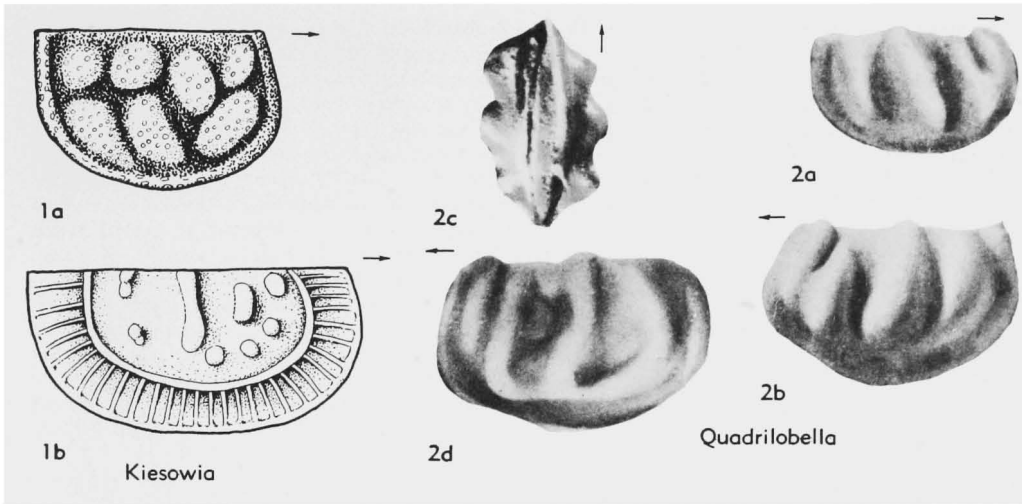

FIG. 83. Quadrijugatoridae (p. Q152-Q153).

lobate, with lobes extending to or beyond dorsal margin, except L_2; velar structure entire, in some specimens slightly convex in anterior and anteroventral parts and developed as wide, thin, fragile flange; dimorphism likely but not proved; subvelar field broad, except posteriorly and anterodorsally. *L.Ord.*, Eu.(Baltoscandia).——FIG. 84,*3*. **P. grewingki* (BOCK), Swed.; *3a*, RV (matrix incompletely removed), lat., ×45; *3b*, RV (slightly broken), lat., ×45 (Hessland, 1949). [HESSLAND.]

Pseudorakverella SARV, 1959 [**P. optata*]. Amplete or slightly preplete, distinctly lobate, with large L_1, L_3 and L_4 covering much of lateral surface, sharp-ridged and with wide bases, L_2 small and developed as dorsoventrally elongate node, L_1 and L_4 united by connecting lobe; adventral structure a narrow ridge running along entire free margin. Dimorphism not observed. Surface smooth. *M.Ord.*, NW.Eu.——FIG. 84,*2*. **P. optata*, Est.; *2a-c*, RV (holotype) lat., int. dors., ×20 (Sarv, 1959). [HESSLAND.]

Quadrilobella IVANOVA, 1955 [**Q. recta*]. Very similar to *Quadrijugator*, possibly synonymous, differing only in having velar ridge much farther from marginal ridge and in having L_2 closely associated with L_1, so that S_1 is much narrower than other sulci and in some species very shallow ventrally (in this respect resembling the arrangement of L_1 and L_2 in *Ceratopsis*). *L.Ord.*, USSR.——FIG. 83,*2a-c*. **Q. recta* IVANOVA, W.Sib.; *2a,b*, RV lat., LV lat.; *2c*, carapace vent.; all ×15 (Ivanova).——FIG. 83,*2d*. *Q. arpilobata* IVANOVA, W. Sib.; LV lat., ×15 (Ivanova). [=*Tetradellina* HARRIS, 1957 (*fide* R. V. KESLING).]

Rigidella ÖPIK, 1937 [**Steusloffia mitis* ÖPIK, 1935]. Quadrilobate, lobes crested, united ventrally by connecting crest, L_2 shorter than other lobes but prominent; S_1 and S_3 generally developed as semisulci; dorsal plica may be present; probably dimorphic, velate flange entire, moderately wide, widest anteroventrally, concave in some specimens but in others incurved anteriorly and anteroventrally; subvelate field comparatively high. *L.Ord.* N.Eu.(Baltoscandia).——FIG. 85,*2*. **R. mitis*, Est.; *2a,b*, ♂ LV lat., RV lat., ×43 (*2a*, Hessland; *2b*, Jaanusson, 1957). [HESSLAND.]

Tallinnella ÖPIK, 1937 [**T. dimorpha*]. Quadrilobate, lobe distinct, extending to dorsal border or above, except L_2 which is shorter and united with connecting lobe or developed as isolated knob; L_1 swollen ventrally, L_1, L_2, and L_3 ridgelike, extending to dorsal border or above; adventral structure forming thick velate ridge or velum that is widest anteroventrally; dimorphism observed in type species only, indicated by broader anteroventral part of velum in heteromorphs; marginal structure tuberculate. *L.Ord.-U.Ord.*, Eu.——FIG. 85,*3*. **T. dimorpha*, M.Ord., Est.; *3a,b*, tecnomorph LV lat., int., ×20 (317); *3c,d*, heteromorph LV lat., int., ×20 (58); *3e*, RV vent. (Swed.), ×15 (36). [HESSLAND.]

Tallinnellina JAANUSSON, 1957 [**Tetradella teres* HESSLAND, 1949]. Quadrilobate, with lobes extending to or even somewhat above dorsal margin, except L_2, which is comparatively long but not reaching dorsal margin; dorsal plica may be developed; velar structure wide and frill-like, running along entire free margin, concave or convex anteriorly and anteroventrally; probably dimorphic; entire subvelate field broad. *L.Ord.*, Eu.(Baltoscandia).——FIG. 84,*1c*. **T. teres*, Llanvirn., Swed.; RV (holotype), lat., ×50 (30).——FIG. 84,*1a,b*. *T. lanceolata* (HESSLAND), Swed.; *1a,b*, LV (holotype) lat., ×48, ×35 (*1a*, 30; *1b*, 36). [HESSLAND.]

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Tallinnopsis SARV, 1959 [**Tetradella calkeri* BONNEMA, 1909]. Distinctly quadrilobate, lobes joined ventrally by connecting lobe, sulci open dorsally; adventral structure developed as low narrow ridge separted from connecting lobe by narrow furrow; dimorphism not observed. *M.Ord.*, N.Eu.——FIG. 86,2. **T. calkeri* (BONNEMA), Est.; *2a,b*, RV lat., LV lat., ×17, ×32 (*1a*, Bonnema, 1909; *1b*, Sarv, 1959). [HESSLAND.]

Tetrada NECKAJA, 1958 [**Tetradella memorabilis* NECKAJA, 1953]. Distinctly quadrilobate and deeply sulcate, with sulci as a rule closed dorsally; adventral structure narrow, in some shells indistinct; dimorphism not observed; surface pitted. *M.Ord.-U.Ord.*, Eu.(NW.Russia).——FIG. 86,3. **T. memorabilis* (NECKAJA); *3a,b*, LV (holotype) lat., vent., ×46 (Neckaja, 1953). [HESSLAND.]

Zygobolboides SPIVEY, 1939 [**Z. grafensis*]. Dorsal margin straight, ventral broadly rounded; valves subequal; cardinal angles obtuse, posterior more rounded than anterior; greatest height slightly behind mid-length; trilobate, L_2 confluent with L_1, L_3, and L_4 distinct; terminal lobes (L_1, L_4) subparallel to free margin and usually connected ventrally by narrow ridge, medial lobe (L_3) gently arcuate and connected to ventral ridge; lobes approximately equal to height of valve; S_2 and S_3 prominent, open dorsally, usually closed ventrally by ventral ridge, which internally is reflected poorly or not at all but otherwise interior shows 3 prominent sulci and 2 ridges that reflect external features; dimorphism probably shown by inflation of posterior lobes, but not now established. *U.Ord.*, N.Am.——FIG. 86,1. **Z. grafensis*, U.Ord.,

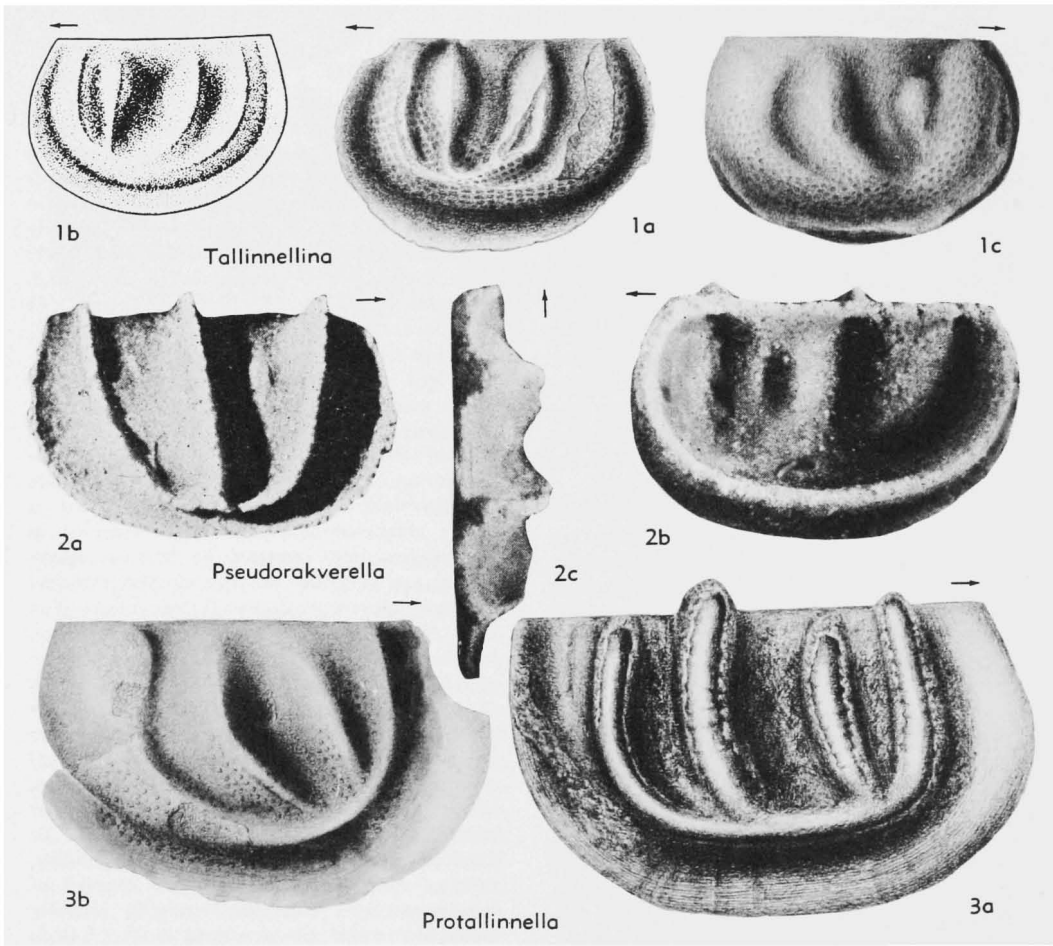

FIG. 84. Quadrijugatoridae (p. Q152-Q154).

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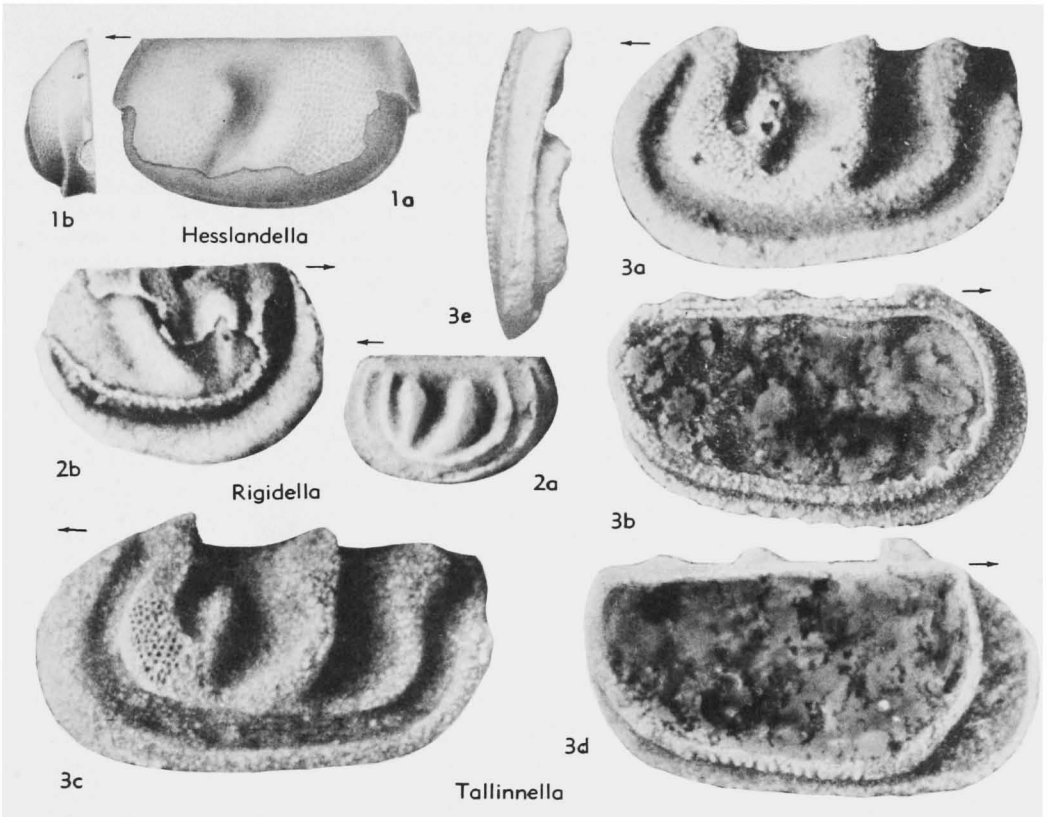

FIG. 85. Quadrijugatoridae (p. Q152-Q153).

USA(Iowa); *1a,b,* LV lat., RV lat., ×35, ×25; *1c,d,* LV int., RV int., ×50; *1e,* LV dors., ×50 (J.H. Burr, Jr., n).

Family SIGMOOPSIDAE Henningsmoen, 1953

[*nom. correct.* JAANUSSON, 1957 (*pro* Sigmoopsiidae HENNINGSMOEN, 1953)] [=Glossopsiinae HESSLAND, 1949; Glossomorphitinae HESSLAND, 1954; Sigmoopsidinae POKORNÝ, 1958] [Materials for this family prepared by R. V. KESLING, University of Michigan, with contributions from IVAR HESSLAND, University of Stockholm, and others as recorded]

Carapace nearly equivalved, with straight hinge line; valves subquadrate to subelliptical in outline and bi-, tri-, or quadrilobate, with gently convex posterior region in most genera forming extralobate area, lobes joined to ventral ridge that by its position corresponds to histium in most genera; S_2 uniformly present, generally long and sinuous, S_3 present in trilobate genera; marginal and one or two parallel structures developed in most species as low unornamented ridges. Dimorphism observed in all genera, expressed in form of outermost ridge or flangelike structure (termed "carina" by HENNINGSMOEN, 1953, and "histium" by JAANUSSON, 1957), here called histium; ridge between marginal and histial structures present in some genera, here called velar, but may not be homologous to velar structures in Hollinidae. [This family seems closely related to the contemporary Quadrijugatoridae.] *L.Ord.-U.Ord., ?L.Sil.-?U.Sil.*

Sigmoopsis HENNINGSMOEN, 1953 [**Ceratopsis platyceras* ÖPIK, 1937]. Valves subelliptical, in most species with distinct forward swing, tri- or quadrilobate, lobes being unequal, L_1 rather large, in some species with backward-directed spine, also in some partly or wholly confluent with small L_2, which does not reach dorsal border, L_3 long, curved, and rather strongly convex, L_4 broad, bordered posteriorly by narrow extralobate area; S_1 short and narrow (if present), S_2 long and sinuous, S_3 long, curved, narrow; histium developed as low rounded or sharply crested ridge, dimorphic; velar ridge present. *M.Ord.-U.Ord.,* Eu.——FIG. 88,*1*. **S. platyceras* (ÖPIK), M.Ord., Est.; *1a,b,* ♀ RV lat., ♂ LV lat., ×20 (Kesling, 1951).

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Aulacopsis Hessland, 1949 [**A. bifissurata*]. Valves subtriangular in outline, bi-, tri-, or quadrilobate, lobes being unequal, L_1 dorsally confluent with L_2 and L_3 with L_4; S_2 long, extending from hinge line to ventral part of valve, S_1 and S_3 (if present) narrow fissures confined to ventral region (some species having both S_1 and S_3, others only S_3, and at least one species having none). *L.Ord.*, Eu.——Fig. 87,*4*. **A. bifissurata*, Swed.; RV lat., ×60 (Kesling, 1951).

?**Brevibolbina** Sarv, 1959 [**B. dimorpha*]. Domicilium approximately amplete, equivalved, unisulcate (sulcus shallow, short, somewhat sinuous, situated mainly at about mid-height of dorsal area), presulcal node low, circular base, posteroventral broad spine or knob directed backward. Dimorphic; tecnomorphs with narrow ridge along part of anteroventral and ventral margins (may be lacking); heteromorphs with wide convex flange along same section of free margin. *M.Ord.-U.Ord.* NW.Eu.——Fig. 88,*5*. **B. dimorpha*, U.Ord., Est.; *5a,b*, heteromorph LV (holotype) lat. (reconstr.), int.; *5c,d*, tecnomorph RV ext., int.; all ×35 (Sarv, 1959). [Hessland.]

Carinobolbina Henningsmoen, 1953 [**Ctenobolbina estona* Öpik, 1937]. Closely similar to *Sigmoopsis* but with much shorter histial structure that is confined to anteroventral and ventral areas. *M. Ord.*, Eu.——Fig. 88,*4*. **C. estona* (Öpik), M.Ord., Est.; *4a,b*, ♀ and ♂ RV lat., ×25 (Henningsmoen, 1953).

Distobolbina Sarv, 1959 [**D. nabalaensis*]. Preplete, generally considerably higher in anterior part, many strongly convex, equivalved; unisulcate, with slightly arcuate sulcus extending from dorsal area almost to ventral margin, indistinct dorsally but fairly deep in central and ventral parts, rather conspicuous presulcal node with circular base, second node occurring dorsal to sulcus and swollen short lobe developed behind ventral part of sulcus extending mainly parallel to corresponding part of ventral margin. Dimorphic, with adventral structure forming narrow ridge near margin in tecnomorphs and strongly convex anteroventral flange in heteromorphs. Surface tuberculate and spinose. *U.Ord.*, NW.Eu.(Baltoscandia).——Fig. 88,*9*. **D. nabalaensis*, Est.; *9a*, heteromorph LV lat. (holotype), *9b*, tecnomorph LV lat., both ×35 (Sarv, 1959). [Hessland.]

?**Disulcina** Sarv, 1959 [**Ctenobolbina perita* Sarv,

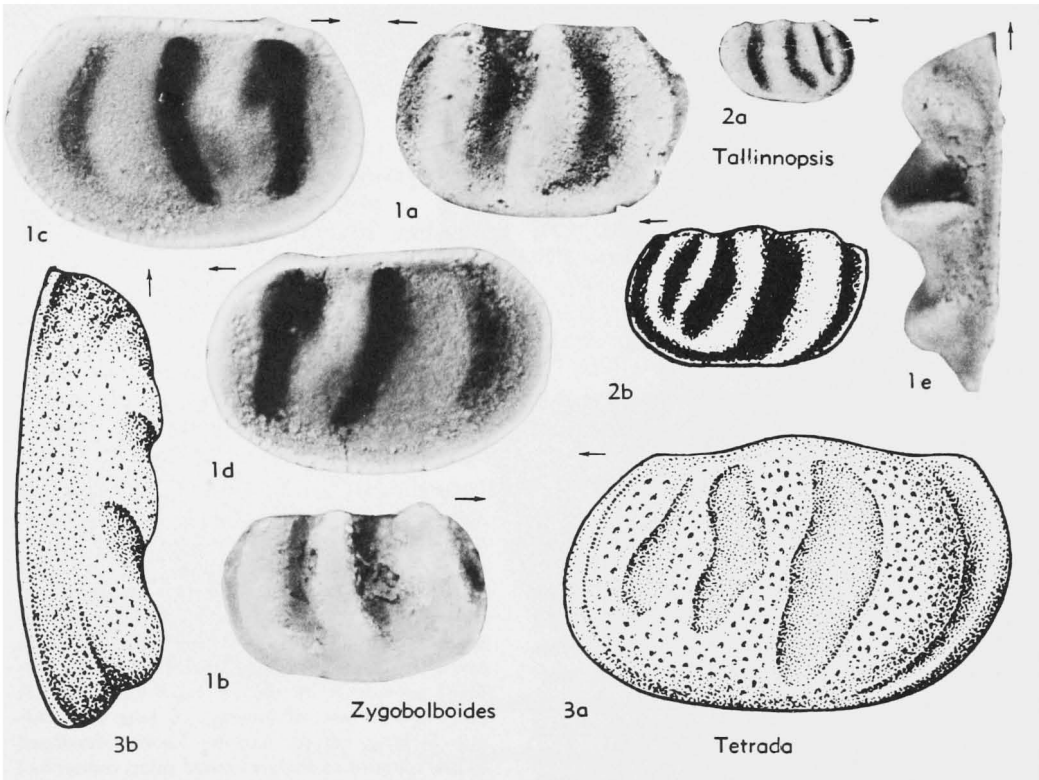

Fig. 86. Quadrijugatoridae (p. Q154-Q155).

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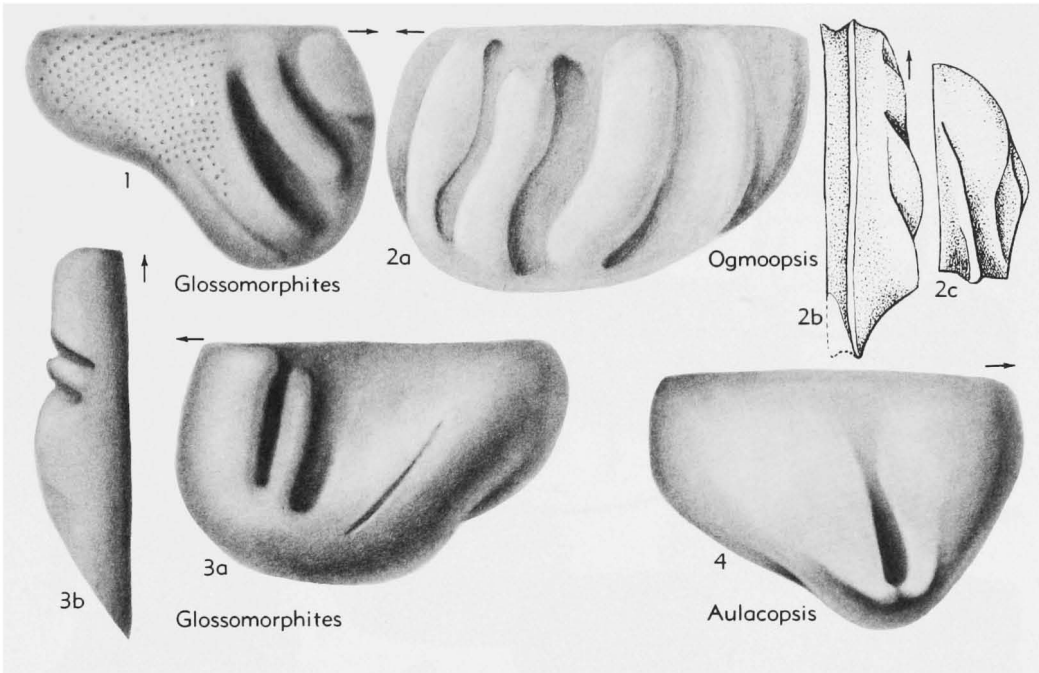

FIG. 87. Sigmoopsidae (p. Q156-Q159).

1956]. Dorsal margin long, cardinal angles distinct, carapace generally somewhat higher in posterior part and slightly preplete, equivalved, bisulcate; sulci arcuate, anterior situated mainly in centrodorsal area, posterior mostly in central area and in some shells extending more toward ventral margin, adventral structure developed as narrow ridge along anterior and ventral margins. Dimorphism not observed. Surface smooth. *M.Ord.-U.Ord.*, NW.Eu.——FIG. 88,2. **D. perita* (Sarv), U.Ord., Est.; *2a*, RV lat. (holotype); *2b*, LV lat. (reconstr.); *2c*, RV int.,; all ×32 (Sarv, 1959). [HESSLAND.]

Glossomorphites HESSLAND, 1954 [*pro Glossopsis* HESSLAND, 1949 (*non* BUSH, 1904)] [**Glossopsis lingua* HESSLAND, 1949]. Valves quadrilobate but lobes unequal, L_1 being elongate (linguiform in some species), L_2 ridgelike, L_3 and L_4 confluent dorsally though separated by a fissure ventrally; sulci unequal, S_1 elongate and rather narrow, S_2 deeper and wider than other sulci and reaching from hinge line to ventral part of valve, S_3 a fissure confined to middle and ventral parts of valve; ventral ridge or histium developed only along anterior and ventral sections of free border. *L.Ord.*, Eu.——FIG. 87,*3*. **G. lingua* (HESSLAND), Swed.; *3a,b*, LV lat., dors., ×50 (Kesling).——FIG. 87,*1*. *G. alatus* (HESSLAND), Swed.; RV lat., ×60 (Kesling, 1951).

Lomatobolbina JAANUSSON, 1957 [**Ctenobolbina mammillata* THORSLAND, 1940]. Unisulcate, S_2 long and sigmoidal; L_2 a small vertically elongate node in front of geniculum, more or less fused with L_1; ventral part of rear half of valve inflated, forming posteroventral lobe, in some species with node or spine at its top, in this respect differing from closely similar *Sigmobolbina;* characteristic marginal flange, in some radially striate, broadest posteroventrally. Dimorphism in histium; in females moderately broad, flangelike, but in male a wedgelike ridge, in ventral view bowed farthest outward in anteroventral region; velar structure, if present, posteriorly confluent with histial structure, apparently broader in females than in males. *M.Ord., ?U.Ord.*, Eu.——FIG. 88,*7*. **L. mammillata* (THORSLUND), M.Ord., Swed.; *7a,b*, ♂ and ♀ RV lat., ×25.——FIG. 88,*8*. *L. craspedota* JAANUSSON, M.Ord., Swed.; *8a,b*, ♂ and ♀ LV lat., ×37.5 (Jaanusson, 1957).

Oecematobolbina JAANUSSON, 1957 [**O. nitens*]. Unisulcate, S_2 broad dorsally, narrowing ventrally, geniculate; no velar structure; a broad, radially striate frill-like marginal structure in some species. Histium in male valve a ridge, in most species bearing 2 ridgelike thickenings and, in some, 2 rows of oblong pits or depressions; in female valve broader, flangelike, internally hollow and partitioned into chambers by radial septa. *M.Ord.*, NW.Eu.(Est.-Swed.-Ire.).——FIG. 88,*6*. **O. nitens*, M.Ord., Swed.; *6a,b*, 2 ♀ LV lat.; *6c,d*, ♂ LV lat.,

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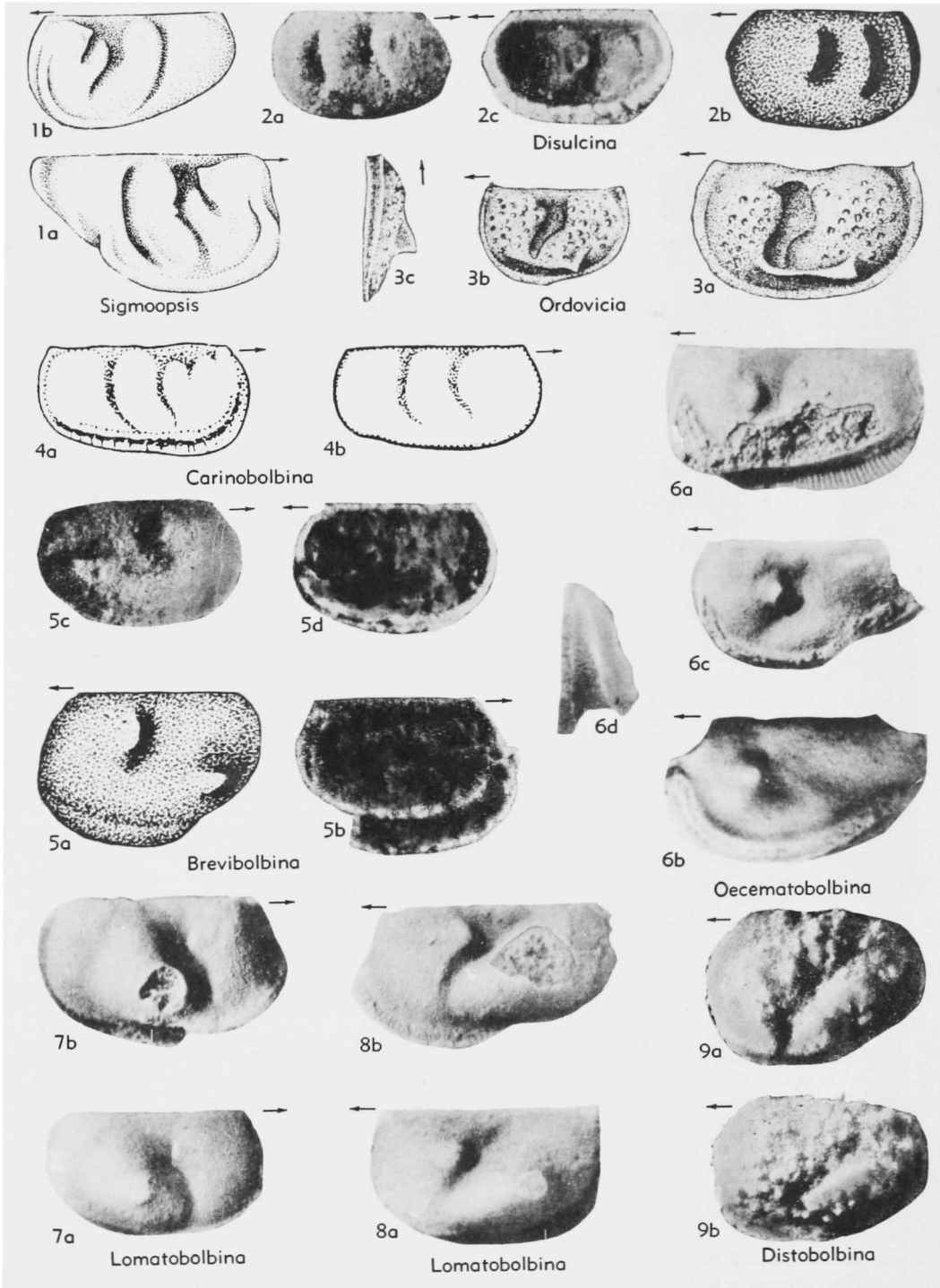

FIG. 88. Sigmoopsidae (p. Q155-Q160).

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ant., all ×37.5 (Jaanusson, 1957).——Fig. 89,6. *O. ctenolopha* (Öpik), M.Ord., Est.; ?♂ LV lat., ×33 (Kesling, 1951).

Ogmoopsis Hessland, 1949 [**O. nodulifera*]. Valves quadrilobate, with subequal elongate ridgelike lobes but L_2 slightly shorter than others; all sulci long, extending from hinge line to ventral ridge or histium. [Genus seems closely related to *Quadrijugator*, from which it differs in having lobes of varied form, with distal surfaces gently convex instead of round, and in having greater space between marginal and velar ridges.] *L.Ord.*, Eu.——Fig. 87,2. **O. nodulifera*, Swed.; *2a*, LV lat., ×50; *2b,c*, LV vent., ant., ×40 (Kesling, 1951).

?**Ordovicia** Neckaja, 1956 [**O. porchowiensis*]. Amplete or somewhat preplete, monosulcate, with deep, long, slightly sinuous sulcus, LV larger than RV, cardinal corners distinct (in many

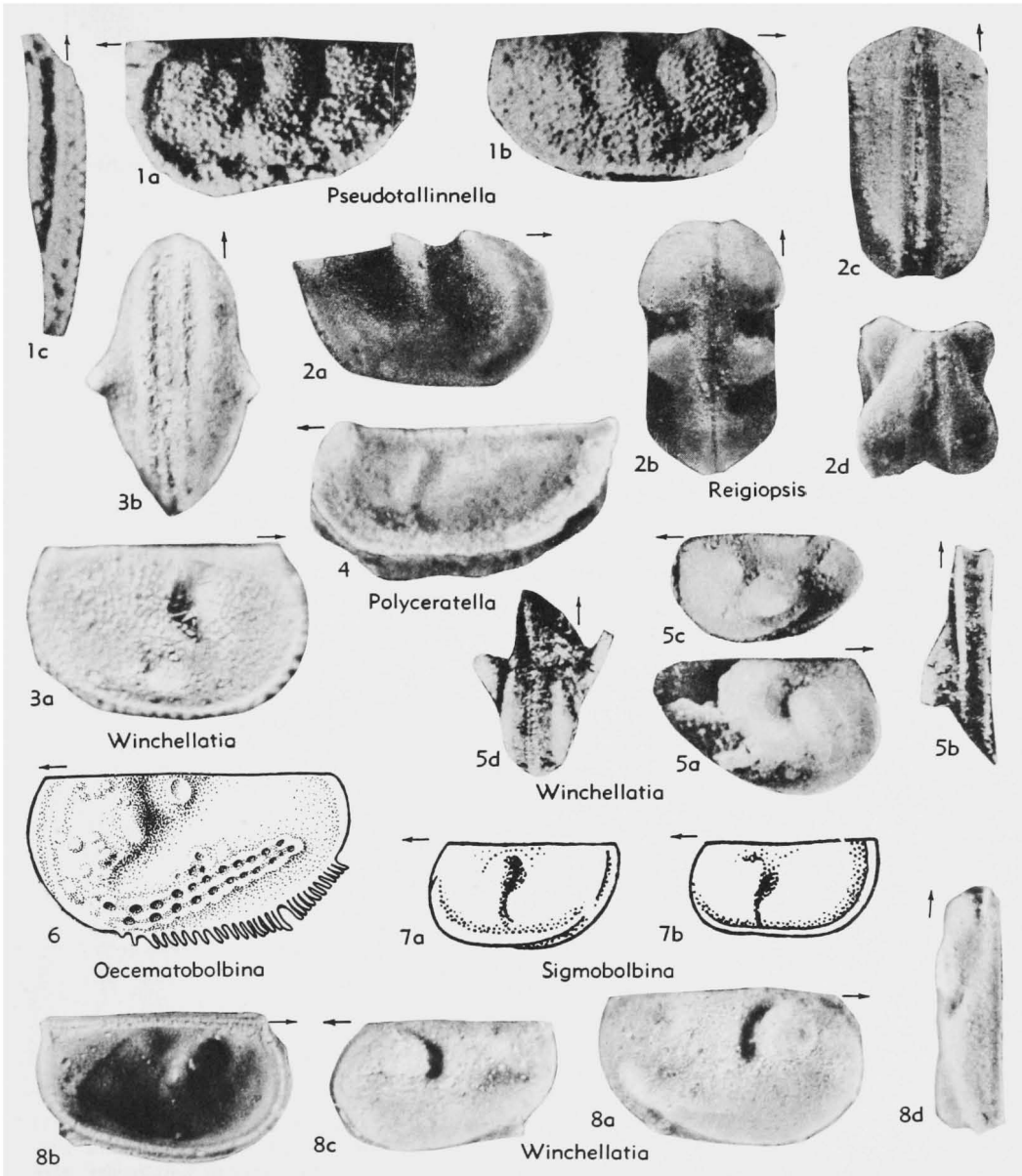

Fig. 89. Sigmoopsidae (p. Q159-Q161).

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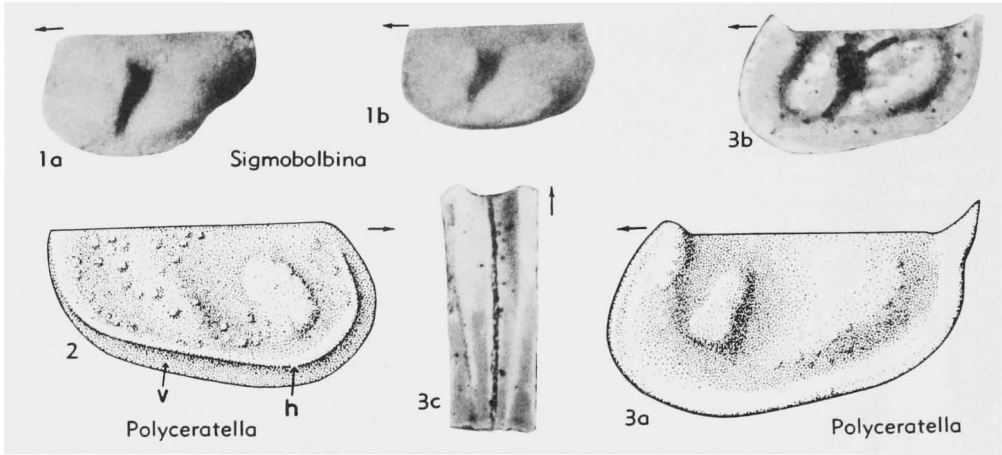

FIG. 90. Sigmoopsidae (p. Q160).

shells extended into short spines), presulcal node small and indistinctly set off, dorsal broad swellings on each side of sulcus in adult specimens rising above hinge, ridge on ventral side of sulcus and extending backward from it approximately parallel to ventral margin and generally ending in spine, adventral structure developed as ridge running along entire free margin, broadest anteroventrally, narrowing anteriorly and posteriorly, marginal ridge along free margin. Dimorphism not reported. Surface tuberculate. [Apparently closely related to or possibly congeneric with *Hesslandella.*] *M.Ord.*, NW.Eu.——FIG. 88,*3*. **O. porchowiensis*, Russia(Pskow area); *3a*, LV (holotype) lat.; *3b,c*, LV (juv.) lat., vent.; all ×27 (Neckaja, 1958). [HESSLAND.]

Polyceratella ÖPIK, 1937 [**Ulrichia kuckersiana* BONNEMA, 1909]. Quadrilobate, L_1 and L_4 more or less parallel to anterior and posterior borders and connected by a ventral lobe; L_3 broad dorsally but constricted ventrally, either confluent with the ventral lobe or separated from it by a furrow; L_2 a knob, separated from ventral lobe by a furrow or almost obsolete; S_2 long, wide dorsally and narrow ventrally; ridge- or flangelike velar structure in all species. Histium formed as projecting edge of ventral lobe, in females broad and frill- or flangelike, widest anteroventrally, in males a narrow ridge. *M.Ord.*, Swed., Est.——FIG. 90,*3*. **P. kuckersiana* (BONNEMA), Swed., Est.; *3a*, ♀ LV lat., ×35 (Jaanusson); *3b,c*, ♀ carapace (holotype) L, vent., ×20 (58).——FIG. 90,*2*. *P. bonnemai* (THORSLUND), Swed.; ♂ RV lat., ×35 (*h*, histial ridge; *v*, velar flange) (36).——FIG. 89, *4*. *P. tetraceras* (ÖPIK), Est.; ♂ LV lat., ×20 (58).

Pseudotallinnella SARV, 1959 [**P. scopulosa*]. Preplete, equivalved, quadrilobate, with comparatively low lobes that may be partitioned into separate knobs, sulci shallow; adventral structures consisting of inner narrow ridge running along anterior and ventral margins and outer ridge different in length but conforming to this. Dimorphism may be indicated by distinctly channeled area between adventral structures in heteromorphs. Surface coarsely tuberculate. *M.Ord.-U.Ord.*, NW.Eu.——FIG. 89,*1*. **P. scopulosa*, U.Ord., Est.; *1a*, heteromorph LV (holotype) lat.; *1b,c*, RV lat., vent.; all ×20 (Sarv, 1959). [HESSLAND.]

?Reigiopsis SARV, 1959 [**R. oepiki*]. Preplete, equivalved, posterior margin forming an acute angle with dorsal margin which is long and straight; dorsal area with 2 large backwardly directed cones separated by sulcal depression; adventral structures comprising outer bend and inner low ridge (apparently velar). Dimorphism not observed. *L.Ord.*, NW.Eu.(Baltoscandia).——FIG. 89,*2*. **R. oepiki*, Est.; *2a-d*, carapace (holotype) R lat., dors., vent., post., ×18 (Sarv, 1959). [HESSLAND.]

Sigmobolbina HENNINGSMOEN, 1953 [**Entomis oblonga* STEUSLOFF var. *kuckersiana* BONNEMA, 1909]. Generally unisulcate but some species with traces of S_1 and S_3, S_2 being sigmoidal as in *Sigmoopsis;* histium of females may be flangelike and of males ridgelike, also in some species terminating posteriorly in spine; velar ridge narrow but distinct. *M.Ord.*, Eu.——FIG. 89,*7*. **S. kuckersiana* (BONNEMA), M.Ord., Est.; *7a,b*, ♀ and ♂ LV lat., ×21 (Pokorný, 1958).——FIG. 90,*1*. *S. sigmoidea* JAANUSSON, M.Ord., Swed.; *1a,b*, ♀ and ♂ LV lat., ×25 (Jaanusson, 1957).

Winchellatia KAY, 1940 [**W. longispina*]. Lobation resembling that of the Devonian hollinid *Flaccivelum* but L_3 smaller and not inflated dorsally; prominent posteroventral projection; female with wide frill-like histium separated from free edge by smooth channel, male with histial ridge. [Genus differs from *Lomatobolbina* in having its marginal structure poorly developed and in lacking

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any form of velar structure.] *M.Ord.-U.Ord.*, N.Am.-Eu.——FIG. 89,*5*. **W. longispina*, M.Ord. (Trenton.), USA(Iowa); *5a,b*, ♀ RV lat., vent.; *5c,d*, ♂ carapace L, vent., all × 30 (Kay, 1940). ——FIG. 89,*3*. *W. minnesotensis* KAY, M. Ord., USA(Minn.-Iowa); *3a,b*, ♂ carapace R, vent., ×50 (J. R. Cornell, n.).——FIG. 89,*8*. *N. lansingensis*, M.Ord.(Decorah), USA(Minn.-Iowa), *8a,b*, ♀ RV lat., LV int.; *8c,d*, ♂ LV lat., dors.; all ×50 (J. R. Cornell, n).

Family TETRADELLIDAE Swartz, 1936

[Materials for this family prepared by H. W. SCOTT, University of Illinois, and R. V. KESLING, University of Michigan]

Straight-hinged ostracodes with subequal valves; bilobate to quadrilobate; dimorphism by anterior and anteroventral loculi occupying position distal to carinate ridge, in some between velate structure and carinate ridge. *M.Ord.-L.Sil.*

Tetradella ULRICH, 1890 [**Beyrichia quadrilirata* HALL & WHITFIELD, 1875]. Subquadrate to subovate, with straight dorsal margin and broadly convex ventral margin; valves subequal, quadrilobate; lobes simple or divided, L_1 and L_4 merging ventrally to form continuous lobe subparallel to free margin, L_2 and L_3 joining ventrally with ventral ridge; loculi along anterior and anteroventral margin situated between L_1 and ventral ridge and velum (abvelate); dimorphism by abvelate loculi. *M.Ord.-U.Ord.*, cosmop.——FIG. 91, *1*. **T. quadrilirata* (HALL & WHITFIELD), M.Ord., USA(N.Y.); *1a-c*, ♀ LV lat., dors., ant., ×27 (Kesling, 1951).——FIG. *92,1*. *T.* sp. cf. **T. quadrilirata* (HALL & WHITFIELD), U.Ord. (Richmond.), USA(Ohio); *1a-d*, ♀ RV lat., dors., ♀ LV lat., dors.; *1e,f*, ♂ RV lat., vent.; *1g,h*, ♀ RV lat., vent.; all ×30 (Kesling & Hussey, 1953). ——FIG. 91,*5*. *T. perornata* ÖPIK, M.Ord., Est.; ? ♂ LV lat., ×40 (Kesling, 1951).——FIG. 91,*6*. *T. marchica* (Krause), M.Ord., USA(Pa.); ? ♂ LV lat., ×18 (Kesling, 1951).——FIG. 91,*2*. *T. lunatifera* (ULRICH), M.Ord., USA(Minn.); *2a-c*, ? ♂ RV lat., vent., ant., ×27 (Kesling, 1951).—— FIG. 91,*4*. *T. ellipsellina* KAY, M.Ord.(Decorah Sh.), USA(Minn.); *4a-c*, ♀ LV lat., vent., ♀ RV lat., ×30 (J. R. Cornell, n).

Dilobella ULRICH, 1890 [**D. typa*]. Small, subovate, valves subequal; L_1 and L_2 fused to form large anterior lobe with dorsal end slightly above hinge line, in some species ventrally connected to L_3 forming U-shaped lobe; L_3 large, extending above hinge line in some species, S_2 long and deep, nearly vertical but curved slightly forward adventrally; both dimorphs with velate ridge near

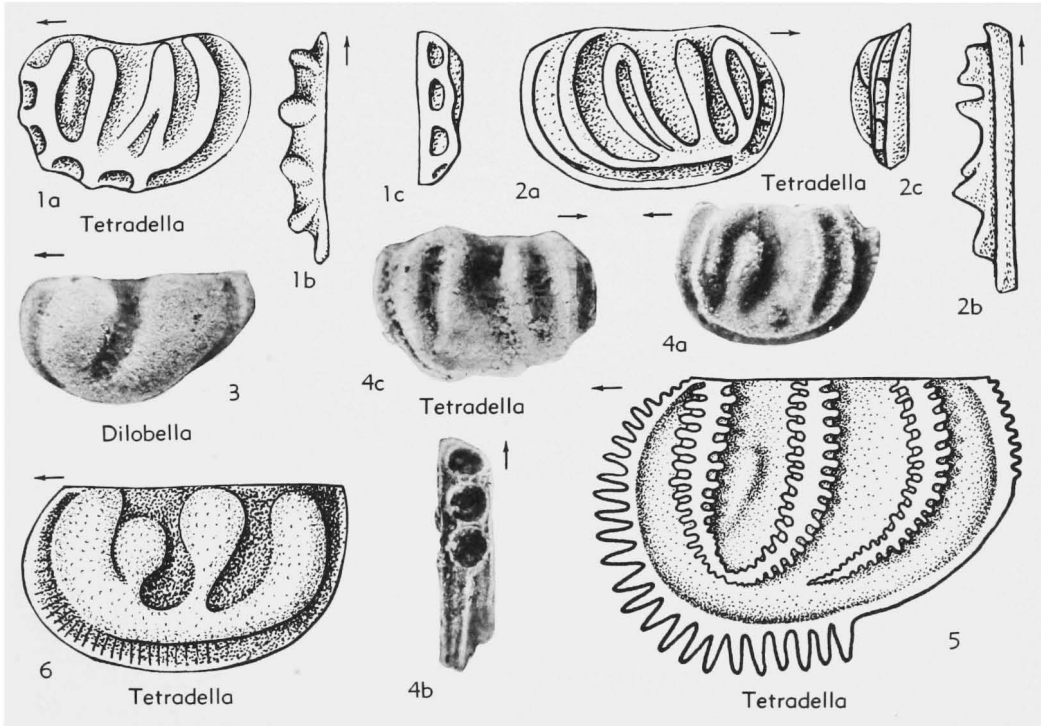

FIG. 91. Tetradellidae (p. Q161-Q162).

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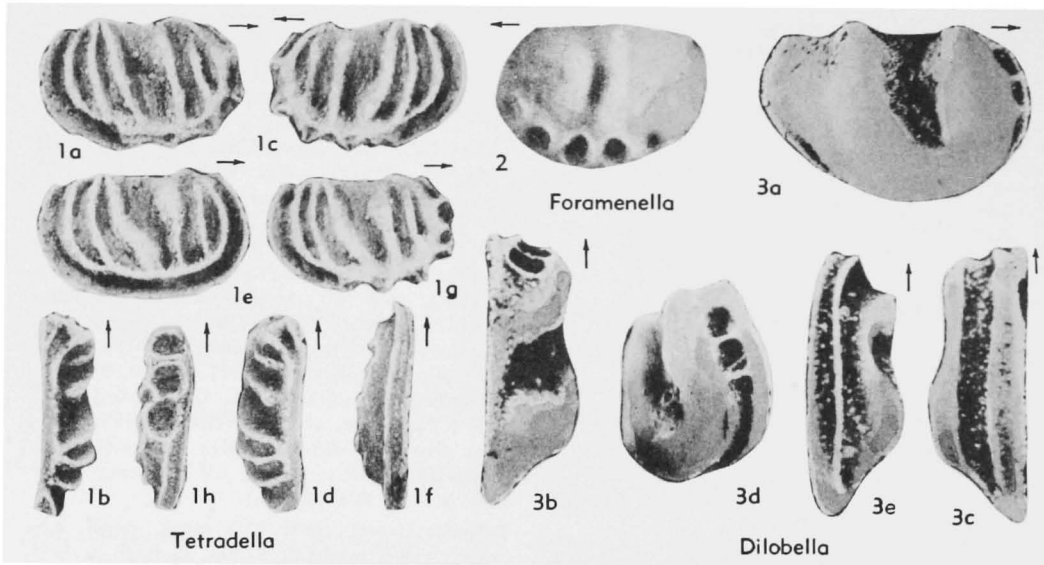

FIG. 92. Tetradellidae (p. Q161-Q162).

marginal ridge, males with bend along U-shaped lobe but without true carina, females with anterior and anteroventral abvelate loculi between velar ridge and carinate edge of U-shaped lobe, carina nearly or completely hiding loculi in lateral view, continuous with lateral surface of U-shaped lobe and hence nearly same as histium. *M. Ord.*, N.Am. —— FIG. 92,3. **D. typa*, Ord. (Trenton.), USA(Minn.); *3a-d*, ♀ RV lat., dors., vent., ant.; *3e*, ♂ LV vent., all ×30 (Kay, 1940). ——FIG. 91,3. *D. simplex* KAY, M.Ord.(Decorah Sh.), USA(Minn.); ♂ LV lat., ×33 (J. R. Cornell, n).

Foramenella STUMBUR, 1956 [**Euprimitia parkis* NECKAJA, 1952]. Small, elongate oval, convex, nearly equivalved; with conspicuous S_2 slightly in front of mid-length giving each valve bilobate appearance; females with 5 loculi in each valve, lateral velate ridge, edges of loculi with slight development of rims but without bordering carinal structure. *U.Ord.-L.Sil.*, Est.——FIG. 92,2. **F. parkis*, ♀ LV lat., ×33 (Sarv, 1959).

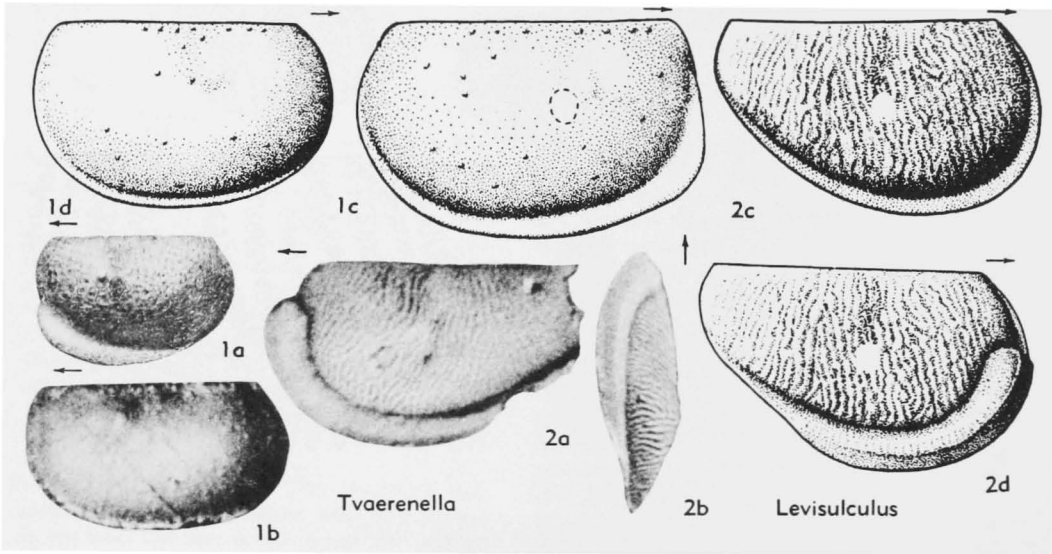

FIG. 93. Tvaerenellidae (p. Q163).

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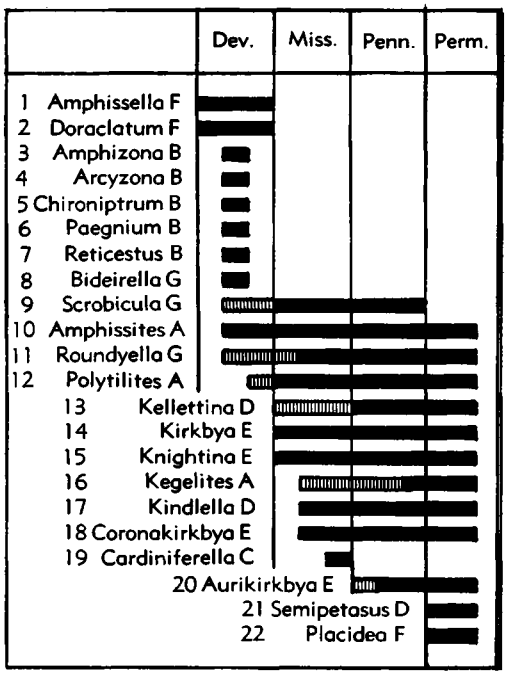

FIG. 94. Stratigraphic distribution of kirkbyacean ostracode genera, with indicated family assignments (A—Amphissitidae, B—Arcyzonidae, C—Cardiniferellidae, D—Kellettinidae, E—Kirkbyidae, F—Placideidae, G—Scrobiculidae) (Moore, n). The accompanying alphabetical list of generic names furnishes a cross reference to the serially arranged numbers on the diagram.

Generic Names with Index Numbers

Amphisella—1
Amphissites—10
Amphizona—13
Arcyzona—4
Aurikirkbya—20
Bideirella—8
Cardiniferella—19
Chironiptrum—5
Coronakirkbya—18
Doraclatum—2
Kegelites—16
Kellettina—13
Kindlella—17
Kirkbya—14
Knightina—15
Paegnium—6
Placidea—22
Polytilites—12
Reticestus—7
Roundyella—11
Scrobicula—9
Semipetasus—21

Family TVAERENELLIDAE Jaanusson, 1957

[*nom. transl.* HESSLAND, herein (*ex* Tvaerenellinae JAANUSSON, 1957)] [Materials for this family prepared by IVAR HESSLAND, University of Stockholm]

Unisulcate to nonsulcate or with sulcal depression, presulcal node or knob or spine flattened and indistinct; no surface ornamentation or indications of crests; with velar dimorphism, flange in heteromorphs being slightly to moderately convex and edges not in contact in closed carapaces. *L.Ord.-U.Ord.*

Tvaerenella JAANUSSON, 1957 [**Primitiella carinata* THORSLUND, 1940]. Nonsulcate or provided with sulcal depression, presulcal node small and indistinct; dimorphic, with velar ridge *or* slightly convex and moderately wide flange that is widest anteroventrally and generally rather long. *L. Ord.-U.Ord.*, NW.Eu.——FIG. 93,*1*. **T. carinata* (THORSLUND), M.Ord., Swed.; *1a*, LV (holotype), heteromorph with anteroventrally curved frill, lat., ×22; *1b*, LV tecnomorph with velar ridge, ×25; *1c*, RV, heteromorph (reconstr.), lat., ×35; *1d*, RV, tecnomorph (reconstr.), lat., ×35 (*1a*, Thorslund, 1940; *1b-d*, Jaanusson, 1957).

Levisulculus JAANUSSON, 1957 [**L. lineatus*]. Preplete, dorsal margin long, shallowly unisulcate (narrow sulcal or semisulcal depression), presulcal node small; dimorphic, velar structure not reaching posterodorsal corner, straight and narrow to wide *or* wide and distinctly convex, widest anteroventrally. *M.Ord.*, NW.Eu.(Baltoscandia). ——FIG. 93,*2*. **L. lineatus*, M.Ord., Swed.; *2a,b*, LV heteromorph (holotype), lat., vent., ×45, ×37; *2c*, RV tecnomorph with straight velum (reconstr.), lat., ×35; *2d*, RV heteromorph with convex velum (reconstr.), lat., ×35 (Jaanusson, 1957).

Family UNCERTAIN

Echinoprimitia HARRIS, 1957 [**E. imputata*]. Small, subrectangular, straight-backed; valves subequal, S_2 present; marginal spines present along anterior and part of ventral margins; spine anterodorsal to S_2. [The smallness of the specimen on which the genus was based and the row of short marginal spines indicates that this represents an instar stage of a genus resembling those included in the Hollinidae or Eurychilinidae. Possibly it is a molt of *Eurychilina papillata* HARRIS. Both were found in the same zone at the same locality.] *M.Ord.*, USA (Okla.). [SCOTT.]

Superfamily KIRKBYACEA Ulrich & Bassler, 1906

[*nom. transl.* SOHN, herein (*ex* Kirkbyidae ULRICH & BASSLER, 1906)] [Diagnosis by I. G. SOHN, United States Geological Survey]

Reticulate, straight-backed, with or without lobes, nodes and carinae; ridge-and-groove hingement, with or without terminal dentition; valves subequal, overlap slight; free margin of one valve rabbeted to receive opposing valve; one or more marginal rims, dimorphism unknown. *?L.Dev., M.Dev.-M.Perm.*

The stratigraphic distribution of kirkbyacean genera is shown graphically in Figure 94.

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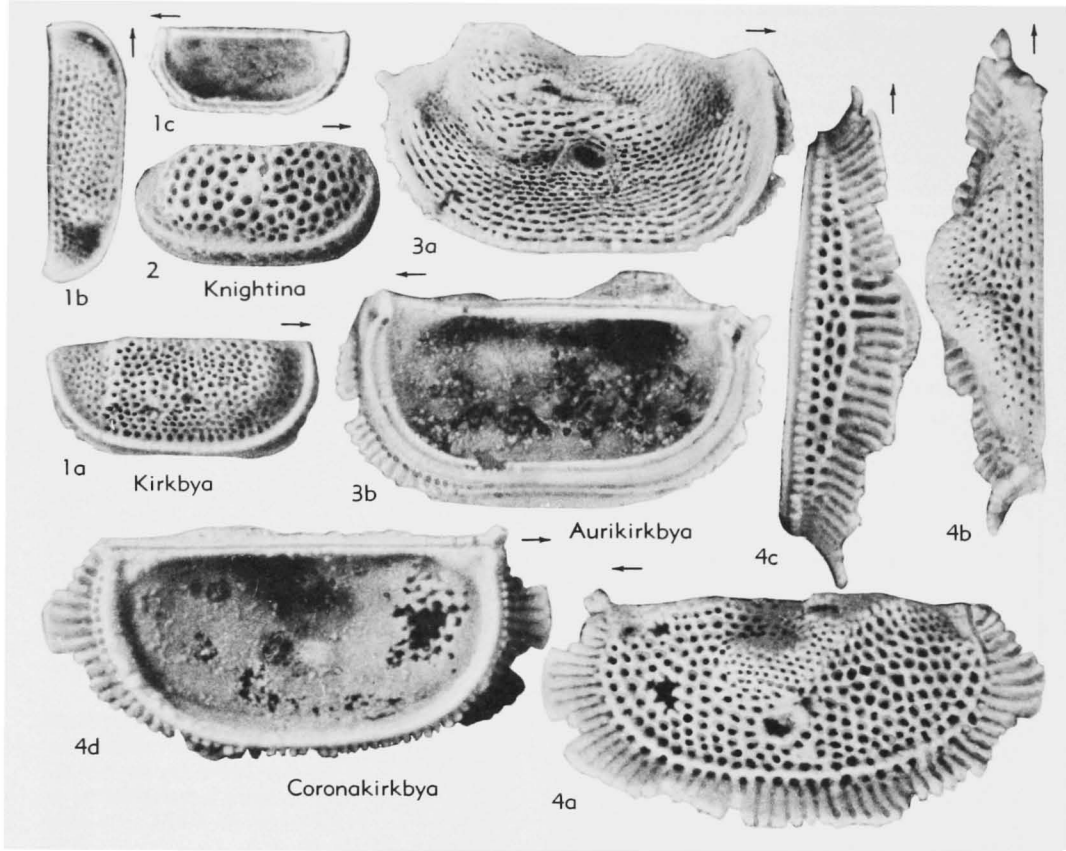

FIG. 95. Kirkbyidae (p. Q164).

Family KIRKBYIDAE Ulrich & Bassler, 1906

[=Kirkbijidae SPIZHARSKY, 1939] [Materials for this family prepared by I. G. SOHN, United States Geological Survey]

Reticulate, lobed or unlobed, with well-developed kirkbyan pit, and without nodes or carinae. *L.Miss.-M.Perm.*

Kirkbya JONES, 1859 [**Dithyrocaris permiana* JONES, 1850]. Elongate, greatest length at or near dorsal margin; posterior cardinal angle acute; lateral surface evenly convex or with posterior shoulder; 2 marginal rims. *L.Miss.-M.Perm.*, N.Am.-Eu.-Asia.——FIG. 95,*1*. *K.* sp., Perm., USA(Tex.); *1a,b*, RV lat., dors., ×40; *1c*, RV int., ×30 (73). ——FIG. 96,*4*. *K. canyonensis* HARLTON, Penn., USA(Tex.); ant. sec. through LV (*ir*, inner ridge; *or*, outer ridge), ×90 (73).

Aurikirkbya SOHN, 1950 [**Kirkbya wordensis* HAMILTON, 1942]. Two dorsal lobes connected ventrally by ridge, terminal teeth well developed, marginal rim thicker than shell wall. *?L.Penn., M.Penn.-M.Perm.*, N.Am.——FIGS. 95,*3*, 96,*2*. **A. wordensis* (HAMILTON), USA(Tex.); 95,*3a,b*, RV lat., int., ×30 (333); 96,*2*, post. section through LV at kirkbyan pit, ×55 (73).

Coronakirkbya SOHN, 1954 [**C. fimbriata*]. Large, centrally lobed, 2 marginal rims; reticulation of lobe smaller than those of valve. *?L.Miss.-?M. Penn., U.Penn.-M.Perm.*, N.Am.——FIG. 95,*4*. **C. fimbriata*, Perm., USA(Tex.); *4a-d*, LV (holotype) lat., dors., vent., int., ×30 (73).

Knightina KELLETT, 1933 [**Amphissites allorismoides* KNIGHT, 1928] [=*Tenebrion* ZANINA, 1956]. Cardinal angles obtuse, with well-developed posterior shoulder, 1 or 2 marginal rims, no terminal dentition. *L.Miss.-M.Perm.*, N.Am.-Eu.-Asia. 95,*2*, 96,*1*. **K. allorismoides* (KNIGHT), Penn., USA(Mo.); 95,*2*, RV lat. (topotype), ×57; 96,*1*, ant. sec. through RV, ×90 (73).

Family AMPHISSITIDAE Knight, 1928

[Materials for this family prepared by I. G. SOHN, United States Geological Survey]

Carapace with one or more nodes and well-developed kirkbyan pit, usually carved into or near central node. *M.Dev.-M.Perm.*

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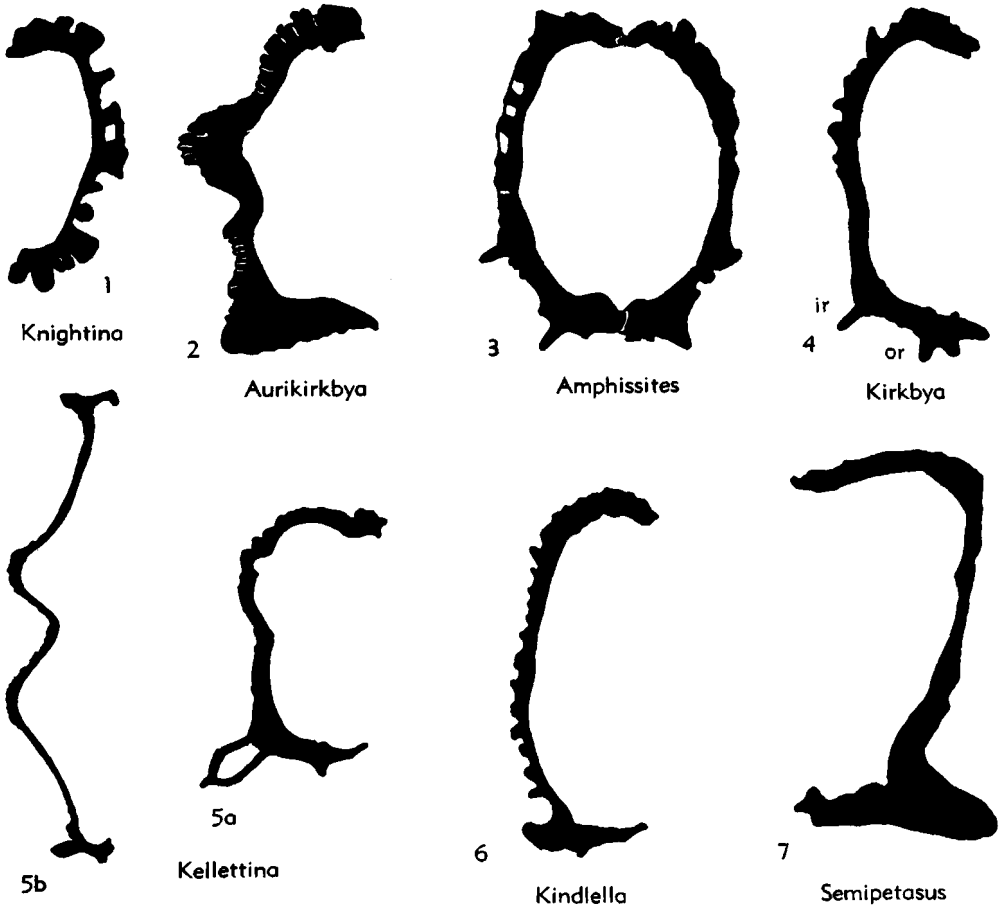

FIG. 96. Sections of kirkbyacean genera (Sohn, n).

Amphissites GIRTY, 1910 [**A. rugosus*] [=*Albanella* HARRIS & LALICKER, 1932; *Binodella* BRADFIELD, 1935; *?Ectodemites* COOPER, 1941]. Median node flanked laterally by carinae which may or may not superpose elongate nodes, and which are connected by dorsal carina subparallel to and joining hinge near cardinal angles; with terminal dentition and 2 marginal rims. *M.Dev.-M.Perm.*, N.Am.-Eu.-Asia.——FIG. 98,*3*. **A. rugosus*, Miss., Ark.; *3a-d*, carapace (lectotype ROUNDY, 1926), L lat., dors., vent., post., ×40 (Sohn, n).——FIG. 96,*3*. *A centronotus* (ULRICH & BASSLER), Penn., USA(Tex.); cross section of carapace in front of central node, ×90 (73).——FIG. 97,*1*. *A. primus* (COOPER), U.Miss., USA(Ill.), (type species of *Ectodemites*); *1a-c*, carapace L, dors., vent., ×30 (Sohn, n). [*Brillius* BRAYER, 1952, is judged to be based on a male corresponding to female *Ectodemites* and accordingly classed doubtfully as synonym of *Amphissites*—SCOTT.]

Kegelites CORYELL & BOOTH, 1933 [*pro Girtyites* CORYELL & BOOTH, 1933 (*non* WEDEKIND, 1914)] [**Girtyites spinosus* CORYELL & BOOTH, 1933] [=*Kirkbyites* JOHNSON, 1936]. Like *Amphissites*, without dorsal carina or anterior node; posterior node trending toward cardinal angle, projecting above hinge line. *M.Miss.-M.Perm.*, N.Am.——FIG. 98,*1*. **K. spinosus* (CORYELL & BOOTH), Penn., USA(Tex.); *1a-c*, carapace (holotype), L lat., R lat., vent., ×80 (Sohn, n).

Polytylites COOPER, 1941 [**P. geniculatus*]. Like *Amphissites*, without carinae but with terminal nodes well developed. *?U.Dev., L.Miss.-M.Perm.*, N.Am.-Eu.-Asia.——FIG. 98,*2a-d*. **P. geniculatus*, Miss., USA(Ill.), *2a-d*, carapace (holotype) L. lat., R lat., dors., vent., ×40 (Sohn, n).——FIG. 98, *2e,f*. *P. digitatus* SOHN, M.Perm., USA(Tex.); *2e,f*, LV (holotype), lat., dors., ×40 (73).

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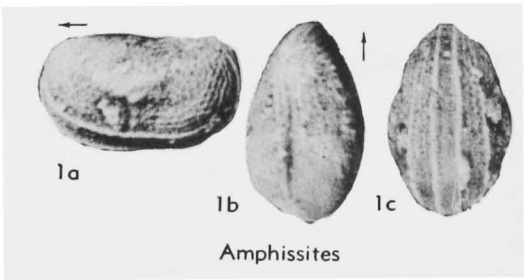

FIG. 97. Amphissitidae (p. Q165).

Family ARCYZONIDAE Kesling, n. fam.

[Materials for this family prepared by R. V. KESLING, University of Michigan]

Carapace with subequal valves, subquadrate to subelliptical or subovate in outline, with marginal and velar structures in all genera but carina only in some; side of valves with large subcentral pit but no node, interior of valves marked by node with clustered adductor muscle scars in position corresponding to external pit; RV hinge consisting of groove that fits edge of LV, hinge line straight. Surface reticulate. *M. Dev.*

Ostracodes of this family previously have been included in the Kirkbyidae on account of their straight hinge line, reticulate surface, and central pit; they differ in the much larger size of the pit and in lacking a central node. The family may contain the ancestors of Kirkbyidae.

Arcyzona KESLING, 1952 [**Amphissites diadematus* VAN PELT, 1933]. Carapace with velar structure in all species consisting of narrow frill, simple ridge, or broadly rounded ridge covered by reticulation of narrow crests; carina, if present, developed as frill-like flange, ridge, or reticulate elevation. Surface coarsely reticulate. *M.Dev.*, N.Am.-Eu.——FIG. 99,*1a*. **A. diadematata* (VAN PELT), USA(Mich.); RV lat., ×40 (201).——FIG. 99,*1b*. *A. rhabdota* KESLING, USA(Mich.); RV lat., ×40 (201).——FIG. 99,*1c*. *A. aperticarinata* KESLING & WEISS, USA(Mich.); RV lat., ×40 (213).

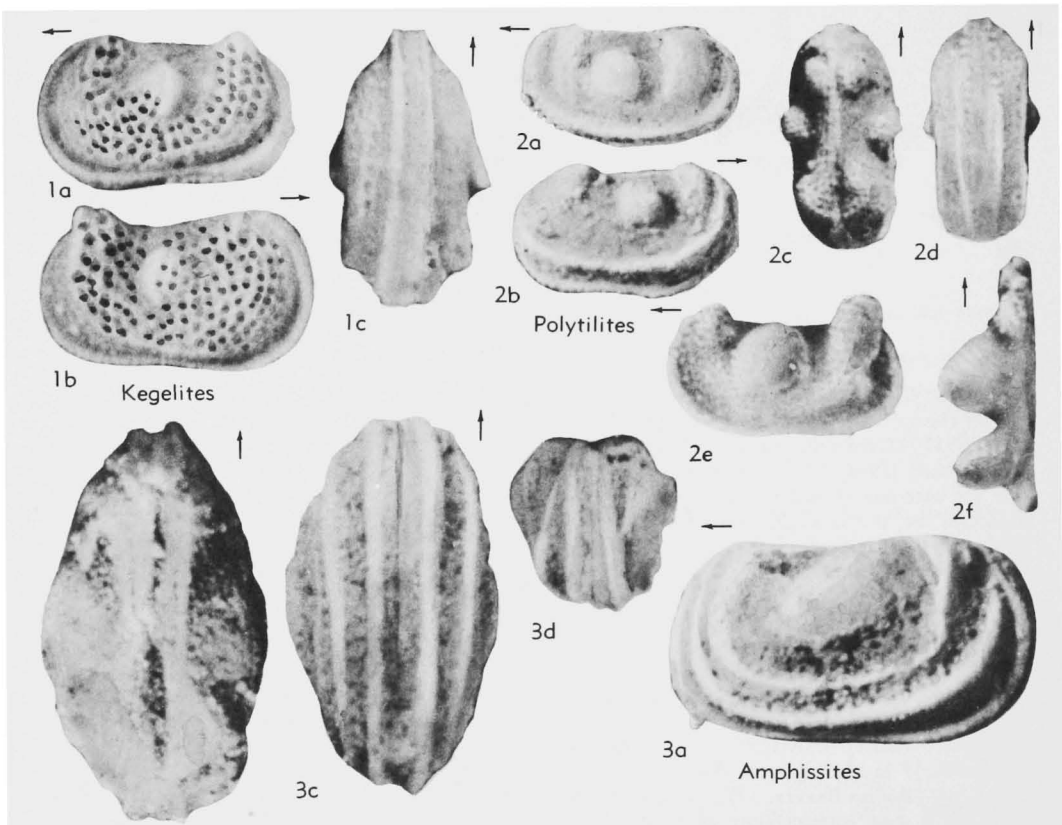

FIG. 98. Amphissitidae (p. Q165).

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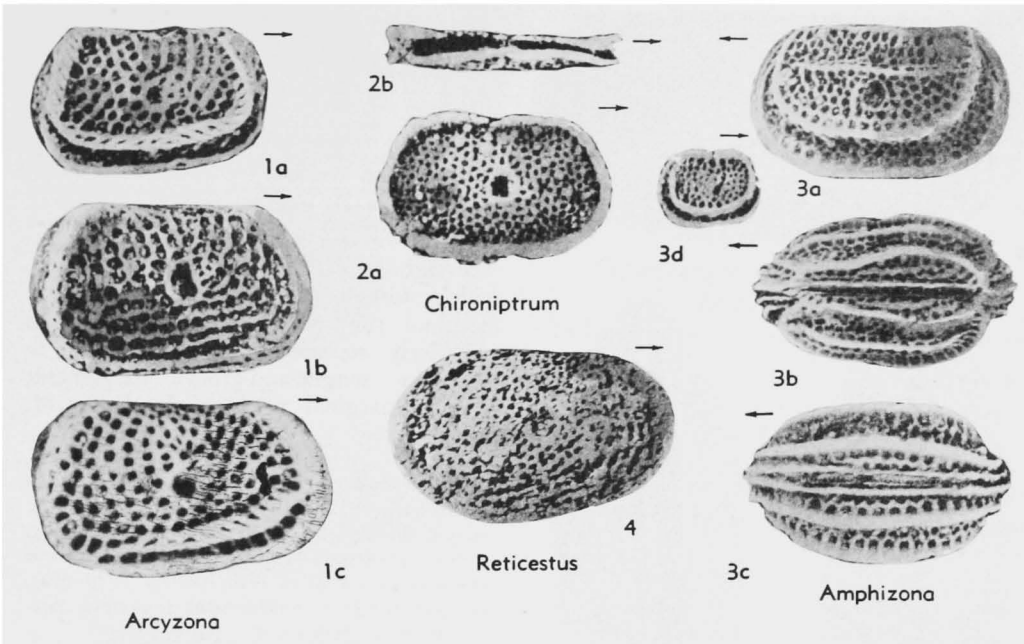

FIG. 99. Arcyzonidae (p. Q166-Q167).

Amphizona KESLING & COPELAND, 1954 [**A. asceta*]. Carapace with dorsal ridge, central horizontal ridge, frill, and well-developed carina; low node in front of central pit; very young instars lack central ridge and node. Surface reticulate. *M.Dev.*, N.Am.——FIG. 99,*3*. **A. asceta*, USA (N.Y.); *3a-c*, adult carapace L lat., dors., vent., ×35; *3d*, young instar R lat., ×35 (207).

Chironiptrum KESLING, 1952 [**C. oiostathmicum*]. Carapace with frill confluent with flangelike dorsal ridge, no carinae. Surface finely reticulate. *M. Dev.*, N.Am.——FIG. 99,*2*. **C. oiostathmicum* USA(Mich.); *2a,b*, RV lat., dors., ×40 (201).

Paegnium KESLING, 1957 [**P. tanaum*]. Carapace elongate, RV overlapping LV; hinge line very long; narrow frill or velar ridge around free border, continuous with a narrower dorsal ridge, in this feature resembling *Chironiptrum;* no carina; low marginal ridge. Surface reticulate; central pit smaller than in other genera of family, scarcely larger than meshes of reticulation. *M.Dev.*, N.Am. ——FIG. 100,*1*. **P. tanaum*, Hamilton, USA (N.Y.); *1a-d*, carapace (holotype) L, R, dors., vent., ×85 (204).

Reticestus KESLING & WEISS, 1953 [**R. acclivitatus*]. Carapace lacking distinct frill, velar ridge, and carina, but lateral surface separated from marginal surface by distinct smooth rounded bend that apparently represents velar structure. Surface reticulate. *M.Dev.*, N.Am.——FIG. 99,*4*. **R. acclivitatus*, USA(Mich.); RV lat., ×30 (213).

Family CARDINIFERELLIDAE Sohn, 1953

Differs from Kirkbyidae in absence of marginal ridges and in presence of a primitive merodont hinge. *U.Miss.*

Cardiniferella SOHN, 1953 [**C. bowsheri*]. Subovate; reticulate except for smooth marginal area; hinge incised; overlap slight. *U.Miss.*, N.Am.—— FIG. 101,*1*. **C. bowsheri*, USA(Tex.); *1a*, RV (holotype), lat.; *1b*, carapace (paratype), dors., ×40 (334).

Family KELLETTINIDAE Sohn, 1954

[*nom. transl.* SOHN, herein (*ex* Kellettininae SOHN, 1954)] [Materials for this family prepared by I. G. SOHN, United States Geological Survey]

Carapace without a well-defined kirkbyan pit. *?L.Miss.(?L.Carb.), M.Miss.-M.Perm.*

Kellettina SWARTZ, 1936 [**Ulrichia robusta* KELLETT, 1933]. Two unequal large nodes on each side of approximate mid-length, not extending below mid-height; well-developed marginal rim. *?L.Carb.*, Eu.(Russ.); *L.Penn.-M.Perm.*, N.Am.-Eu.-Asia.——FIG. 102,*3*. **K. robusta* (KELLETT), Perm., USA(Kans.); LV (holotype), ×40 (Sohn, n).——FIG. 96,*5*. *K. vidriensis* HAMILTON, Perm., USA(Tex.); *5a,b*, ant. transv. and long. secs. through LV, ×45 (73).

Kindlella SOHN, 1954 [**K. fissiloba*]. Shallow marginal rim; lobes extending below mid-height. *M.*

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FIG. 100. Arcyzonidae (p. Q167).

Miss.-M.Perm., N.Am.-Eu.——FIGS. 96,*6*, 102,*1*. **K. fissiloba*, M.Perm., USA(Tex.); 102,*1a,b*, carapace (holotype) R, L, ×40 (Sohn, n); 96,*6*, ant. transv. sec. through LV, ×95 (73).

Semipetasus SOHN, 1954 [**S. signatus*]. Large, with confluent elongate lobes, minute terminal dentition. *L.Perm.-M.Perm.*, N.Am.——FIGS. 96,*7*, 102,*2*. **S. signatus*, M.Perm., USA(Tex.); 102,*2a,b*. LV (holotype), lat., dors., ×20 (Sohn, n); 96,*7*, RV ant., transv. sec. through RV, ×48 (73).

?Family PLACIDEIDAE Schneider, 1956

[Materials for this family prepared by I. G. SOHN, United States Geological Survey] [Proper assignment of the Placideidae and Scrobiculidae is unknown at this time. SOHN believes that they are not Kirkbyacea because they lack the kirkyban pit. He would assign them questionably to the Podocopida. A reported muscle-scar pattern with as many as 40 units suggests a possible relationship with the metacopines. However, outline, hingement, free margin, and a strongly reticulated surface do not conform with other metacopines. These families display characters somewhat transitional between the Kirkbyacea and the metacopines and perhaps future studies may show that this is their true position.]

Straight-backed, subquadrate reticulated, with or without dorsocentral node, and with marginal rim; adductor muscle scar an irregularly rounded rosette with up to 40 spots, tongue-and-groove hingement; straight marginal pore canals. *L.Dev.-M. Perm.*

Placidea SCHNEIDER, 1956 [**Amphissites lutkevichi* SPIZHARSKY, 1939]. No dorsocentral node, ventral margin slightly concave, more than 1 mm. long. *L.Perm.-M.Perm.*——FIG. 103,*3a*. **P. lutkevichi* (SPIZHARSKY), Russian Platform; LV ×40 (50). ——FIG. 103,*3b*. *P. trituberculata* SCHNEIDER, Russian Platform, carapace L, ×40 (239).

?**Amphissella** STOVER, 1956 [**A. papillosa*]. Differs from *Placidea* in straight to slightly convex ventral margin and small size (less than 0.75 mm. in length). *Dev.*——FIG. 103,*1*. **A. papillosa;* M. Dev. (Hamilton), N.Y.; carapace L (holotype), ×40 (348).

?**Doraclatum** STOVER, 1956 [**D. compandium*]. Differs from *Amphisella* in possessing a dorsocentral node. *Dev.*——FIG. 103,*2*. **D. compandium*, M.Dev. (Hamilton), N.Y.; carapace L (holotype), ×40 (348).

?Family SCROBICULIDAE Posner, 1951

[See note under Placideidae.] [Materials for this family prepared by I. G. SOHN, United States Geological Survey, with addition by R. H. SHAVER, Indiana University and Indiana Geological Survey]

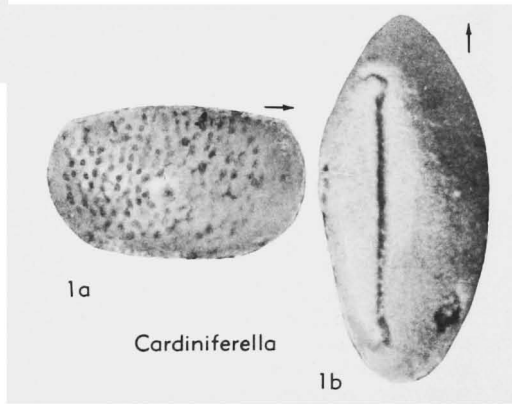

FIG. 101. Cardiniferellidae (p. Q167).

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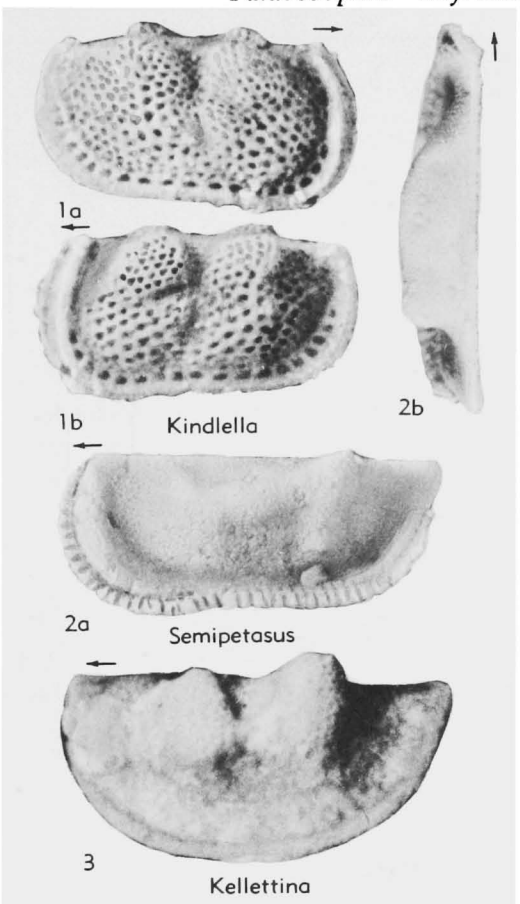

FIG. 102. Kellettinidae (p. Q167-Q168).

Subquadrate or suboval, small, straight-hinged, inequivalved, reticulated, with slightly impressed tongue-and-groove hingement, subcentral roseate muscle scar, no marginal rims. *?M.Dev., L.Carb.(Miss.)-M.Perm.*

Scrobicula POSNER, 1951 [**Cytherella? scrobiculata* JONES, KIRKBY & BRADY, 1884]. Dorsal margin of larger valve curved, overreaching impressed hinge. *?M.Dev.-?U.Dev., L.Carb.*, Eu.——FIG. 104,*2*. **S. scrobiculata* (figured specimen), L.Carb., Russia; *2a-c*, LV lat., vent., dors., ×65 (281).

?Bideirella STOVER, 1956 [**B. reticulata*]. Resembling *Roundyella* in small size, subequal valves, subrectangular outline in lateral view, reticulated surface, smooth central spot, and smooth marginal band, but differing in presence of 2 low vertical ridges near ends of each valve. Morphology of hinge, contact margin, and adductor muscle scar unknown. *M.Dev.*, N.Am.——FIG. 104,*1*. **B. reticulata; 1a*, carapace (holotype), lat.; *1b-d*, carapaces (paratypes), lat., lat., dors.; all ×30 (348). [SHAVER.]

Roundyella BRADFIELD, 1935 [**Amphissites simplicissimus* KNIGHT, 1928] [=*Scaberina* BRADFIELD, 1935]. Dorsum straight, surface with or without scattered papillae and small spines. *?M.Dev.-?L. Miss., M.Miss.-M.Perm.*, N.Am.——FIG. 104,*3*. **R. simplicissima*, Penn., USA(Mo.), *3a,b*, ?RV lat., int., ×30 (Sohn, n).

Superfamily OEPIKELLACEA Jaanusson, 1957

[*nom. transl.* HESSLAND, herein (*ex* Oepikellidae JAANUSSON, 1957)]

Median sulcus absent, surface smooth, pitted, reticulate, or nodular; velar structure present. *L.Ord.-M.Penn.*

The Aparchitidae are included provisionally in this superfamily. The genus *Aparchites* is so poorly known that it is not clear at this time whether or not this is a valid family.

The stratigraphic distribution of genera assigned to the Oepikellacea is shown graphically in Figure 105.

Family OEPIKELLIDAE Jaanusson, 1957

[Materials for this family prepared by IVAR HESSLAND, University of Stockholm]

Carapace nonsulcate, dimorphic; tecnomorphic specimens generally amplete, ad-

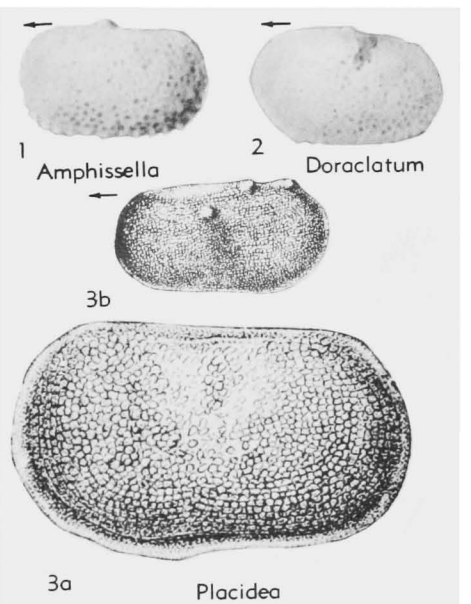

FIG. 103. Placideidae (p. Q168).

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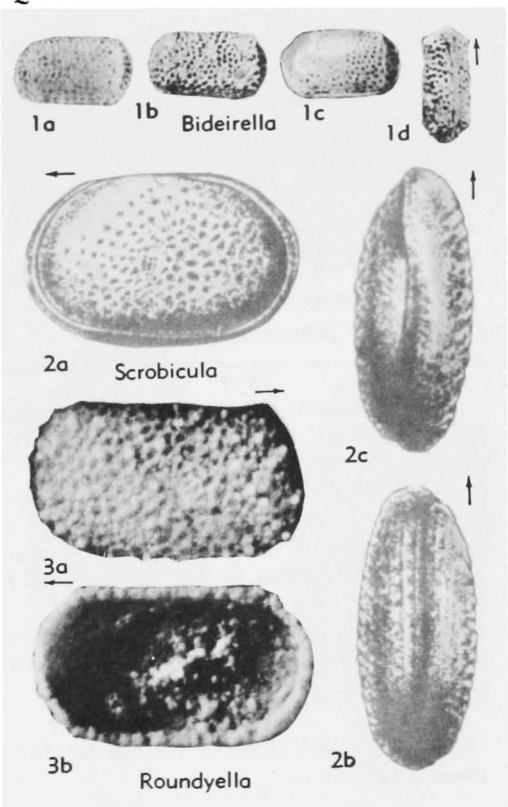

FIG. 104. Scrobiculidae (p. Q169).

ventral structure in heteromorphs developed as velar dolon in ventral or anteroventral position, in tecnomorphs forming narrow ridge or seemingly not developed. *M.Ord.-U.Ord.*

Oepikella THORSLUND, 1940 (as *Öpikella*) [**Öpikella tvaerensis* THORSLUND, 1940]. Inequivalved, LV overlapping RV along entire free margin; adductor muscle scar large (in some species surrounded by vascular marks); heteromorphs with moderate wide anteroventral incurved frill. *M.Ord.-U.Ord.*, Eu.-N.Am.——FIG. 106,*1*. *?O. frequens* (STEUSLOFF), M.Ord. (Edinburg F.), USA(Va.); *1a,b*, LV (heteromorph) lat.; LV (heteromorph) int.; *1c,d*, RV (tecnomorph lat., LV (tecnomorph) lat.; all ×20 (J. C. Kraft, n).——FIG. 110,*1*. **O. tvaerensis* (THORSLUND), M.Ord., Swed.; *1a,b*, RV (holotype), lat., post., ×15; *1c*, RV heteromorph, lat. [=*O. asklundi* (THORSLUND)], ×15 (369).

?Family APARCHITIDAE Jones, 1901

[Materials for this family prepared by IVAR HESSLAND, University of Stockholm]

Carapace nonsulcate, inequivalved, largely amplete; adductor muscle scar not visible

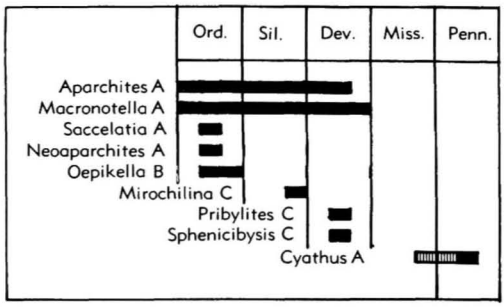

FIG. 105. Stratigraphic distribution of oepikellacean ostracode genera, with indicated family assignments (A—Aparchitidae, B—Oepikellidae, C—Pribylitidae) (Moore, n).

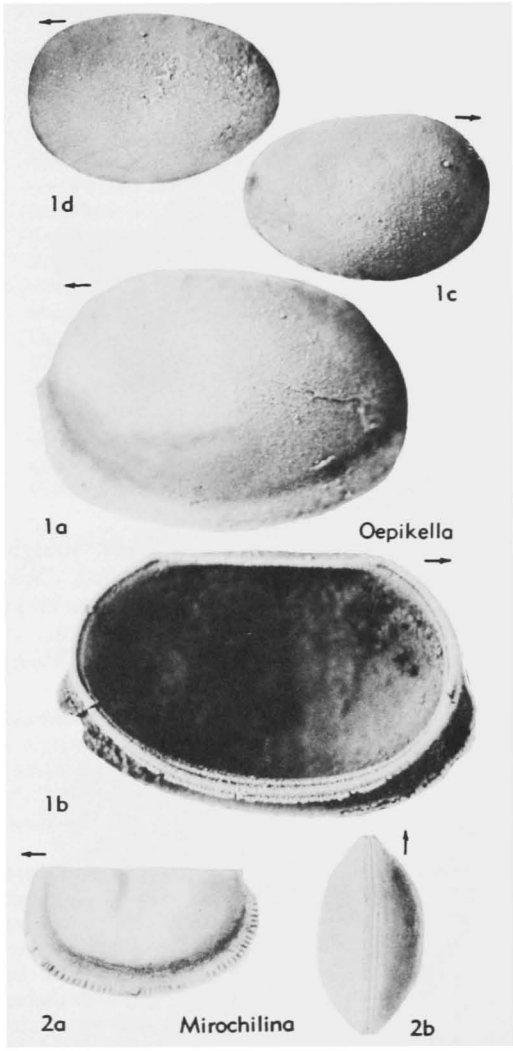

FIG. 106. Oepikellidae, Pribylitidae (p. Q170, Q173).

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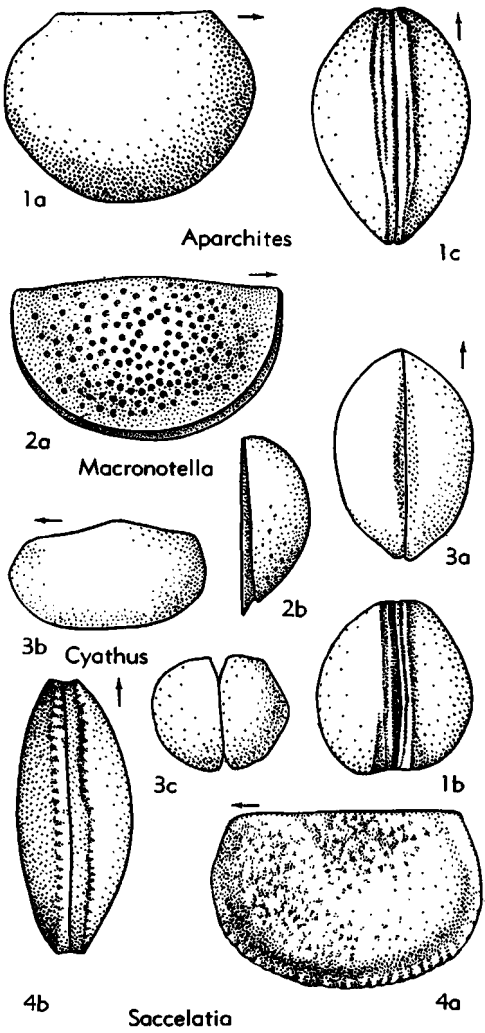

FIG. 107. Aparchitidae (p. Q171).

exteriorly or indistinct but may also be well defined; velar structure developed as low ridge which may be tuberculate, extending along ventral border and in some along part of end borders or entire free border; subvelar area channeled; dimorphism not observed. *L.Ord.-M.Penn.*

Aparchites JONES, 1889 [**A. whiteavesi;* SD S. A. MILLER, 1889]. Carapace generally swollen; hinge line of varying length, distinctly shorter than carapace; cardinal angles as a rule distinctly obtuse; adductor muscle scar not visible exteriorly; velar ridge smooth or tuberculate. *L.Ord.-M.Dev.*, Eu.-N. Am.-Austral.-Asia. —— FIG. 107,*1*. **A. whiteavesi*, M.Ord., Can.(Man.); *1a-c*, carapace (holotype) R lat., end, vent., ×10 (186).——FIG. 108,*2a*. *?A. kauffmanensis* SWAIN, M.Ord.(Chazy.), USA(Pa.); RV lat., ×20 (356).——FIG. 108,*2b-e*. *?A. crossotus* KESLING, M.Dev., USA(Mich.); *2b-e*, RV (holotype) lat., lat. showing muscle scar, int., vent., ×40 (201).——FIG. 108,*2f-h*. *A. fimbriatus* (ULRICH), M.Ord., USA(Minn.); *2f*, ?heteromorph carapace L lat., ×22; *2g,h*, ?heteromorph carapace L, vent., ×22 (J. R. Cornell, n).——FIG. 109,*1*. *A. fimbriatus* (ULRICH), M.Ord. (Edinburg F.), USA (Va.); *1a,b*, LV lat., LV int., ×10, ×9; *1c*, carapace vent., ×13; *1d,e*, LV lat., LV lat. (juv. instars), ×13; *1f*, muscle scar, ×22 (J. C. Kraft, n). [In checking proofs, HESSLAND notes that Figures 108 and 109, illustrating species added by the editor, are questionably assignable to *Aparchites;* moreover, he judges that *"A. fimbriatus"* actually belongs with oepikellid forms.—Ed.]

?Cyathus ROTH & SKINNER, 1930 [**C. ulrichi*]. Carapace very small (max. length about 0.5 mm., possibly only larval specimens known), elongated, tumid, with poorly defined cardinal angles; dorsal margin somewhat shorter than carapace, depressed between largely equal umbones; adductor muscle scar not visible exteriorly; low ridge along ventral border interpreted as velar structure. *M. Penn.*, N.Am.——FIG. 107,*3*. **C. ulrichi*, M.Penn., USA(Colo.); *3a-c*, carapace (holotype) dors., L lat., end view ×48 (298).

Macronotella ULRICH, 1894 [**M. scofieldi*] [=*Baltonotella* SARV, 1959]. Carapace mainly regularly arched, greatest thickness in central part; dorsal margin same length as carapace or somewhat shorter; cardinal angles generally well defined but may also be rounded; velate ridge smooth; adductor muscle scar indicated exteriorly by distinct rounded spot which is smooth like peripheral part of valves; remaining part of surface distinctly punctate or reticulate. *L.Ord.-Dev.*, N.Am.-Eu. ——FIGS. 107,*2*, 108,*3*. **M. scofieldi*, M.Ord.; 107, *2a,b*, RV (syntype, Ky.) lat., end view, ×15 (83); 108,*3*, LV (Minn.) lat., ×50 (J. R. Cornell, n).

?Neoaparchites BOUČEK, 1936 [**Primitia obsoleta* JONES & HOLL, 1865]. Like *Aparchites* but not indisputably known whether adventral structure is developed, possibly a velar ridge; cardinal angles rounded. *?Sil.* (Pleist. erratic), Eu.

?Saccelatia KAY, 1940 [**Aparchites arrectus* ULRICH, 1894] [=*Saccaletia* KAY, 1940 (invalid original spelling)]. Carapace small (length less than 1 mm.), with straight and long dorsal margin; cardinal angles well defined, obtuse; carapace thickest centroventrally, outline lentiform in ventral view; adductor muscle scar not visible exteriorly; adventral row of tubercles or spines or ridge interpreted as velar structure. *M.Ord.*, N. Am.-Eu.(Balt.).——FIGS. 107,*4*, 108,*1a-c*. **S. arrecta* (ULRICH), M. Ord., USA(Minn.); 107,*4a,b*, carapace (holotype) L, vent., ×40 (194); 108,*1a*,

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LV lat., ×50; 108,*1b*, RV int., ×50; 108,*1c*, carapace dors., ×50 (108,*1a-c*, J. R. Cornell, n).—— Fig. 108,*1d-f*. *S. bullata* Kay, M.Ord., USA (Minn.); *1d-f*, carapace L, dors., vent., ×45 (J. R. Cornell, n).——Fig. 108,*1g,h*. *S. arcamuralis* Kay, M.Ord., USA(Minn.); *1g,h*, RV lat., LV lat., ×45 (J. R. Cornell, n).

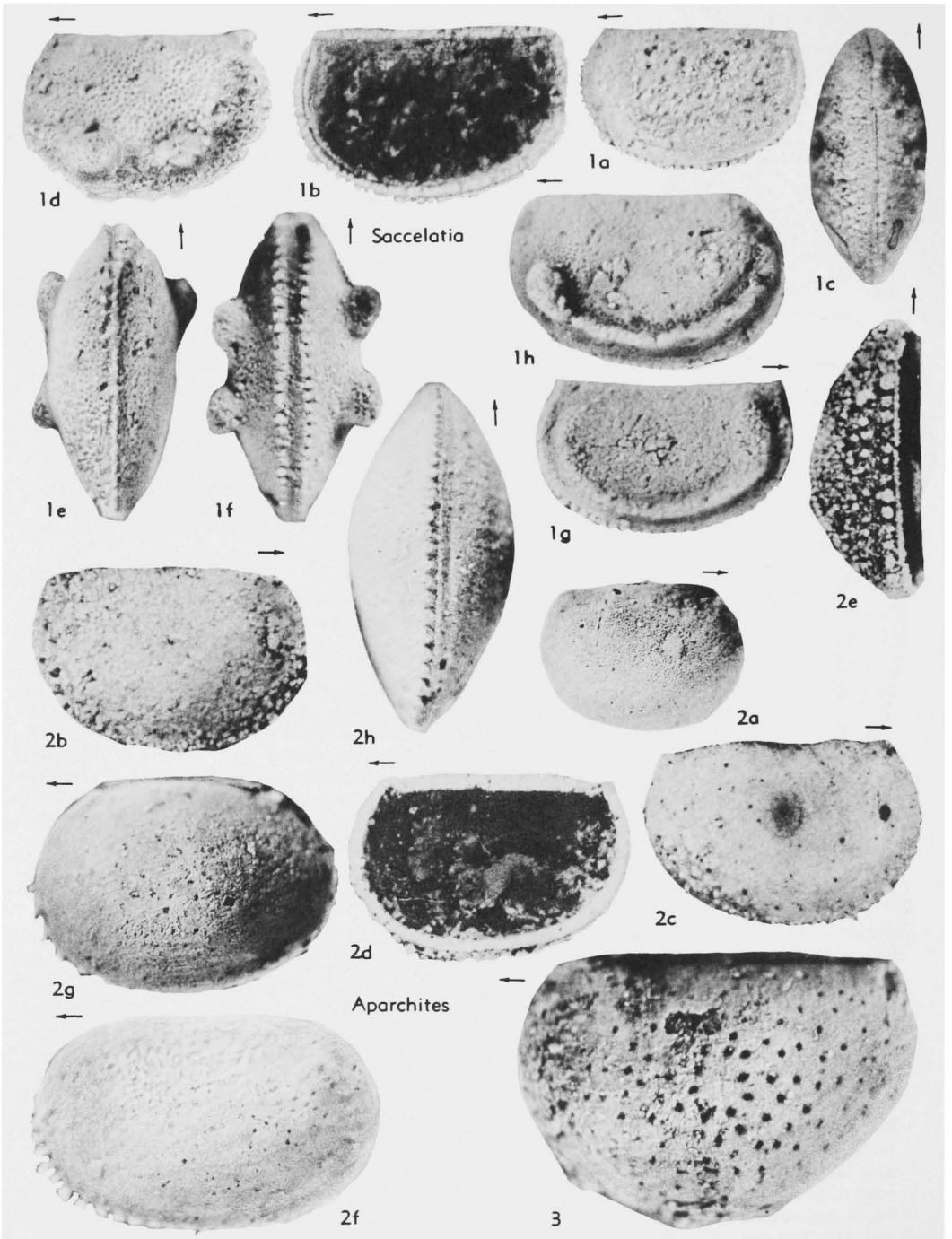

Fig. 108. Aparchitidae (p. Q171).

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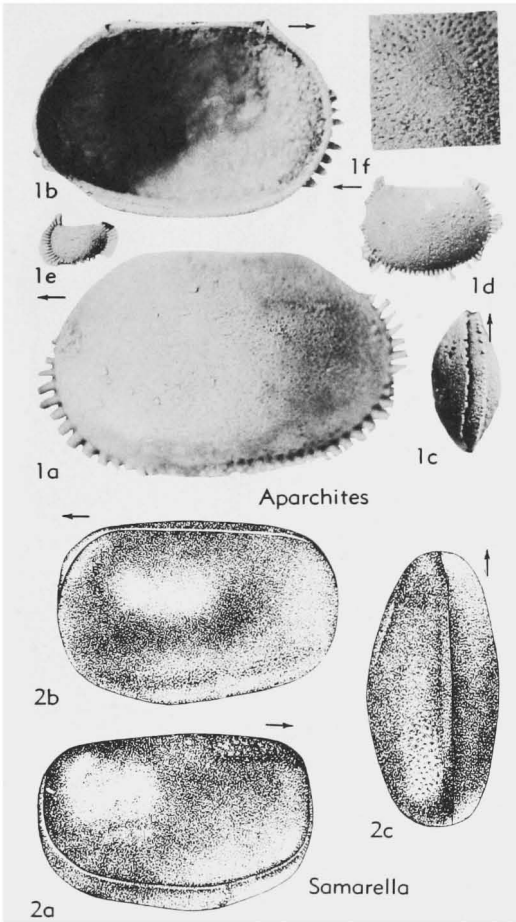

FIG. 109. Aparchitidae, Paraparchitidae (p. Q171, Q194).

Family PRIBYLITIDAE Pokorný, 1958

[Materials for this family prepared by IVAR HESSLAND, University of Stockholm, with addition by JEAN BERDAN, United States Geological Survey]

Carapace small, nonsulcate, or with very shallow S_2 with long straight hinge line, and well-defined cardinal angles, generally amplete or slight preplete or postplete; thickest in ventral half; adventral structure interpreted as velar variously indicated by sharp bend or ridge, with or without tubercles. Dimorphism not observed. *U.Sil.-M. Dev.*

Pribylites POKORNÝ, 1950 [**P. moravicus*] [=*Paraprybylites* POKORNÝ, 1950] Carapace very small (length less than 0.6 mm., possibly only representing larval specimens) with bulbous anterior cardinal areas, amplete, preplete, or slightly postplete, trapezoidal in ventral view, RV overlapping LV ventrally; adductor muscle scar not visible exteriorly, sharp bend or short ridge (in some reduced to ventral spine) may indicate velar structure, marginal structure may be denticulate; subvelar area approximately straight. *M.Dev.*, Eu.——FIG. 110, *2. *P. moravicus*, Czech.; *2a-c*, carapace (holotype), L lat., vent., dors., ×60 (275).

?Mirochilina BOUČEK, 1936 [**M. jarovensis*]. Small, straight-hinged, with obtusely angled cardinal extremities, subtriangular in transverse section, lateral and ventral surfaces of valves disposed almost perpendicularly to each other; with weak median sulcus that ends in shallow median pit; narrow striated frill on anteroventral, ventral, and posterior contact margins; surface smooth. *U.Sil. (Ludlov.)*, Eu.——FIG. 106,*2*. **M. jarovensis*, Czech.; *2a,b*, carapace (holotype) L, dors., ×40 (10). [BERDAN.]

Sphenicibysis KESLING, 1952 [**S. hypoderota*] [=*Sphenicibys* POKORNÝ, 1958 (errore)]. Carapace subtriangular in end views, amplete or gently preplete; RV distinctly more swollen in ventral half than LV; adductor muscle scar not visible exteriorly; sharp adventral bend with small tubercles interpreted as velar structure; marginal structure indicated by low ridge; subvelar area straight. *M.Dev.*, N.Am.——FIG. 110,*3*. **S. hypoderota*, USA(Mich.); *3a-c*, carapace (holotype) L lat., R lat., vent., ×50 (201).

Superfamily PRIMITIOPSACEA Swartz, 1936

[*nom. transl.* HESSLAND, herein (*ex* Primitiopsidae SWARTZ, 1936)] [Diagnosis by IVAR HESSLAND, University of Stockholm]

Unisulcate (sulcus or sulcal pit corresponding to S_2) or nonsulcate; hingement may consist of median groove and corresponding ridge with lateral pits and prominences. Dimorphic, with more or less closed posterior velar chamber in heteromorphs but adventral structures may or may not be developed in tecnomorphs. *M.Ord.-M.Dev.*

The stratigraphic distribution of genera assigned to the Primitiopsacea is indicated in Figure 111.

Family PRIMITIOPSIDAE Swartz, 1936

[=Primitiopsididae POKORNÝ, 1958] [Materials for this family prepared by IVAR HESSLAND, University of Stockholm]

Characters of superfamily. *M.Ord.-M.Dev.*

Subfamily PRIMITIOPSINAE Swartz, 1936

[*nom. transl.* HESSLAND, 1949 (*ex* Primitiopsidae SWARTZ, 1936)] [=Primitiopsiinae HENNINGSMOEN, 1953]

Carapace with distinct sulcus or sulcal pit, indistinct presulcal node, velar structure

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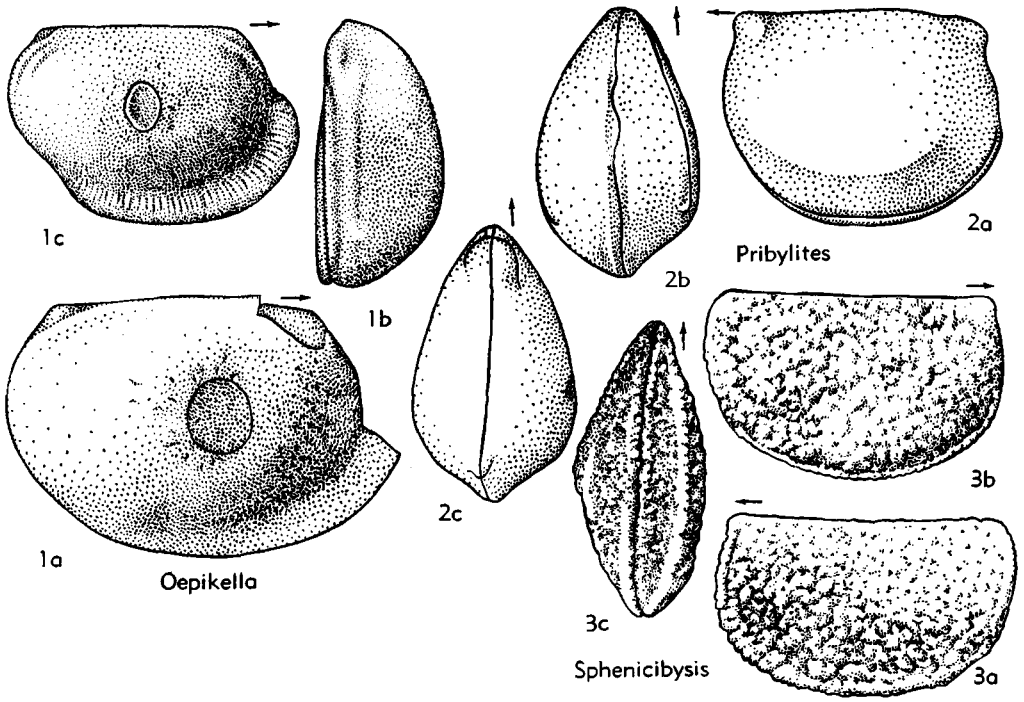

FIG. 110. Oepikellidae, Pribylitidae (p. Q170, Q173).

forming bend or ridge in both sexes except along posterior part in heteromorphs where closed or open pouch is developed; surface generally reticulate. *M.Ord.-M.Dev.*

Primitiopsis JONES, 1887 [**P. planifrons*]. Carapace rather elongate in heteromorph specimens, RV overlapping LV; hinge depressed between dorsal ridges, dorsum narrow; sulcal structure developed as S_2 depression with adductorial pit in ventral part. Dimorphic; velar structure forming ventral bend posteriorly, in heteromorphs constituting pouch by meeting of velar flanges, surface of flanges smooth, marginal structure tuberculate. *M.Ord. - M.Sil.,* N.Am.(Okla.) - Eu.(Scand.).—FIG. 112,*3*. **P. planifrons,* M.Sil.(Wenlock.), Swed.; *3a-c,* heteromorph carapace (neotype, MARTINSSON, 1955) L, vent., dors., ×25 (52).

Clavofabella MARTINSSON, 1955 [**C. incurvata*]. Inequivalved, RV overlapping LV; hinge consisting of median groove with corresponding ridge and lateral elongate pits and sockets; unisulcate (sulcal pit). Dimorphic, showing velar structure developed as ridge that in heteromorphs widens to form posterior flanges which do not meet; surface pitted or reticulate, marginal structure tuberculate. *M.Sil.,* Eu.(Scand.-Eng.).—FIG. 112,*2*. **C. incurvata,* Wenlock., Swed.; *2a-d,* heteromorph carapaces with velar frill, L lat., vent. oblique, dors., vent., ×25; *2e-g,* tecnomorph carapace lacking velar frill, L lat., dors., vent., ×25 (52).

Limbinaria SWARTZ, 1956 [**L. multipunctata*]. Nonlobate, with deep sulcal pit, domicilium largely amplete, with distinct cardinal angles, RV overlapping LV along entire free margin. Dimorphic, adventral structure developed as narrow ridge in tecnomorphs and wide flat flange along posterior and adjacent parts of ventral margin in hetero-

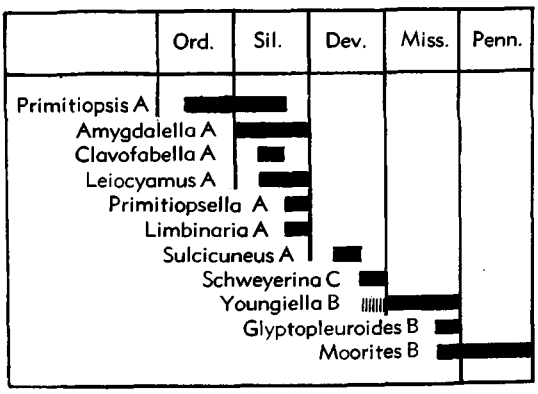

FIG. 111. Stratigraphic distribution of (A) primitiopsacean and (B) youngiellacean ostracode genera, including (C) *Schweyerina,* of uncertain family (Moore, n).

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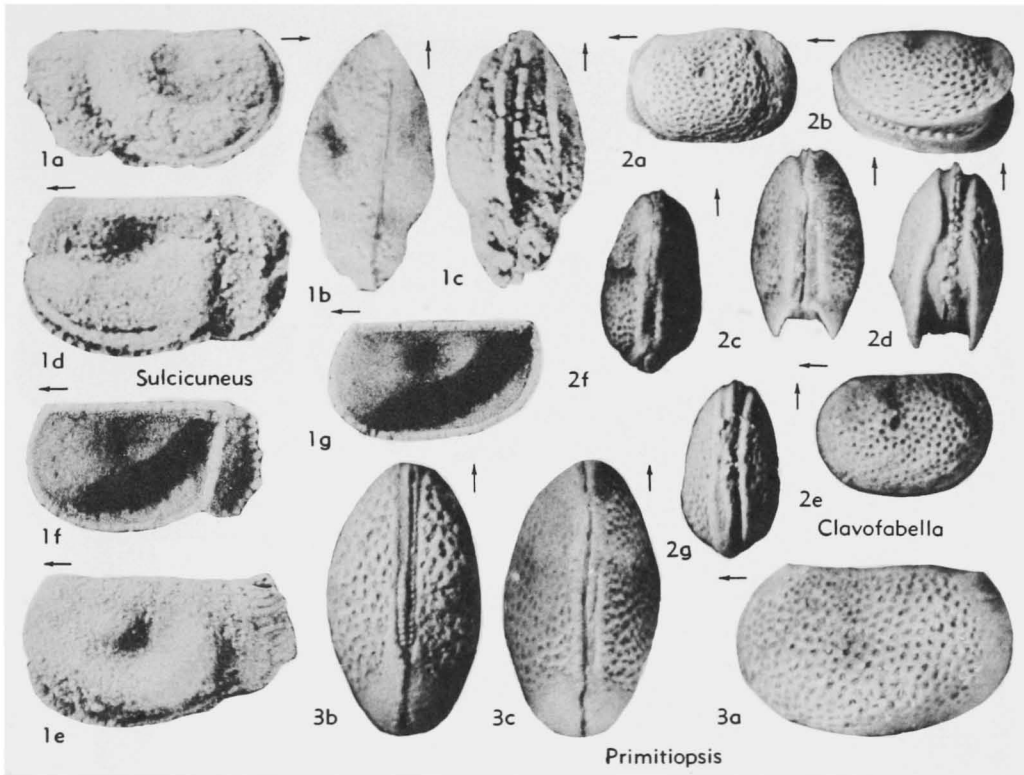

FIG. 112. Primitiopsidae (p. Q174-Q175).

morphs, distinct dorsal plica along entire dorsal margin. Surface coarsely pitted or reticulate. *U. Sil.*, N.Am.——FIG. 114,2. **L. multipunctata*, Tonoloway Ls., USA(Va.); *2a*, heteromorph LV (holotype) lat.; *2b*, tecnomorph RV lat.; both ×45 (359).

Primitiopsella POLENOVA, 1960 [*pro Leperditellina* POLENOVA, 1955 (*non* NECKAJA, 1955)] [**L. miranda* POLENOVA, 1955]. Dorsal margin almost straight to slightly convex; tecnomorph carapace amplete, almost equivalved, nonlobate, RV slightly overlapping LV; shallow sulcal depression; dimorphic, some shells with closed broad swelling parallel to posterior margin (or additionally along posterior part of ventral margin) may be connected to short adventral ridge paralleling ventral margin (which in tecnomorphs seems to continue along posterior margin). Surface smooth or finely pitted. *U.Sil.(Ludlov.)*, USSR(Urals)-Est.——FIG. 113,*1*. **P. miranda* (POLENOVA), Urals; *1a-c*, carapace (heteromorph) L lat., dors., vent.; *1d*, carapace (outline) R lat. (tecnomorph); ×41 (279). [HESSLAND-REYMENT.]

Sulcicuneus KESLING, 1951 [**S. porrectinatium*]. Carapace subtriangular in end view, LV larger than RV; unisulcate, median sulcus (S_2) well developed, extending to about mid-height, presulcal node small; adductor muscle spot composed of scars (6 in holotype of type species) arranged in rosette around central scar. Dimorphic, velar structure forming ridge that may be tuberculate, in heteromorphs forming posterior flanges which may meet or form a gap; velum marginally tuberculate. *M.Dev.*, N.Am.——FIG. 112,*1*. **S. porrectinatium*, Traverse Gr., USA(Mich.); *1a-c*, carapace (holotype) R lat. (heteromorph) dors..

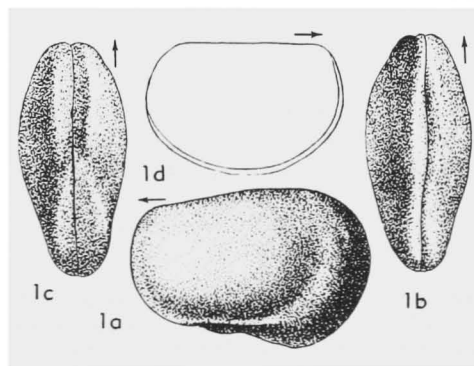

FIG. 113. *Primitiopsella miranda* (POLENOVA) (Primitiopsidae, (p. Q175).

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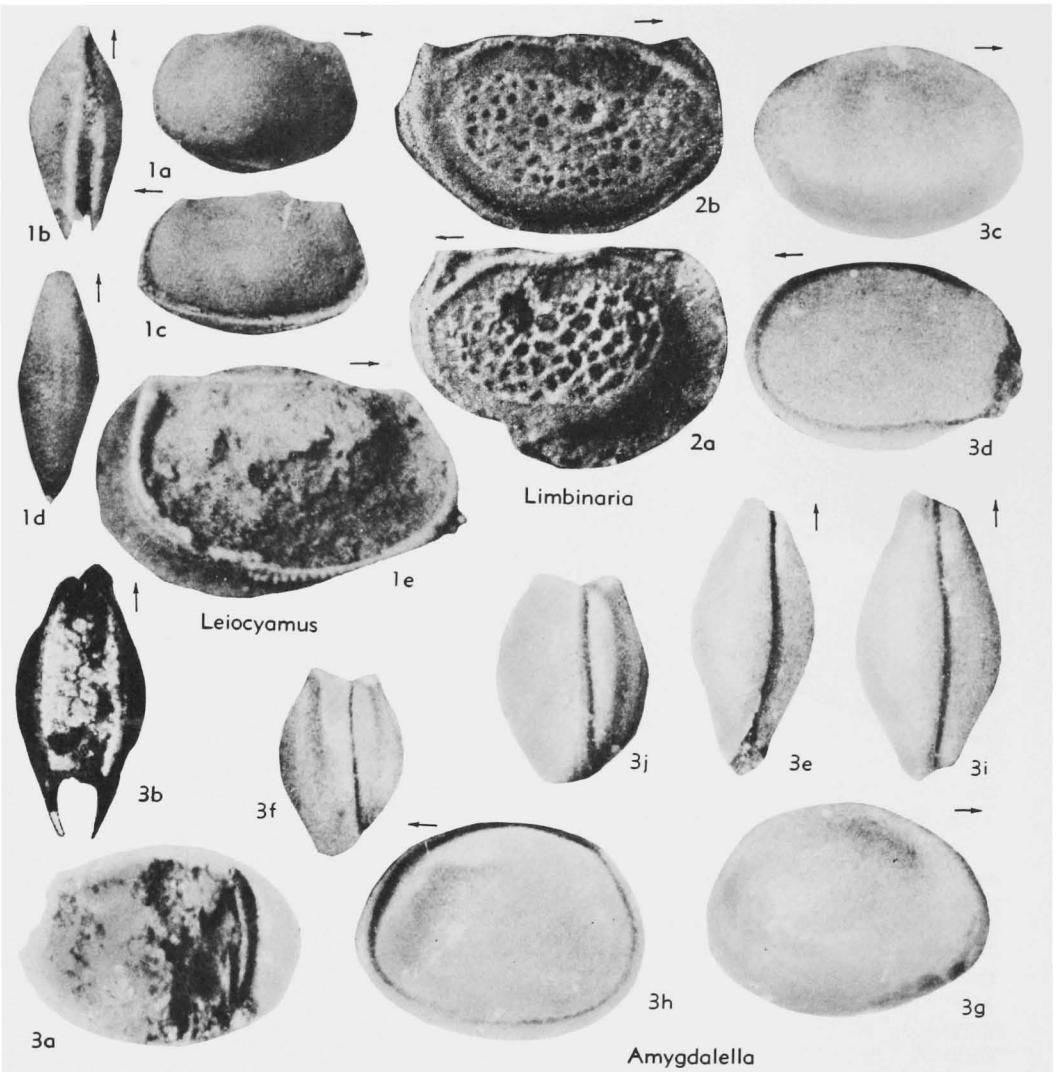

FIG. 114. Primitiopsidae (p.*Q*174-*Q*177).

vent.; *1d,e,* carapace L (heteromorph); *1f,* RV int.; *1g,* RV int. (tecnomorph); all ×40 (200).

Subfamily LEIOCYAMINAE Martinsson, 1956

Velar structure in one sex only consisting of flange, widest posteriorly and there forming a chamber; without sulcus or sulcal pit, no preadductorial node. Surface smooth or pitted. *M.Sil.-U.Sil.*

Leiocyamus MARTINSSON, 1956 [**L. apicatus*]. Inequivalved, RV larger than LV, nonsulcate; hinge depressed between dorsal ridges or umbones (larger on LV) forming simple groove in one valve and corresponding ridge in other. Dimorphic,

[HESSLAND has reported (too late for incorporation in *Treatise* systematic text) that recent studies by MARTINSSON (The primitiopsid ostracodes from the Ordovician of Oklahoma and the systematics of the family Primitiopsidae: Uppsala Univ. Geol. Inst., Bull. v. 38, p. 139-154, 1960) serve to establish the primitiopsid nature of species from Middle Ordovician strata of Oklahoma desribed by HARRIS (Ostracoda of the Simpson Group; Oklahoma Geol. Survey, Bull. 75, 333 p., 10 pl., 1957). Accordingly, the stated stratigraphic range of the family is revised to include the Middle Ordovician occurrences. MARTINSSON's revised arrangement of primitiopsid genera is indicated in the following outline: Subfamily PRIMITIOPSINAE Swartz, 1936 *(Primitiopsis, Clavofabella, Limbinaria, Primitiopsella);* subfamily ANISOCYAMINAE Martinsson, nov. *(Anisocyamus,* Martinsson, nov., based on *Primitiopsis elegans* Harris, 1957, as type species); Subfamily SULCICUNEINAE Martinsson, nov. *(Sulcicuneus);* Subfamily POLENOVULINAE Martinsson, nov. (*Polenovula* Martinsson, nov., based on *Leperditellina? crassa* Polenova, 1955, as type species, and *Viazoviella* Martinsson, nov., based on *Leperditellina miranda* Polenova, 1955, as type species).—ED.]

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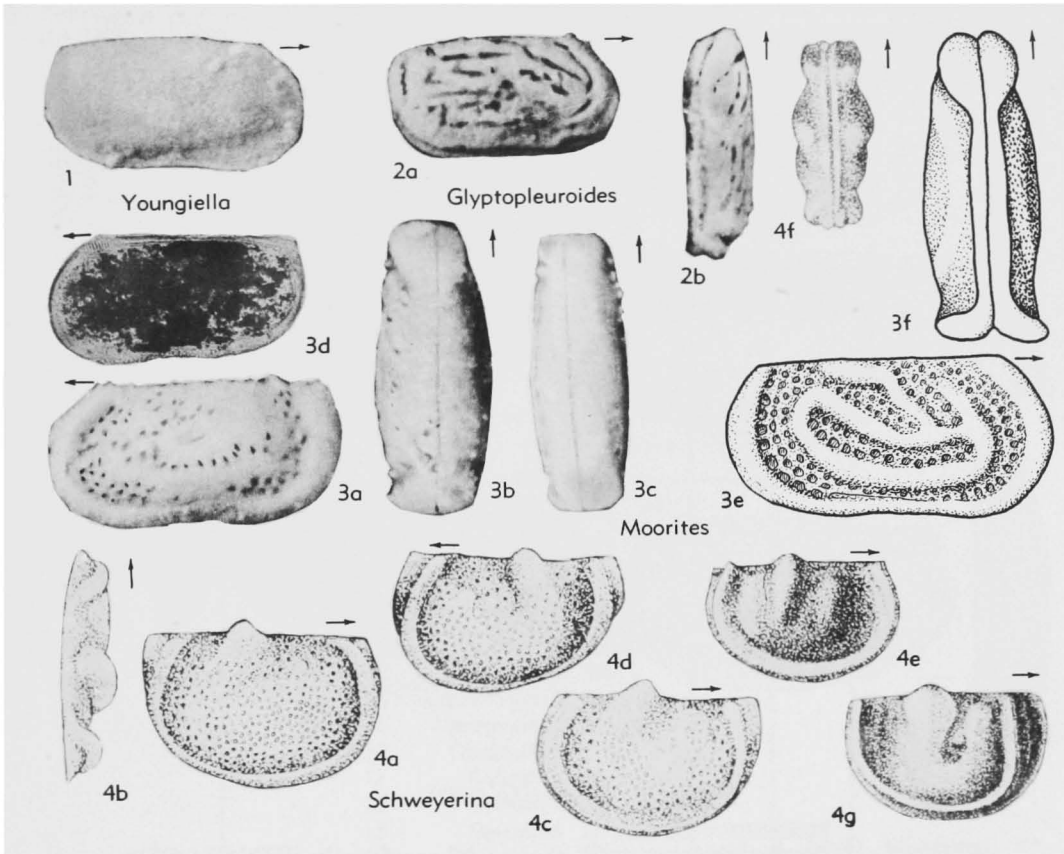

FIG. 115. Youngiellidae and Family Uncertain (p. Q177-Q178).

velar structure in heteromorphs developed as flange which is broad and convex posteriorly and continued forward along ventral side of valve, not forming a closed chamber. *M.Sil.-U.Sil.*, NW.Eu. ——FIG. 114,*1*. **L. apicatus*, Wenlock., Swed.; *1a-b*, carapace of posteriorly chambered specimen (holotype), R lat., vent., ×25; *1c,d*, carapace of unchambered specimen, L lat., vent., ×25; *1e*, LV of chambered specimen, int., ×55 (243).

Amygdalella MARTINSSON, 1956 [**A. subclusa*] [=*Amygalella* LEVINSON, 1957 (errore)]. Inequivalved, RV larger than LV, hinge depressed between dorsal ridges; nonsulcate; dimorphic, with velate structure in females consisting of posterior pouch which can be almost closed (no extension along ventral margin). *Sil.*, NW.Eu.(Baltoscandia). ——FIG. 114,*3*. **A. subclusa*, Baltoscandia (drift boulder); *3a*, RV (heteromorph) (holotype), int. showing post. chamber; *3b*, chambered carapace, long. sec.; *3c-f*, chambered carapace R, L lat., vent., ant.; *3g-j*, unchambered carapace R, L lat., vent., ant.; all ×20 (106).

?Superfamily YOUNGIELLACEA Kellett, 1933

[*nom. transl.* SOHN, herein (*ex* Youngiellidae KELLETT, 1933)] [Diagnosis by I. G. SOHN, United States Geological Survey]

Carapace minute, suboblong, with straight taxodont hinge bearing vertical teeth and sockets. Surface smooth, reticulate or ridged. *?U.Dev., L.Miss.(L.Carb.)-U.Penn.*

The stratigraphic distribution of youngiellacean ostracode genera is plotted in Figure 111.

Family YOUNGIELLIDAE Kellett, 1933

Characters of superfamily. *L.Miss.(L. Carb.)-U.Penn.*

Youngiella JONES & KIRKBY, 1895 [*pro Youngia* JONES & KIRKBY, 1886 (*non* LINDSTRÖM, 1885)] [**Youngia rectidorsalis* JONES & KIRKBY, 1886]. Smooth or faintly reticulate, without marginal rim. *L.Carb.(Miss.)*, Eu.-N.Am.——FIG. 115,*1*.

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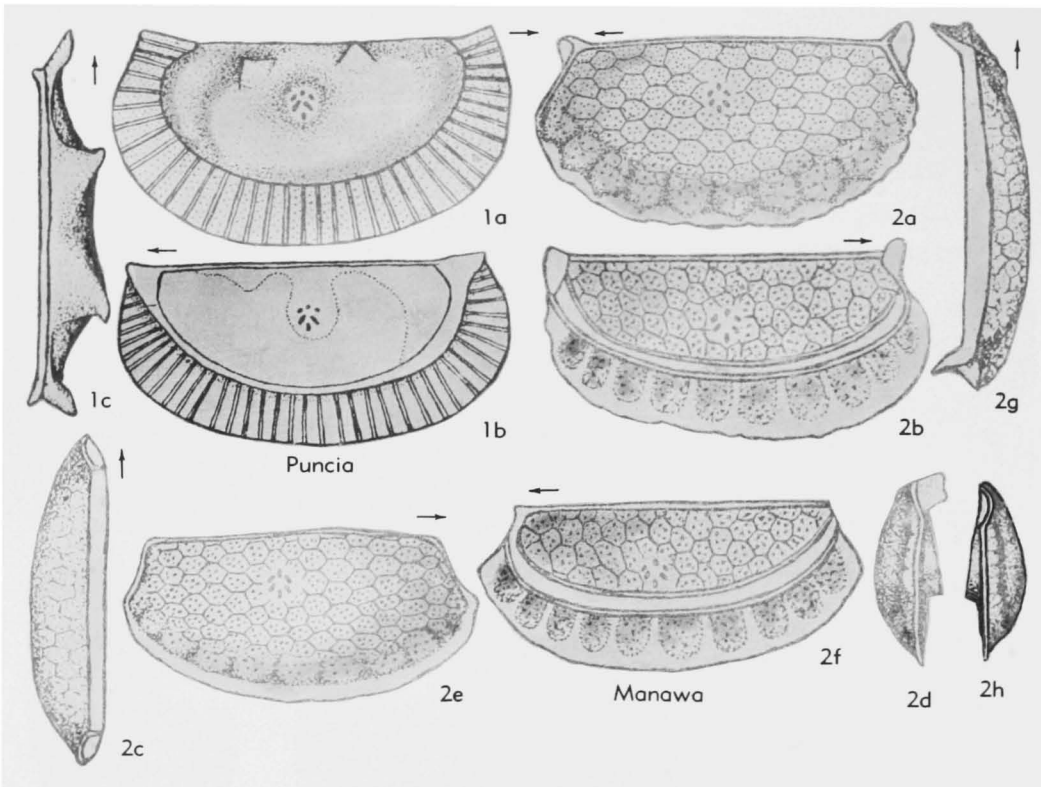

FIG. 116. Punciidae (p. Q179).

*Y. *rectidorsalis* (JONES & KIRKBY), L.Carb. (Scremerston Gr.), Eng.; carapace R, ×80 (Sohn, n).

?**Glyptopleuroides** CRONEIS & GALE, 1938 [**G. insculptus*]. Unpitted, with marginal rim and bifurcating elongate ridges on surface of valves. *U. Miss.*, N.Am.——FIG. 115,*2*. **G. insculptus*, Ill.; *2a,b*, RV lat., dors., ×40 (Sohn, n).

Moorites CORYELL & BILLINGS, 1932 [**M. hewetti* (=**Glyptopleurina? minuta* WARTHIN, 1930)] [=*?Hardinia* CORYELL & ROZANSKI, 1942]. Rims along end margins, surface with coarse pits in elongate undefined depressions between rims. *Miss.-U.Penn.*, N.Am.——FIG. 115,*3*. **M. minutus* (WARTHIN), U.Penn., Tex.; *3a-c*, carapace L, dors., vent., ×80; *3d*, RV converted to fluorite, int. viewed with transmitted light to show hinge, ×80 (Sohn, n); *3e,f*, carapace R, vent., ×60 (200).

Family UNCERTAIN

Schweyerina ZASPELOVA, 1952 [**S. ovata*]. Bilobed, with marginal ribs and reticulate surface. *U.Dev.*, Eu.——FIG. 115,*4a-d*. **S. ovata*, USSR; *4a,b*, carapace (holotype) R, dors.; *4c,d*, RV (paratype) lat., LV lat.; all ×70 (406).——FIG. 115,*4e-g*. *S. normalis; 4e,f*, carapace (holotype) R, dors.; *4g*, RV lat.; all ×50 (406).

?Superfamily PUNCIACEA Hornibrook, 1949

[*nom. transl.* SYLVESTER-BRADLEY, herein (*ex* Punciidae HORNIBROOK, 1949)] [Diagnosis by P. C. SYLVESTER-BRADLEY, University of Leicester]

Carapace small, delicate, and differing from most other Palaeocopida by discrete muscle-scar pattern. *Rec.*

Family PUNCIIDAE Hornibrook, 1949

[Materials for this family prepared by P. C. SYLVESTER-BRADLEY, University of Leicester]

Carapace elongate, semi-elliptical with long straight hinge-line, with or without terminal articulating brackets. Contact margins extended by wide, double-walled, septate frill; muscle-scar pattern in ring of 6 scars. Soft parts unknown. [Family based on 2 monotypical genera discovered in the South Pacific from 2 dredgings. The carapaces bear a remarkable resemblance to the Ordovician-Devonian Eurychilinidae and seem to comprise the only surviving members of the Palaeocopida. This is agreed to by BETTY KELLETT NADEAU after studying type specimens. H. W. SCOTT (1960) thinks that

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Puncia and *Manawa* should be classified in the Eurychilinidae, treating Punciidae as a junior synonym of Eurychilinidae. This would call for reporting the range of Eurychilinidae and Hollinacea as L.Ord.-Rec. —Moore.] *Rec.*

Puncia Hornibrook, 1949 [**P. novozealandica*]. Frill wide, divided into about 40 compartments by radial septa. Shallow median sulcus contains muscle-scar pattern. *Rec.*, S.Pac.——Fig. 116,*1*. **P. novozealandica; 1a-c,* RV lat., int., dors., ×90 (174).

Manawa Hornibrook, 1949 [**M. tryphena*]. Frill wide, divided into about 11 compartments and bearing a translucent rim; no median sulcus. RV hinge terminating at both ends in brackets which overlap bevels at ends of LV hinge. *Rec.*, S.Pac. ——Fig. 116,*2*. **M. tryphena; 2a-d,* LV lat., int., dors., post., ×90; *2e-h,* RV lat., int., dors., post. ×90 (174).

Superfamily and Family UNCERTAIN

Craspedobolbina Kummerow, 1923 (1924) [**C. dietrichi*]. S_1 nearly obsolete, S_2 deep, L_2 not well defined anteriorly. Velate structure developed as frill in pouchless valves, and as rim in pouched valves, or may be rim in both. Surface granulose, reticulate, or smooth. *Ord.*(boulder in glacial drift), N.Ger. [Berdan-Scott.]

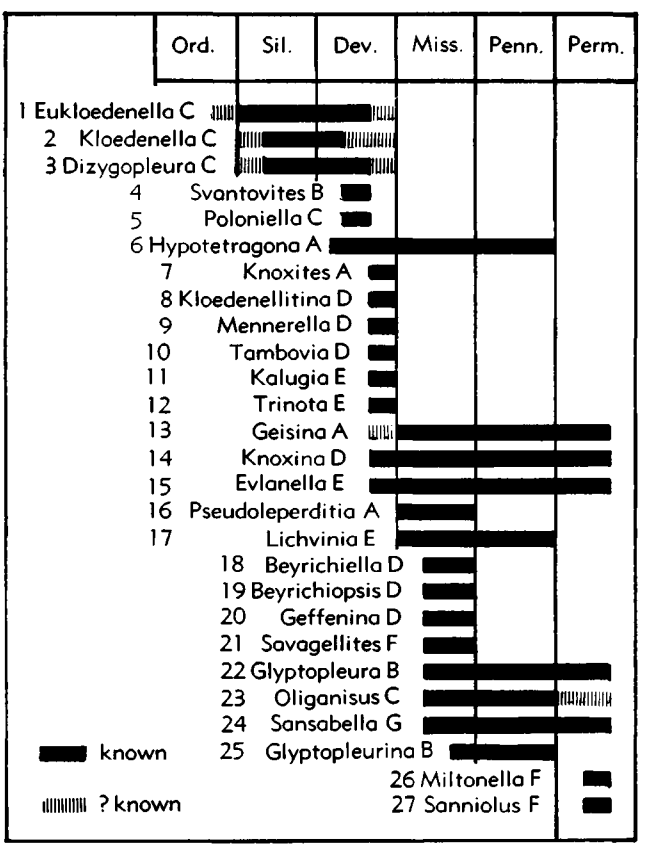

Fig. 117. Stratigraphic distribution of kloedenellacean ostracode genera (Moore, n). Classification of the genera in families is indicated by letter symbols (A—Geisinidae, B—Glyptopleuridae, C—Kloedenellidae, D—Knoxinidae, E—Lichviniidae, F—Miltonellidae, G—Sansabellidae) and the following alphabetical list furnishes a cross reference to the serially arranged numbers on the diagram. [For Knoxinidae, read Beyrichiopsidae.]

Generic Names with Index Numbers

Beyrichiella—18
Beyrichiopsis—19
Dizygopleura—3
Eukloedenella—1
Evlanella—15
Geffenina—20
Geisina—13
Glyptopleura—22
Glyptopleurina—25
Hypotetragona—6
Kalugia—11
Kloedenella—2
Kloedenellitina—8
Knoxina—14
Knoxites—7
Lichvinia—17
Mennerella—9
Miltonella—26
Oliganisus—23
Poloniella—5
Pseudoleperditia—16
Sanniolus—27
Sansabella—24
Savagellites—21
Svantovites—4
Tambovia—10
Trinota—12

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