rine Research, Mem., no. 2, xiv+647 p. (New Haven).

Wenz, W.

(105) 1938-44, *Gastropoda. Allgemeiner Teil und Prosobranchia:* Handbuch der Paläozoologie, ed. O. H. SCHINDEWOLF, v. 6, pts 1-7, 1639 p.; Teil 1, 1938; 2, 1938; 3, 1939; 4, 1940; 5, 1941; 6, 1943; 7, 1944 (Berlin).

(106) 1940, *Ursprung und frühe Stammesgeschichte der Gastropoden:* Archiv f. Molluskenkunde, v. 72, p. 1-10 (Frankfurt a. M.).

Woodward, S. P.

(107) 1851-56, *A manual of the Mollusca:* pt. 1, viii+158 p., pl. 1-12, 1851; pt. 2, xii+330 p., pl. 13-24, 1854; pt. 3, xvi+486 p., 1856 (London).

Wrigley, Arthur

(108) 1934, *English Eocene and Oligocene Cassididae, with notes on the nomenclature and morphology of the family:* Malac. Soc. London, Proc., v. 21, p. 108-130, pl. 15-17.

(109) 1948, *The colour patterns and sculpture of molluscan shells:* Same, v. 27, p. 206-217.

(110) 1949, *The Structure of the calcareous operculum of Natica:* Same, v. 28, p. 23-26.

Yonge, C. M.

(111) 1938, *Evolution of ciliary feeding in the Prosobranchia, with an account of feeding in Capulus ungaricus:* Marine Biol. Assoc., v. 22, p. 453-468 (Cambridge).

(112) 1947, *The pallial organs in the aspidobranch Gastropoda and their evolution throughout the Mollusca:* Philos. Trans. Roy. Soc., ser. B, v. 232, p. 443-518 (London).

Zittel, K. A. von

(113) 1881-85, *Mollusca und Arthropoda:* Handbuch der Palaeontologie, pt. 1 (Palaeozoologie), v. 2, 893 p. (München, Leipzig).

SOURCES OF ILLUSTRATIONS

(114) **Adams, Arthur, & Reeve, L.**
(115) **Cox, L. R.**
(116) **Dall, W. H.**
(117) **Delpey, Geneviève**
(118) **Edwards, F. E.**
(119) **Haller, Béla**
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(121) **Hudleston, W. H.**
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(124) **Kobelt, Wilhelm**
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(128) **Orbigny, Alcide d'**
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SYSTEMATIC DESCRIPTIONS

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INTRODUCTION

The authorship of this section, mainly concerned with the Archaeogastropoda, is as follows: All genera with Paleozoic type species by J. B. KNIGHT, R. L. BATTEN & E. L. YOCHELSON; all genera with Mesozoic type species by L. R. Cox; Cenozoic Pleurotomariidae, Haliotidae, and Neritopsidae by L. R. Cox; Cenozoic Fissurellidae and Scissurellidae by MYRA KEEN aided in part by GRACE JOHNSON; Phasianellidae by ROBERT ROBERTSON; all other genera with Cenozoic type species by MYRA KEEN. Contributions have been integrated by L. R. Cox.

Acknowledgments for advice on various matters relating to Recent gastropods are made to Prof. ALASTAIR GRAHAM, Dr. D. R. CROFTS, Dr. VERA FRETTER, Dr. J. E. MORTON, and Dr. H. BURRINGTON BAKER. Also, appreciation is expressed to Mrs. Nancy Lou Patterson, who prepared most of the drawings on Paleozoic gastropods in systematic portions of the text and to Miss M. F. PRIOR, Miss L. RIPLEY, Mrs. SALLY KAICHER, and the late Mr. G. L. WILKINS for work on other illustrations. Prof. JEAN ROGER of Paris kindly loaned specimens of *Michaletia semigranulata* and *Cochleochilus cottaldinus*. Dr. N. D. NEWELL supplied photographs of type specimens of *Paraeuryalox, Hesperocirrus,* and *Sororcula*.

Class GASTROPODA Cuvier, 1797

[*nom. correct.* DUMÉRIL, 1806, *pro* 'gastéropodes' CUVIER, 1797, invalid vernacular name, *nom. auct. conserv.* proposed COX, 1958 (ICZN pend.)] [=*Gasteropodia*+*Spironotia* RAFINESQUE, 1815; Gasteropoda SCHWEIGGER, 1820 (also GOLDFUSS, 1820); Gasteropodophora GRAY, 1821; Paracephalophora DE BLAINVILLE, 1824; Gastraeopoda BECK, 1837; Pselaphocephala BRONN, 1862; Gasterozoa THIELE, 1926]

Definition of the class has been given in a foregoing section (p. *186*). *L.Cam.-Rec.*

Subclass PROSOBRANCHIA Milne Edwards, 1848

[*nom. emend.* KEFERSTEIN, 1863 (*pro* Prosobranchiata *nom. correct.* S. P. WOODWARD, 1851, also MORRIS and LYCETT, 1851, *pro* 'prosobranches' MILNE EDWARDS, 1848, invalid vernacular name), *nom. auct. conserv.* proposed Cox, 1958 (ICZN pend.)] [=Ctenobranchiata SCHWEIGGER, 1820, *extent.* GRAY, 1840; Streptoneura SPENGEL, 1881]

Gastropoda displaying full effects of larval torsion in that auricle (or auricles), together with ctenidium (or ctenidia) when present, lie anterior to ventricle; visceral nerve cords cross, one from right pleural ganglion to left side passing above and one from left pleural ganglion to right side passing below alimentary canal; mantle cavity open to front, containing, on right side, anteriorly directed rectum and anus. Except in a few forms, mantle cavity also contains either one ctenidium and osphradium, lying on left side, or paired but rarely equal ctenidia and osphradia. Head with single pair of tentacles. Sexes distinct except in a few genera. Operculum commonly but not invariably present. Shell of many shapes, absent only rarely. Habitat marine, fresh-water, or terrestrial. *L.Cam.-Rec.*

Order ARCHAEOGASTROPODA Thiele, 1925

[=Scutibranches CUVIER, 1817 (*partim*); Scutibranchia GOLDFUSS, 1820, restricted FISCHER, 1885; Aspidobranchiata SCHWEIGGER, 1820, *extent.* PELSENEER, 1893; Diotocardia MÖRCH, 1865]

Prosobranchia in which ctenidia (present in all but a few genera) are "aspidobranch" (i.e., bipectinate, with filaments alternating on two sides of axis) and free at front end; ctenidia and osphradia paired in more primitive families, otherwise single. No siphon or proboscis. Heart with two auricles, except in Patellacea and Helicinidae. Kidneys two, except in Patellacea and Neritacea, the right large, the left reduced. Gonoduct, except in Neritacea, opening in both sexes into right kidney, genital products being thence discharged by way of ureter and mantle cavity into the sea; male thus without prostate and penis. Nervous system not concentrated, pedal cords ladder-like. Inner layers of shell nacreous in many but not all genera. Habitat marine (except some Neritacea). *L. Cam.-Rec.*

Suborder BELLEROPHONTINA Ulrich & Scofield, 1897

[*nom. correct.* Cox & KNIGHT (*ex* Bellerophontacea ULRICH & SCOFIELD, 1897, subordinal name)] [=Prorhipidoglossa, Amphigastropoda SIMROTH, 1906; Planspiralia, Belleromorpha NAEF, 1911]

Shell most commonly isostrophic, rarely slightly asymmetrical; mostly closely coiled, but in some genera cyrtiform; predominantly with median labral sinus or slit, or tremata, probably exhalant in function and usually generating a selenizone; shell wall of variable thickness, no evidence of nacre; operculum unknown; presence of paired and equal ctenidia and osphradia, also of single pair of retractor muscles, inferred (latter from muscle scars); nothing known of other soft parts. *L.Cam.-L.Trias.*

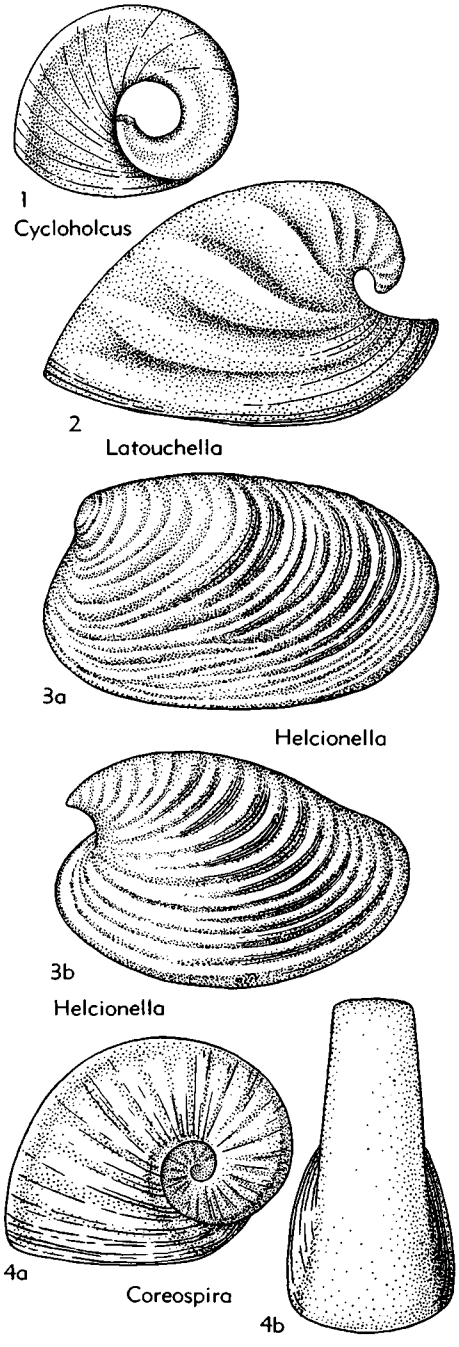


FIG. 89. Helcionellacea (Helcionellidae, Coreospiridae) (p. I172).

Superfamily HELCIONELLACEA Wenz, 1938

[*nom. transl.* KNIGHT, BATTEN & YOCHELSON, herein (*ex* Helcionellinae WENZ, 1938)]

Cap-shaped to coiled bellerophontiform shells; commonly with strong rugae clearly defined on both interior and exterior; with septum or septa partitioning off the apex. *L.Cam.-U.Cam.*

Family HELCIONELLIDAE Wenz, 1938

[*nom. transl.* KNIGHT, BATTEN & YOCHELSON herein (*ex* Helcionellinae WENZ, 1938)]

Elongate cap-shaped shells lacking a train; apex not central, presumably posterior. *L.Cam.-U.Cam.*

Helcionella GRABAU & SHIMER, 1909 [*Metoptoma? rugosa* HALL, 1847 =*Helcion subrugosa* D'ORBIGNY, 1850, *pro H. rugosa* (HALL) D'ORBIGNY, 1850, *non H. rugosa* J.SOWERBY, 1817)] [?=*Quilcanella* RUSCONI, 1952 (125, p. 86); ?*Pichynella* RUSCONI, 1954 (125, p. 2)]. Shell moderately low to high cap-shaped, with very strong concentric rugae; muscle scars unknown. *Cam.*, N.Am.-N.Afr.-NE.Asia. —— FIG. 89,*3*. **H. subrugosa* (D'ORBIGNY), L.Cam., N.Y.; *3a,b*, individuals showing extremes in variation, ×3.3.

Family COREOSPIRIDAE Knight, 1947

Shell with complete or incomplete coiling; no anal emargination; flattened, with nearly rectangular cross section; with posterior trainlike extension of shell margin. *L.Cam.-U.Cam.*

Latouchella COBBOLD, 1921 [**L. costata*] [=*Oelandia* WESTERGÅRD, 1936]. Cap-shaped, with apex curved backward; surface with strong collabral rugae; much resembles *Helcionella* except for its posterior train and inferred orientation (16, p. 366). *Cam.*, N.Am.-Eu.-NE.Asia.——FIG. 89,*2*. *L. pauciplicata* (WESTERGÅRD), M.Cam., Swed.; left side; ×4.

Coreospira SAITO, 1936 [**C. rugosa*]. Tightly coiled, loosely coiled, or whorls barely in contact; disclike, outer whorl face flattened and with protruding margin; surface with collabral rugae or growth lines. *L.Cam.-M.Cam.*, N.Am.-NE.Asia. —— FIG. 89,*4*. **C. rugosa*, L.Cam., Korea; *4a,b*, left side, anterior, both ×10.

Cycloholcus KNIGHT, 1947 [**C. nummus*]. Disclike, possibly with pierced umbilici; sides with a rounded groove (73, p. 5). *U.Cam.*, N.Am.—— FIG. 89,*1*. **C. nummus*, Tenn.; ×2.7.

Superfamily BELLEROPHONTACEA M'Coy, 1851

[*nom. transl.* WENZ, 1938 (*ex* Bellerophontidae M'COY, 1851)]

Characters as defined for suborder, but invariably with median emargination or tremata. *U.Cam.-L.Trias.*

Although the soft parts of bellerophont gastropods have never been observed, their shells are very similar in many respects to those of the pleurotomarians and show significant homologies with them. As with pleurotomarians, the bellerophont shell typically consists of a long narrow tube (the helicocone) which expands from a point and is coiled loosely on itself. In both groups an anal emargination occurs close to the middle of the labrum. In view of this fact, it is difficult to avoid the conclusion that the internal anatomy of the bellerophonts was very much like that of the pleurotomarians. The groups differ in that the coiling of the bellerophont shell is isostrophic, whereas the pleurotomarian shell is conispiral. The living pleurotomarians retain vestiges of primitive symmetry, for both members of bilaterally paired internal organs, such as ctenidia, are in general developed, although not equally. In this respect they differ from all other living gastropods. Because the bellerophonts appear earlier in the fossil record the vestigial symmetry was probably expressed more fully in them, a view supported by the bilaterally symmetrical shell. Indeed, it seems probable that the degree of bilateral symmetry was as high as could be consistent with torsion in early ontogeny (Fig. 57, *Knightites*).

The bilateral symmetry of the shell has led some workers to infer that torsion did

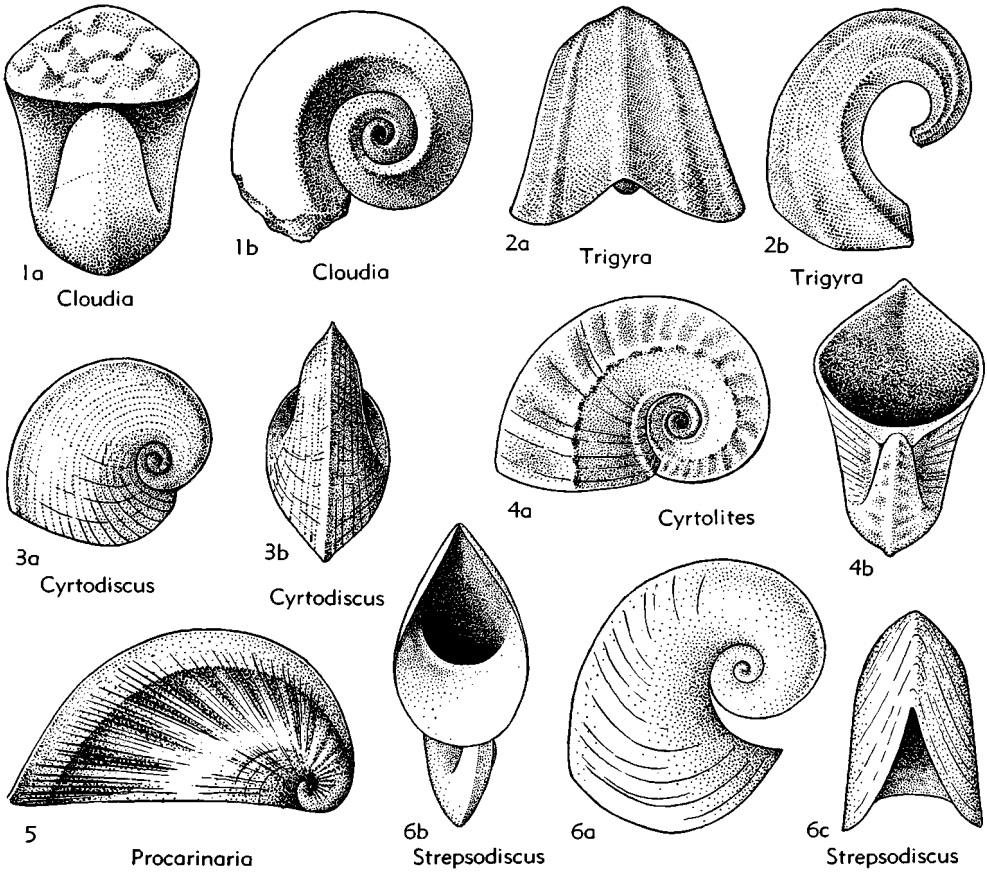


FIG. 90. Bellerophontacea (Cyrtolitidae) (p. *I*174-*I*175).

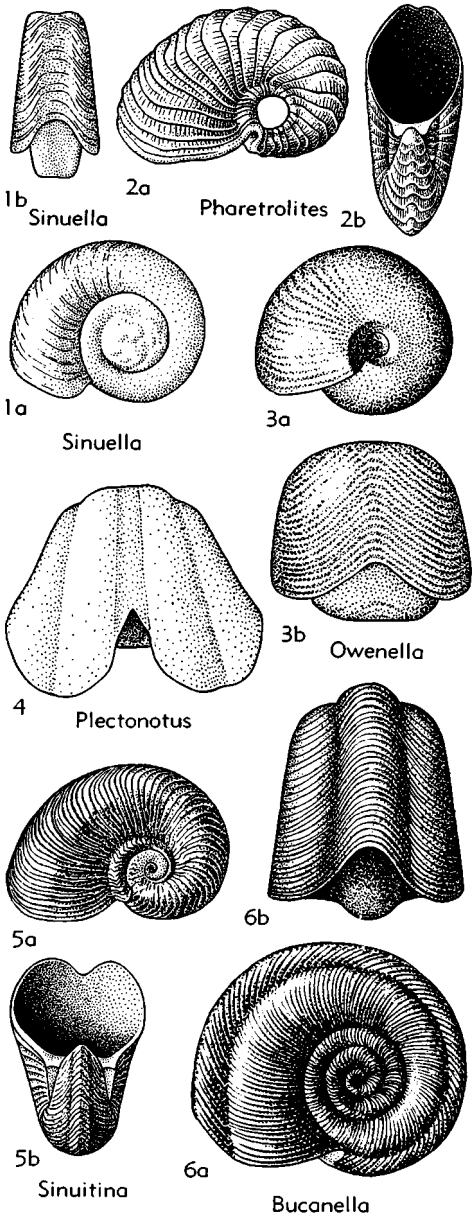


FIG. 91. Bellerophontacea (Sinuitidae——Bucanellinae). (p. *I*175)

not take place in the bellerophonts as it does in Pleurotomariacea and all other Anisopleura (SIMROTH, 1906; WENZ, 1940; MOORE, in MOORE, LALICKER & FISCHER, 1952; BOETTGER, 1955). If this were true, the shell would have been carried by bellerophont gastropods with the outer lip and anal emargination behind, an orientation quite opposite to that of the pleurotomarians, which resemble the bellerophonts so closely in other respects. The massive coil, which is commonly accompanied by an even more massive parietal inductura, would then have been poised above the head, in the position termed "exogastric" by some authors. This would have presented mechanical difficulties of no small magnitude for an animal moving about with its shell, and it is hard to see how the head and foot could have been withdrawn into the shell.

Apparently these authors were misled by the belief that torsion originally took place after development of adult musculature. CROFTS (1955) has shown that the larval left-hand muscle, the right-hand (columellar) muscle of the adult, had not begun to develop until after torsion had reached 90 degrees, so that torsion was not the cause of asymmetrical coiling.

For these reasons the Bellerophontacea are thought to have undergone torsion although they had a symmetrically coiled shell (76). They are here classed in the Prosobranchia and interpreted as the earliest and most primitive Archaeogastropoda. Because of their apparent affinities with the pleurotomarians, it is suggested that they were not only aspidobranch, but also rhipidoglossate, feeding chiefly on vegetable matter.

Family CYRTOLITIDAE S. A. Miller, 1889

[?=Procarinariidae WENZ, 1938]

Anal emargination a shallow sinus, commonly angular but without slit or selenizone; coiling generally open, especially in adult whorls. *U.Cam.-L.Sil.*

Strepsodiscus KNIGHT, 1948 [**S. major*]. Anal emargination a deep angular sinus; coiling slightly asymmetrical, with closely coiled early whorls protruding toward left, last whorl disjunct, all whorls sharply crested; has posterior train; growth lines are only surface features known (75, p. 3). *U.Cam.*, N.Am.——FIG. 90,*6*. **S. major*, Colo.; *6a-c*, left side, apertural, anterior views, ×1.3.

Cloudia KNIGHT, 1947 [**C. buttsi*]. Anterior lip with gently curved sinus; coiling close, with wide, steep umbilici; whorl section lozenge-shaped, with sharply rounded lateral angles; ornament unknown (73, p. 5). *U.Cam.*, N.Am.——FIG. 90,*1*. **C. buttsi*, Ala.; *1a,b*, apertural and left sides of steinkern, ×1.

Trigyra RAYMOND, 1908 [**T. ulrichi*]. Anterior

emargination shallow, V-shaped; coiling disjunct; 5 strong spiral costae on outer whorl surface, comprising a single median one, 2 on outer angles, and 2 about midway between the others; surface marked by 2 sets of fine obscure threads that cross one another. *M.Ord.*, N.Am.——Fig. 90,2. **T. ulrichi*, Vt.; *2a,b*, anterior and left side, ×2.

Cyrtolites Conrad, 1838 [**C. ornatus*] [=*Microceras*, Hall, 1845]. Anterior lip with somewhat shallow, angular sinus, aperture quadrate, whorls barely in contact or possibly disjunct in some species; with sharp median carina and pair of lateral ridges; umbilici widely open; ornament wide collabral undulations and fine cancellating threads. *M.Ord.-L.Sil.*, N.Am.-Eu.——Fig. 90,4. **C. ornatus*, U.Ord., N.Y.; *4a,b*, left side and apertural views, ×2.

Cyrtodiscus Perner, 1903 [**Oxydiscus (Cyrtodiscus) procer*; SD Knight, 1937]. Anterior lip with shallow V-shaped sinus; coiling discoidal with whorls seemingly in contact; ornament spiral threads or wanting. *M.Ord.-U.Ord.*, N.Am.-Eu.-Asia.——Fig. 90,3. **C. procer* (Perner), Ord., Czech.; *3a,b*, left side and adapertural views, ×2.

?Procarinaria Perner, 1911 [**Carinaria bohemica* Perner, 1903]. Anterior lip sharply angular but without sinus; whorls enlarging very rapidly, angular above, with high, thin carina; ornament collabral undulations. *U.Sil.*, Eu.——Fig. 90,5. **P. bohemica* (Perner), Czech.; left side, ×2.

Family SINUITIDAE Dall in Zittel-Eastman, 1913

[=Protowarthiidae Ulrich & Scofield, 1897 (ICZN pend.)]

Anal emargination mostly an open U-shaped sinus but narrowing to a broad slit in some advanced Euphemitinae. *U.Cam.-M.Perm.*

Subfamily BUCANELLINAE Koken, 1925

[*nom. transl.* Knight, Batten & Yochelson, herein (*ex* Bucaniellidae Koken, 1925)]

Sinus relatively small; phaneromphalous; surface marked by fine, sharp collabral or spiral threads. *U.Cam.-M.Perm.*

Owenella Ulrich & Scofield, 1897 [**Bellerophon antiquatus* Whitfield, 1878]. Rounded, as wide as long, umbilici narrow. *U.Cam.*, N.Am.——Fig. 91,3. **O. antiquata* (Whitfield), Wis.; *3a,b*, left and anterior side, ×3.3.

Sinuella Knight, 1947 [**S. minuta*]. Small, narrow, with shallow peripheral groove; umbilici wide (73, p. 8). *U.Cam.*, N.Am.——Fig. 91,1. **S. minuta*, Tex.; *1a,b*, left and anterior sides, ×20.

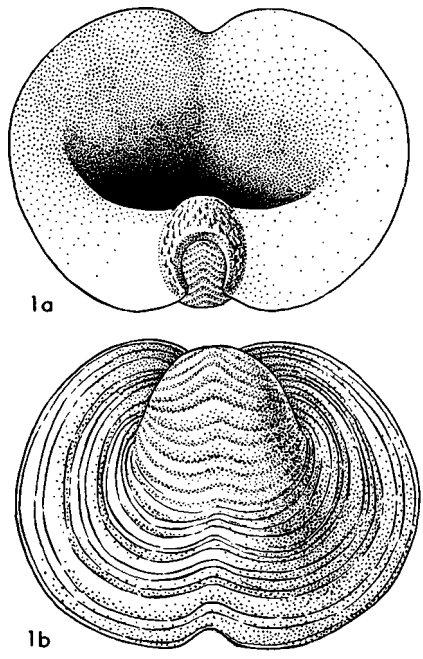
Bucanella Meek, 1871 [**B. nana*]. With 3 spiral lobes, the central more prominent than the lateral ones. *Ord.-Dev.*, N.Am.-S.Am.-Eu.-N.Afr.

B. (Bucanella) [=*Bucaniella* Koken, 1896 (obj.); *Tritonophon* Öpik, 1953]. Spiral lobes clearly marked, umbilici wide. Ornament transverse in earlier species, spiral in later ones. *L.Ord.-Dev.*, N.Am.-Eu.——Fig. 91,6. **B. (B.) nana*, L.Ord., Colo.; *6a,b*, left and anterior sides, ×5.3.

B. (Plectonotus) Clarke, 1899 [**P. derbyi*; SD Clarke, 1913]. Sinus relatively narrow, pointed; pseudoselenizone bordered by faint threads; central lobe broad, indistinct; umbilici narrow; ornament unknown. *Dev.*, N.Am.-S.Am.-Eu.-N.Afr.——Fig. 91,4. **B. (P.) derbyi* (Clarke), Brazil; anterior side of steinkern, ×1.

Pharetrolites Wenz, 1943 [**Cyrtolites pharetra* Lindström, 1884]. Anterior lip with shallow angular sinus; discoidal coil with few whorls and wide, pierced umbilici; ornament collabral imbricating lamellae (147, p. 1941). *M.Sil.*, Eu.——Fig. 91,2. **P. pharetra* (Lindström), Gotl.; *2a,b*, left and apertural sides, ×2 (90).

Sinuitina Knight, 1945 [**Tropidocyclus cordiformis* Newell, 1935]. Moderately narrow; central lobe narrow, not sharply delimited; a small channel within a narrow ridge surrounding the narrow open umbilici (71, p. 333). *Sil.-M.Perm.*, N.Am.-Eu.——Fig. 91,5. **S. cordiformis* (Newell), U. Penn., Kan.; *5a,b*, left and apertural sides, ×2.



Ptomatis

Fig. 92. Bellerophontacea (Sinuitidae——Sinuitinae) (p. 1177).

Subfamily SINUITINAE Dall in Zittel-Eastman, 1913

[*nom. transl.* Knight, Batten & Yochelson, herein (*ex* Sinuitidae Dall, 1913)]

Sinus relatively wide. *U.Cam.-M.Dev.*

Anconochilus Knight, 1947 [**A. barnesi*]. Lateral

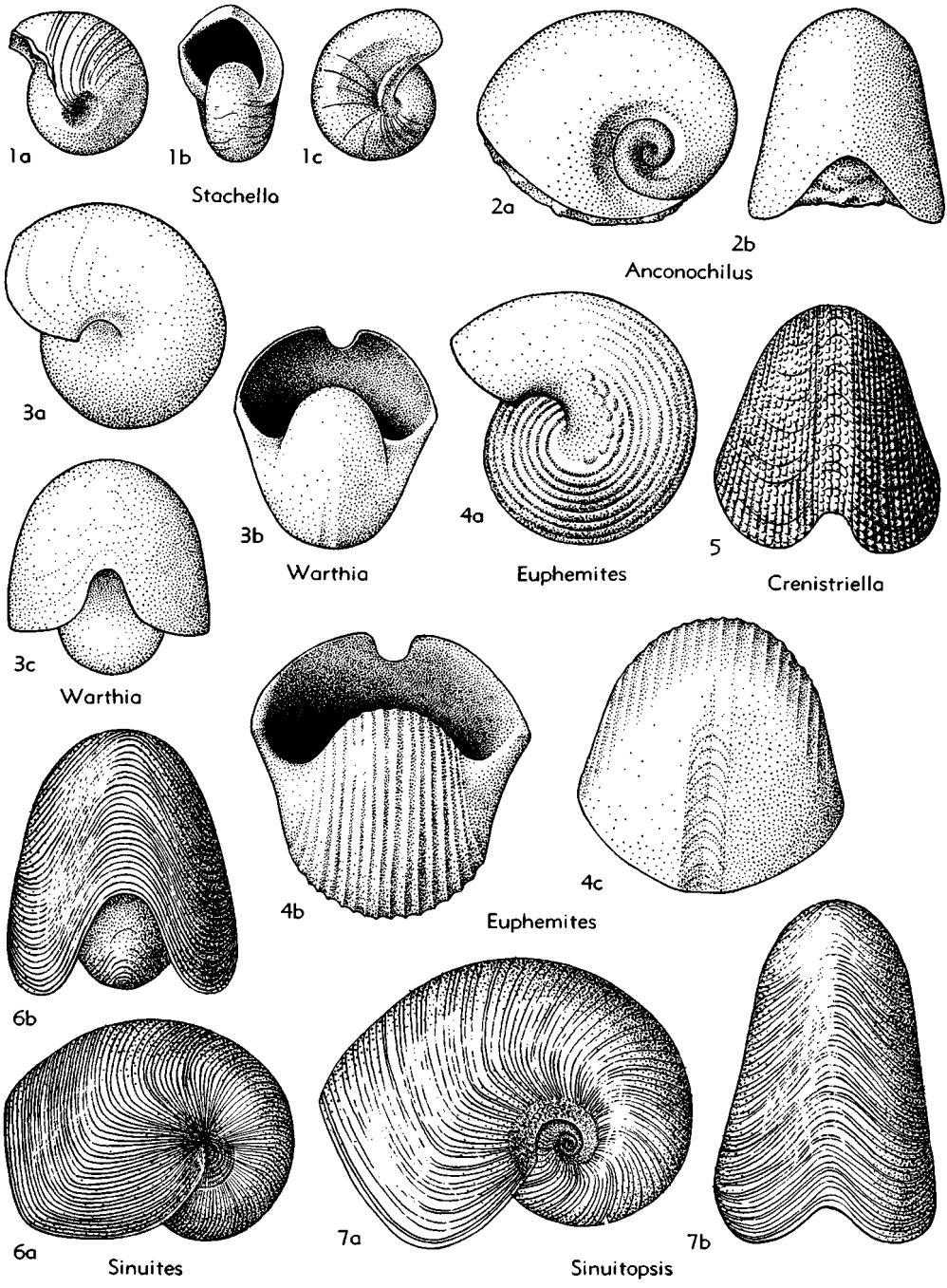


FIG. 93. Bellerophontacea Sinuitidae——Sinuitinae, Euphemitinae) (p. *I*175-*I*179).

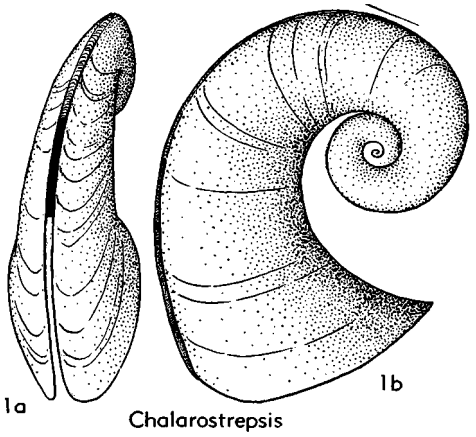


FIG. 94. Bellerophontacea (Bellerophontidae—— Tropidiscinae) (p. 1179).

lips merging into a posterior train; surface features unknown (73, p. 7). *U.Cam.*, N.Am.——FIG. 93, *2*. **A. barnesi*, Tex.; *2a,b*, left and anterior sides, ×1.

Sinuites KOKEN, 1896 [**Bellerophon bilobatus* SOWERBY, 1839; SD BASSLER, 1915]. Lateral lips lobelike, close to sides; bases of columellar lips surrounded by a delicate inductura. *Ord.*, N.Am.-Eu.-N.Afr.-NE.Asia.

S. (Sinuites) [=*Protowarthia* ULRICH & SCOFIELD, 1897; *Discolites* EMMONS, 1855 (*non* MONTFORT, 1808)]. Relatively wide, anomphalous. *Ord.*, N. Am.-Eu.-N.Afr.——FIG. 93,*6*. **S. (S.) bilobatus* (SOWERBY), M.Ord., Eng.; *6a,b*, left and anterior sides, ×1.5.

S. (Sinuitopsis) PERNER, 1903 [**S. neglecta*; SD COSSMANN, 1904]. Rather narrow, with shallow open umbilici. *U.Ord.*, Eu.-NE.Asia.——FIG. 93, *7*. **S. (S.) neglecta*, Czech.; *7a,b*, left and anterior sides, ×2.

Ptomatis CLARKE, 1899 [**Bellerophon patulus* HALL, 1843; SD PERNER, 1903] [=*Fuchsella* SPRIESTERSBACH, 1942 (133, p. 156)]. Anterior sinus shallow, wide; apertural margins widely explanate; parietal inductura (in type species) moderately thick, bearing longitudinal pustules, lacking behind, as though abraded; collabral ornament of growth lines and undulations, *M.Dev.*, N.Am.-S.Am.-S.Afr.——FIG. 92,*1*. **P. patulus* (HALL), N.Y.; *1a,b*, apertural and abapertural sides, ×1.3.

Crenistriella KNIGHT, 1945 [**Bellerophon crenistria* HALL, 1879]. Lateral lips gently convex in side view; shallow peripheral depression; ornament many spiral rows of fine pustules (71, p. 344). *M.Dev.*, N.Am.——FIG. 93,*5*. **C. crenistria* (HALL), N.Y.; anterior side, ×3.

Subfamily EUPHEMITINAE Knight, 1956

Sinus relatively narrow, almost a slit in more advanced species; anterior lip thin, joining at sharp angle the thickened lateral lips, which are close to the sides; shell exterior entirely covered by inductural layers which comprise the perinductura (102), secreted by an anterior flap of the mantle, and the inductura proper, parietal in position and secreted by a posterior lobe of the mantle that extends over the perinductura for a considerable distance beyond the aperture; in some species, a third layer (coinductura, 102) forms a parietal thickening over

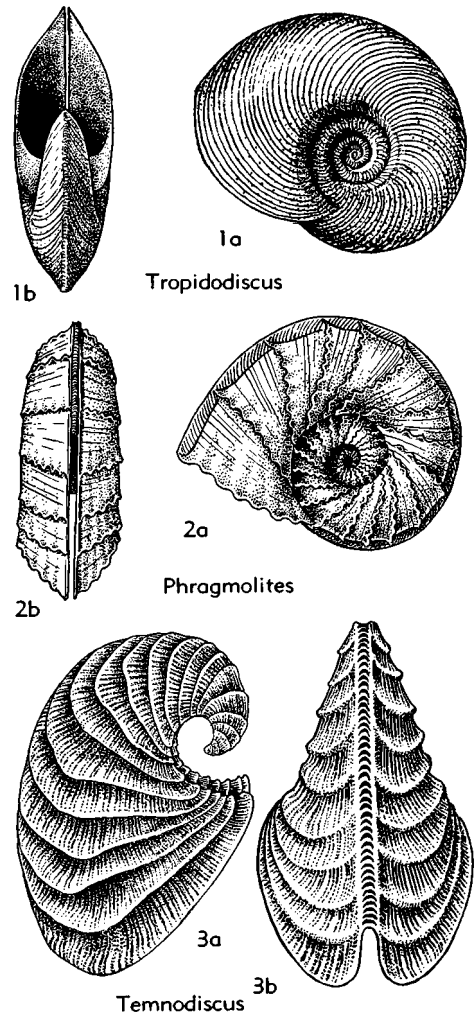


FIG. 95. Bellerophontacea (Bellerophontidae—— Tropidiscinae) (p. 1179).

the inductura proper within the aperture; a more or less broad selenizone occurs but is generally obscured by the perinductura. *?Dev., Miss.-Perm.*

Euphemites WARTHIN, 1930 [*pro Euphemus* M'COY, 1844 (*non* LAPORTE-CASTELNAU, 1836)] [**Bellerophon urii* FLEMING, 1828; SD WAAGEN, 1880]. Numerous (approximately 10) more or less strong sharp spiral cords on parietal inductura, reaching far within whorls and commonly continuing with inductura over exterior rather more than a half volution; similar cords on coinductura where this layer is present; perinductural pustules occur in some species. *?Dev., L.Carb.(Miss.)-Perm.*, Eu.-N.Am.-S.Am.-N.Afr.-Asia.——FIG. 93,*4*. **E. urii* (FLEMING), L.Carb., Scot.; *4a-c*, left, apertural, abapertural sides, ×2.7.

Warthia WAAGEN, 1880 [**W. brevisinuata*; SD DE KONINCK, 1882]. Closely resembles *Euphemites* but lacks ornament. *U.Carb.(Penn.)-M.Perm.*, Asia-Austral.-N.Am. —— FIG. 93,*3*. *W. polita*

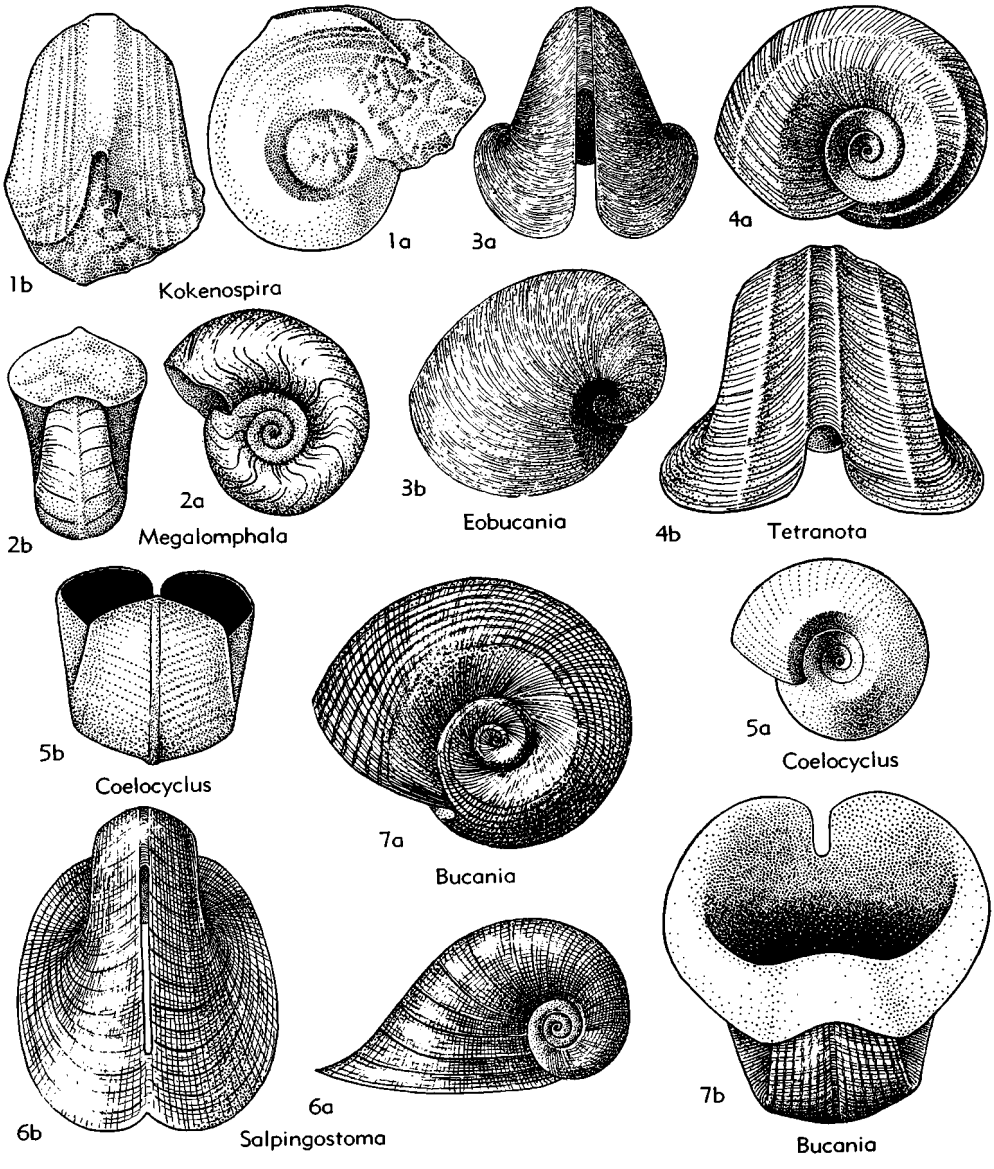


FIG. 96. Bellerophontacea (Bellerophontidae——Bucaniinae) (p. *I*179-*I*180).

WAAGEN, Perm., India; *3a-c,* left, apertural, anterior sides, ×4.

?**Stachella** WAAGEN, 1880 [**Bellerophon pseudohelix* STACHE, 1877; SD DEKONINCK, 1883]. Slightly asymmetrical; no ornament except growth lines; organization of shell layers unknown. *L. Perm.-M.Perm.,* Eu.-SE.Asia.——FIG. 93,*1.* **S. pseudohelix* (STACHE), *M.Perm.,* Ger.; *1a-c,* left, apertural, right sides, ×1 (134).

Family BELLEROPHONTIDAE M'Coy, 1851

Anal emargination generally consisting of a slit. *U.Cam.-L.Trias.*

Subfamily TROPIDODISCINAE Knight, 1956

Coil narrow, with wide umbilici; slit deep; commonly with a definite posterior train. *U.Cam.-Dev.*

Chalarostrepsis KNIGHT, 1948 [**C. praecursor*]. Last half whorl disjunct; slit deep; no ornament except growth lines (76, p. 5). *U.Cam.,* N.Am.——FIG. 94,*1.* **C. praecursor,* Can.(Que.); *1a,b,* oblique anterior, left side, ×2.7.

Tropidodiscus MEEK & WORTHEN, 1866 [*pro Tropidiscus* MEEK, 1866 (*non* STEIN, 1855)] [**Bellerophon curvilineatus* CONRAD, 1842] [=*Tropidocyclus* DEKONINCK, 1882 (obj.); *Oxydiscus* KOKEN, 1889 (obj.); *Zonidiscus* SPITZ, 1907; *Joleaudella* PATTE, 1929]. Lenticular, with acuminate periphery; slit deep, narrow, selenizone narrow; ornament collabral lines or imbricating lamellae. *L. Ord.-Dev.,* N.Am.-S.Am.-Eu.-Asia.——FIG. 95,*1.* **T. curvilineatus* (CONRAD), L.Dev., N.Y.; *1a,b,* left and apertural sides, ×1.3.

Phragmolites CONRAD, 1838 [**P. compressus*] [=*Conradella* ULRICH & SCOFIELD, 1897]. Whorls more or less rounded; apertural margins flaring periodically to form narrow, strongly scalloped varices; deep, narrow slit between low, sharp keels which are joined at top by the selenizone; ornament obscure spiral threads. *M.Ord.-U.Ord.,* N. Am.-Eu.——FIG. 95,*2. P. obliqua* (ULRICH & SCOFIELD), M.Ord., Minn.; *2a,b,* left and anterior sides, ×2.7.

Temnodiscus KOKEN, 1896 [**Cyrtolites lamellifer* LINDSTRÖM, 1884; SD REED, 1920] [=*Cyrtolitina* ULRICH in ULRICH & SCOFIELD, 1897 (obj.)]. Whorls disjunct; slit moderately deep; varices formed by rather strong foliaceous periodic expansions of lateral lips; ornament numerous spiral cords. *M.Ord.-Sil.,* N.Am.-Eu.——FIG. 95,*3.* **T. lamellifer* (LINDSTRÖM), M.Sil., Gotl.; *3a,b,* left and anterior sides, ×2.7.

Subfamily BUCANIINAE Ulrich & Scofield, 1897

[*nom. transl.* KNIGHT, BATTEN & YOCHELSON, herein (*ex* Bucaniidae ULRICH & SCOFIELD, 1897)] [=Salpingostominae KOKEN, 1925]

Apertural margins tending to flare; umbilici open; mostly with slit and selenizone, but some with slit not continuing into the apertural expansion and others with a series of tremata. *L.Ord.-Dev.*

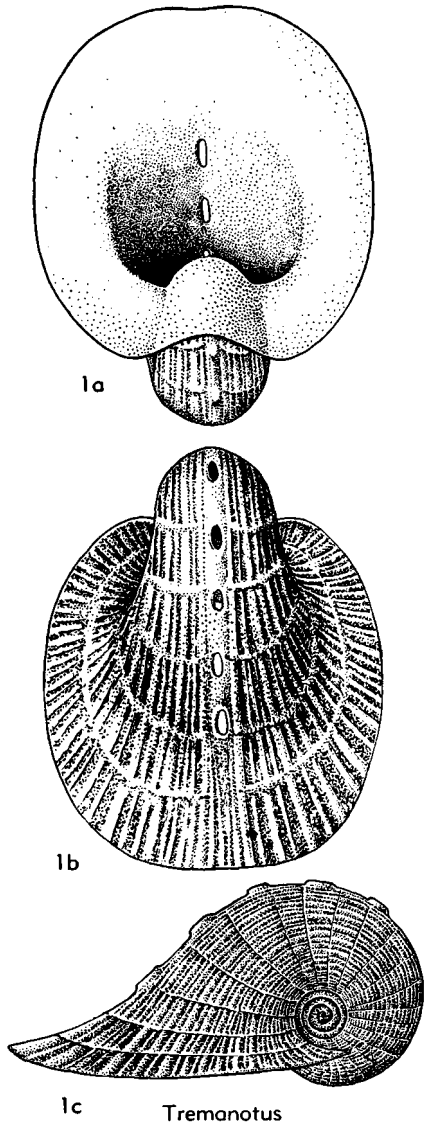


FIG. 97. Bellerophontacea (Bellerophontidae—— Bucaniinae) (p. *1180*).

Tribe BUCANIIDES Ulrich & Scofield, 1897

[*nom. transl.* KNIGHT, BATTEN & YOCHELSON, herein (*ex* Bucaniidae ULRICH & SCOFIELD, 1897)]

Exhalant emargination a short slit. *M. Ord.-Dev.*

Eobucania KOBAYASHI, 1955 [**E. pulchra*]. With few rapidly expanding whorls, apertural margin

with moderately deep slit, slightly concave selenizone between pair of threads on slight dorsal elevation; ill-defined angulation marking off lateral from posterior slopes; aperture flaring slightly at angulation (78, p. 404). L.Ord., N.Am.——Fig. 96,*3*. **E. pulchra,* Can.(B.C.); *3a,b,* anterior and left sides, ×4 (Kobayashi).

Bucania Hall, 1847 [**Bellerophon sulcatinus* Emmons, 1842; SD Waagen, 1880] [=*?Tubogyra* Perner, 1903; *Loxobucania* Knight, 1942 (70, p. 487)]. Aperture but little, if at all, expanded, wider than long, especially at rear; ornament spiral threads, or threads normal to anterior margin and converging forward, or both types of threads crossing to form a pitted surface. *M.Ord.-Sil.,* N.Am.-Eu.-NE.Asia.——Fig. 96,*7*. **B. sulcatina* (Emmons), M.Ord., N.Y.; *7a,b,* left and apertural sides, ×1.3.

Tetranota Ulrich & Scofield, 1897 [**Bucania bidorsata* Hall, 1847]. Resembles *Bucania* in form but selenizone lies on low crest between pair of spiral cords; some species with additional spiral cords on slopes between crest and circumumbilical angle; ornament collabral threads. *M. Ord.-U.Ord.,* N.Am.-Eu.——Fig. 96,*4*. **T. bidorsata* (Hall), M.Ord., N.Y.; *4a,b,* left and anterior sides, ×2.7.

Kokenospira Bassler, 1915 [*pro Kokenia* Ulrich & Scofield, 1897 (*non* Holzapfel, 1895)] [**Bucaniella esthona* Koken, 1889]. Resembles *Tetranota* but has higher whorls and narrower umbilici; spiral cords more numerous and smaller. *M.Ord.-U.Ord.,* N.Am.-Eu.——Fig. 96,*1*. **K. esthona* (Koken), Ord. (float), Ger., *1a,b,* right side and anterior view of steinkern, ×1.3.

?Megalomphala Ulrich & Scofield, 1897 [**Bellerophon contortus* Eichwald, 1860]. Like *Bucania* but lacks spiral sculpture. *M.Ord.-Dev.,* N.Am.-Eu.——Fig. 96,*2*. **M. contorta* (Eichwald), M. Ord., Est.; *2a,b,* left and apertural sides, ×1 (37).

Coelocyclus Perner, 1903 [**Bellerophon (Coelocyclus) rarissimus*]. Like *Bucania* but with umbilical slopes conforming to uniform conical slope and without spiral ornament. *M.Sil.-M.Dev.,* N.Am.-Eu.——Fig. 96,*5*. *C. perplexus* (Walcott), M. Dev., Nev.; *5a,b,* left and apertural sides, ×0.7.

Tribe SALPINGOSTOMATIDES Koken, 1925

[*nom. transl.* Knight, Batten & Yochelson, herein (*ex* Salpingostominae Koken, 1925)]

Exhalant orifice consisting of one or more tremata. *M.Ord.-Sil.*

Salpingostoma C. F. Roemer, 1876 [**Bellerophon megalostoma* Eichwald, 1840]. Aperture expanded widely; slit a trema confined to whorl side, not extending onto lip, generating a selenizone; ornament growth lines. *M.Ord.-Sil.,* N.Am.-Eu. ——Fig. 96,*6*. *S. boulli* (Whitfield), M.Ord., Minn.; *6a,b,* left and adapertural sides, ×0.7.

Tremanotus Hall, 1865 [**T. alpheus*] [=*Trematonotus* Fischer, 1883 (obj.); *Gyrotrema* Lindström, 1884 (obj.); *Tremagyrus* Perner, 1903]. Aperture rather widely expanded at final growth stage; slit represented by a row of tremata, all but last few closed, not extending onto expanded lip; ornament spiral cords of several sizes or growth lines alone. *M.Ord.-M.Sil.,* N.Am.-Eu.-Austral.——Fig. 97,*1*. **T. alpheus,* M.Sil., N.Y.; *1a-c,* apertural, adapertural, left sides, ×0.7.

Subfamily CARINAROPSINAE Ulrich & Scofield, 1897

[*nom. transl.* Knight, Batten & Yochelson, herein (*ex* Carinaropsidae, Ulrich & Scofield, 1897)]

Shell with tendency toward rapid expansion of whorls, reduction of coiling, and generally development of parietal lip into a platelike extension; inner floor of whorls bearing a longitudinal keel; selenizone on a moderately developed dorsal crest. *?L.Ord., M.Ord.-Dev.*

Bucanopsis Ulrich, in Ulrich & Scofield, 1897 [**B. carinifera*] [=*Bucaniopsis* Reed, 1921 (obj.)]. Longitudinal keel on floor of whorls well developed but with coiling moderately reduced and parietal extension slight; ornament fine spiral threads. *M.Ord.-Sil.,* N.Am.-Eu.——Fig. 98,*1*. **B. carinifera,* M.Ord., Ky.; *1a-c,* apertural, abapertural, left sides, ×2.7.

Sphenosphaera Knight, 1945 [**Bellerophon clausus* Ulrich in Ulrich & Scofield, 1897]. Coil reduced only slightly; parietal extension moderate; longitudinal keel on floor of whorl well developed but rounded; ornament only growth lines (71, p. 334). *M.Ord.-M.Sil.,* N.Am.-Eu.——Fig. 98,*2*. **S. clausa* (Ulrich), M.Ord., Tenn.; *2a-c,* apertural, abapertural, left sides, ×1.3.

Carinaropsis Hall, 1847 [**Carinariopsis carinata* (Hall) Fischer, 1885; (=*Cyrtolites subcarinatus* d'Orbigny, 1850, *pro Cyrtolites carinatus* (Hall) Orb., 1850, *non Cyrtolites carinatus* Sowerby, 1839); SD Fischer, 1885] [=*Carinariopsis* Fischer, 1885 (obj.); *Phragmostoma* Hall, 1861]. Coil greatly reduced, parietal extension platelike; longitudinal keel on floor of whorl well developed; ornament growth lines. *M.Ord.-U.Ord.,* N.Am.-Eu. ——Fig. 98,*3*. *C. cymbula* (Hall), M.Ord., Ky.; *3a-c,* apertural, abapertural (with window), left sides, ×1.3.

Phragmosphaera Knight, 1945 [**P. miranda*]. Coil somewhat reduced, parietal extension platelike; no longitudinal keel on floor of whorl, ornament fine spiral threads (71, p. 338). *Dev.,* N.Am.——Fig. 98,*5*. **P. miranda,* M.Dev., N.Y.; *5a,b,* abapertural and apertural sides, ×1.

Gyrospira Boucot, 1956 [**G. tourteloti*]. Disjunct after first 2 whorls with aperture flaring on sides and back; slit about 0.3 whorl in depth, a gently arched selenizone on crest of whorl; surface with obscure collabral undulations (7, p. 46). *?Dev.,* S.Am.——Fig. 98,*4*. **G. tourteloti,* Bolivia; *4a,b,* right and apertural sides, ×1.3.

Subfamily PTEROTHECINAE Wenz, 1938

[*nom. transl.* KNIGHT, BATTEN & YOCHELSON, herein (*ex* Pterothecidae WENZ, 1938]

Helicocone expanding very rapidly, coil vestigial; well-developed plate within aperture suggesting that of *Crepidula* and forming a chamber that protects the visceral mass in the otherwise shallow, open shell; aperture widely explanate; selenizone on dorsal crest; ornament growth lines. *M.Ord.-M. Dev.*

Trends initiated in the Carinaropsinae seem to be perfected in this subfamily, possibly as a result of adaptation to creeping

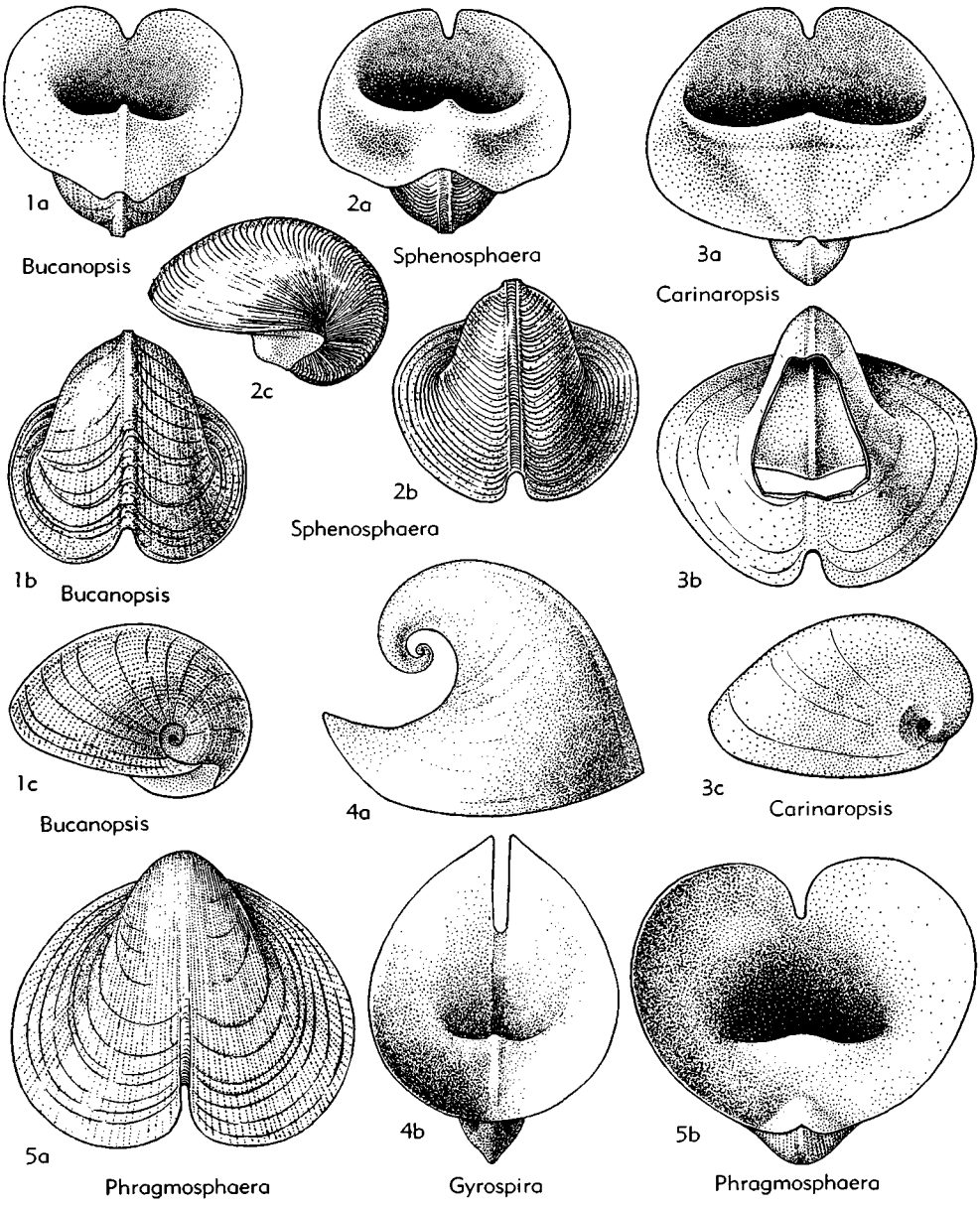


FIG. 98. Bellerophontacea (Bellerophontidae——Carinaropsinae) (p. 1180).

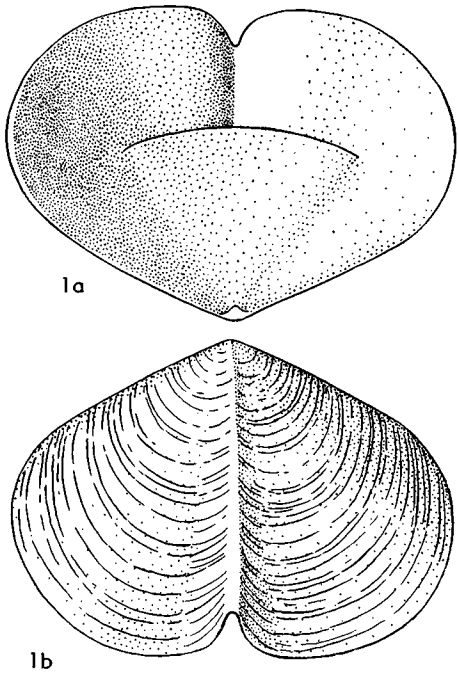


FIG. 99. Bellerophontacea (Bellerophontidae—— Pterothecinae) (p. *I*182).

about on the soft surface of very fine sediments; many fossil specimens occur in rock composed of such fine sediment.

Pterotheca SALTER, 1853 [**Atrypa transversa* PORTLOCK, 1843; SD S.A.MILLER, 1889] [=*Clioderma* HALL, 1861; *Aulacomerella* VON HUENE, 1900 (60, p. 210)]. Shell elliptical in outline; visceral chamber triangular, with a pair of short diverging septa near apex on inner surface of the apertural plate. *M.Ord.-U.Ord.*, N.Am.-Eu.——FIG. 99,*1*. **P. transversa* (PORTLOCK), Ire.; *1a,b*, apertural and abapertural sides, ×1.3.

Cyclotheca TEICHERT, 1935 [**Pterotheca bohemica* BARRANDE, 1867]. Shell roughly diamond-shaped in outline; inner surface of visceral plate with many regular, fine, transverse striae. *U.Sil.*, Eu. ——FIG. 100,*3*. **C. bohemica* (BARRANDE), Czech.; *3a,b*, abapertural and apertural sides, ×3.3.

Aspidotheca TEICHERT, 1935 [**A. schrieli*]. Shell subcircular in outline; visceral plate longitudinally quadripartite. *L.Dev.*, Eu.——FIG. 100,*1*. **A. schrieli*, Ger.; *1a,b*, apertural and abapertural sides, ×0.7.

Pedasiola SPRIESTERSBACH, 1919 [**P. rhenana*; SD KNIGHT, 1937]. Shell elliptical in outline, with raised hooklike apex; apertural plate short, stout, with median ridge and 2 lateral wings; externally with median fold bordered by a groove on each side; anal emargination and surface features not well known. *M.Dev.*, Eu.——FIG. 100,*2*. **P. rhenana*, Ger.; *2a,b*, apertural and abapertural sides, ×0.7.

Subfamily BELLEROPHONTINAE M'Coy, 1851

[*nom. transl.* KNIGHT, BATTEN & YOCHELSON, herein (*ex* Bellerophontidae M'Coy, 1851)]

Superficially resembling *Nautilus;* whorls commonly broadly rounded; umbilici narrow or absent; ornament growth lines. *M. Ord.-L.Trias.*

Cymbularia KOKEN, 1896 [**C. galeata;* SD PERNER, 1903]. Early whorls rounded but last one strongly angulated and somewhat asymmetrical in adult stage, with narrow deep slit; umbilici closed on one or both sides. *M.Ord.-M.Sil.*, N.Am.-Eu.—— FIG. 102,*1*. **C. galeata*, Ord., Est.; *1a-c*, left, apertural and anterior sides, ×1.3.

Liljevallospira KNIGHT, 1945 [**Bellerophon tubulosus* LINDSTRÖM, 1884]. Like *Bellerophon* but with backward projections from each lateral lip curving into the umbilici and nearly closing them, the projections forming on each side hollow spiral tubes that open behind the aperture (71, p. 334). *M.Sil.;* Eu.——FIG. 102,*2*. **L. tubulosus* (LINDSTRÖM), Gotl.; *2a-c*, left and apertural sides, section, ×1.5 (90).

Prosoptychus PERNER, 1903 [**Bellerophon (Prosoptychus) plebeius;* SD KNIGHT, 1937]. Like *Bellerophon* but final lateral lips somewhat explanate and columellar margins of lip thickened; parietal inductura moderately thick. *U.Sil.*, Eu.——FIG. 101,*1*. **P. plebeius* (PERNER), Czech.; *1a,b*, left and abapertural sides, ×2.

Bellerophon MONTFORT, 1808 [**B. vasulites*]. Whorls commonly broadly rounded but some may have a subdued crest. *Sil.-L.Trias.*, cosmop.

B. (Bellerophon) [=*Bellerophus* DEBLAINVILLE, 1825 (obj.); *Mogulia* WAAGEN, 1880; *Waagenia* DEKONINCK, 1882 (*non* NEUMAYR, 1878, *nec* BAYLE, 1879); *Waagenella* DEKONINCK, 1883 (*pro Waagenia* DEKONINCK, 1882); *Sphaerocyclus* PERNER, 1903]. Inductura thin, in some species laterally extended over axial region; ornament commonly growth lines. *Sil.-L.Trias.*, cosmop.—— FIG. 102,*4*. **B. (B.) vasulites*, M.Dev., Ger.; *4a-c*, apertural, anterior, left sides, ×2.

B. (Aglaoglypta) KNIGHT, 1942 [**Bellerophon koeneni* CLARKE, 1904]. Like *B. (Bellerophon)* but ornamented with quincuncially arranged pustules (70, p. 487). *M.Dev.-U.Dev.*, cosmop.—— FIG. 102,*6*. **B. (A.) koeneni* (CLARKE), M.Dev., N.Y., ×2.

B. (Pharkidonotus) GIRTY, 1912 [**Bellerophon percarinatus* CONRAD, 1842]. Like *B. (Bellerophon)* but with a strongly thickened inductura that may be padlike in shape; ornament generally collabral undulations; selenizone on crest of low dorsal ridge; no umbilici. *L.Carb.(Miss.)-Perm.*,

N.Am.-Eu.——Fig. 102,5. **B. (P.) percarinatus* (Conrad), M.Penn., Mo.; *5a-c*, apertural, left, abapertural sides, ×2.

Ptychosphaera Perner, 1903 [**P. constricta*]. Whorl with several asymmetrical constrictions at early growth stage and with slight asymmetry of coil at adult stage; a deep, angular sinus culminates seemingly in a short slit. *U.Sil.*, Eu.——Fig. 102,7. **P. constricta*, Czech.; apertural side, ×2.

?**Ptychobellerophon** Delpey, 1941 [**P. gubleri*]. Columellar fold on each side borders depression resembling siphonal channel; seemingly no anal emargination (28, p. 36). (Possibly the lateral channels functioned as inhalant canals, but it is improbable that currents passed from one side to the other as postulated by Delpey; the path of the exhalant currents is unknown.) *L.Perm.*, SE. Asia.——Fig. 102,3. **P. gubleri*, IndoChina; apertural side, ×2 (28).

Subfamily KNIGHTITINAE Knight, 1956

Strong spiral ornament; selenizone somewhat depressed, bordered by generally obscure ridges; umbilici narrow. *Dev.-M. Perm.*

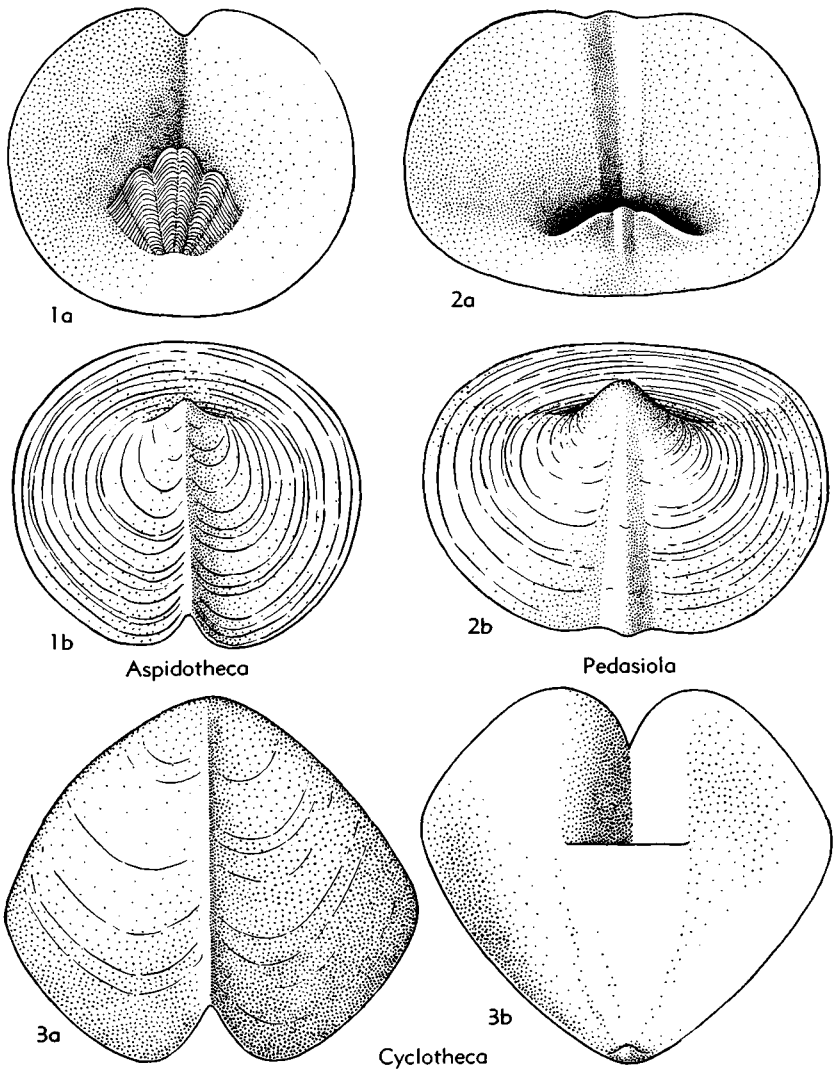


Fig. 100. Bellerophontacea (Bellerophontidae——Pterothecinae) (p. *1182*).

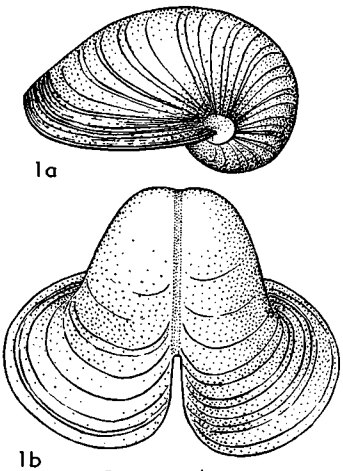


FIG. 101. Bellerophontacea (Bellerophontidae—— Bellerophontinae) (p. *I*182).

The spiral ridges are the loci of a pair of shallow mantle folds within the shell that seem to have carried ciliary currents of clean oxygenated water into the inhalant chamber of the mantle cavity. From here the current passed through the ctenidia to the exhalant chamber where it picked up waste and foreign matter and passed by way of the excurrent opening (the slit) to the outside (Fig. 57).

Knightites MOORE, 1941 [**K. multicornutus*]. Spiral ornament generally conspicuous, commonly crossed by well-developed collabral elements (102, p. 149). *Dev.-M.Perm.*, N.Am.-S.Am.-Eu.-N.Afr.-Asia.

K. (Retispira) KNIGHT, 1945 [**R. bellireticulata*]. Lateral lips of aperture expanded only moderately or not at all; incurrent channels inconspicuous; parietal inductura commonly thin; collabral ornament ranging from fine growth lines to cords and undulations (71, p. 335). *Dev.-M.Perm.*, N. Am.-S. Am.-Eu.-N. Afr.-Asia.—— FIG. 103,*5*. **K. (R.) bellireticulata* (KNIGHT), M.Perm., Tex.; *5a,b*, left and anterior sides, ×5.

K. (Cymatospira) KNIGHT, 1942 [**Bellerophon montfortianus* NORWOOD & PRATTEN, 1855]. Lateral lips of aperture strongly expanded at final growth stage; collabral undulations prominent at intermediate growth stage, especially on ridges over inhalant canals along selenizone; parietal inductura with toothlike extension into aperture (70, p. 487). *U.Miss.-Penn.*, N.Am.——FIG. 103, *1*. **K. (C.) montfortianus* (NORWOOD & PRATTEN), U.Penn., Tex.; *1a,b*, apertural and abpertural sides, ×1.3.

K. (Knightites). Collabral elements tending periodically to form projecting tubes on inhalant ridges; lateral lips without marked final expansion. *U.Penn.-M.Perm.*, N.Am.——FIG. 103,*2*. **K. (K.) multicornutus*, U.Penn., Kan.; *2a-c*, abapertural side of large specimen, left and apertural sides of smaller mature specimen, ×1.5.

Patellilabia KNIGHT, 1945 [**P. tentoriolum*]. Apertural margins progressively expanding backward and at sides; parietal inductura with forward projecting tooth; ornament numerous spiral threads (71, p. 336). *Miss. (L.Carb.)-L.Perm.*, N.Am.-S. Am.——FIG. 103,*3*. **P. tentoriolum*, U.Penn., Mo.; *3a,b*, apertural and abapertural sides, ×0.7.

?BELLEROPHONTACEA, INCERTAE SEDIS

Isospira KOKEN, 1897 [**I. bucanioides*]. Isostrophic coiling but without trace of sinus or slit; ornament cancellate, of spiral and collabral cords; parietal lip unknown. *U.Ord.*, Eu.——FIG. 103,*4*. **I. bucanioides*, Est.; anterior side, ×2.7 (80).

BELLEROPHONTACEA, GENERA INQUIRENDA

Patellostium WAAGEN, 1880 [**Bellerophon macrostoma* C.F.ROEMER, 1844; SD ULRICH & SCOFIELD, 1897]. Wide expansion of apertural margins is only character surely determinable. *M.Dev.*, Eu.

Euphemitella TASCH, 1953 [**E. emrichi*]. Based on steinkerns representing unrecognizable genus or genera (137, p. 397). *U.Penn.*, Kan.

Suborder MACLURITINA Cox & Knight, 1960

Shell hyperstrophic to depressed-orthostrophic, commonly with angulation on outer part of upper whorl surface coinciding with or forming outer border of channel thought to have been exhalant; shell wall thick, outer layer calcitic, inner layers thick, aragonitic but not nacreous; operculum heavy, calcareous, paucispiral in *Maclurites* with attachments for 2 retractor muscles, unknown in other genera; right ctenidium inferred to have been reduced and in some forms possibly absent; nature of reproductive system and other soft parts uncertain [The outer layer may show preserved color pattern.] *U.Cam.-Trias.*, *?U. Cret.*

Superfamily MACLURITACEA Fischer, 1885

[*nom. transl.* KNIGHT, BATTEN & YOCHELSON, herein (*ex* Macluritidae FISCHER, 1885)]

Hyperstrophic (except genuinely sinistral *Omphalocirrus*), with or without umbilicus

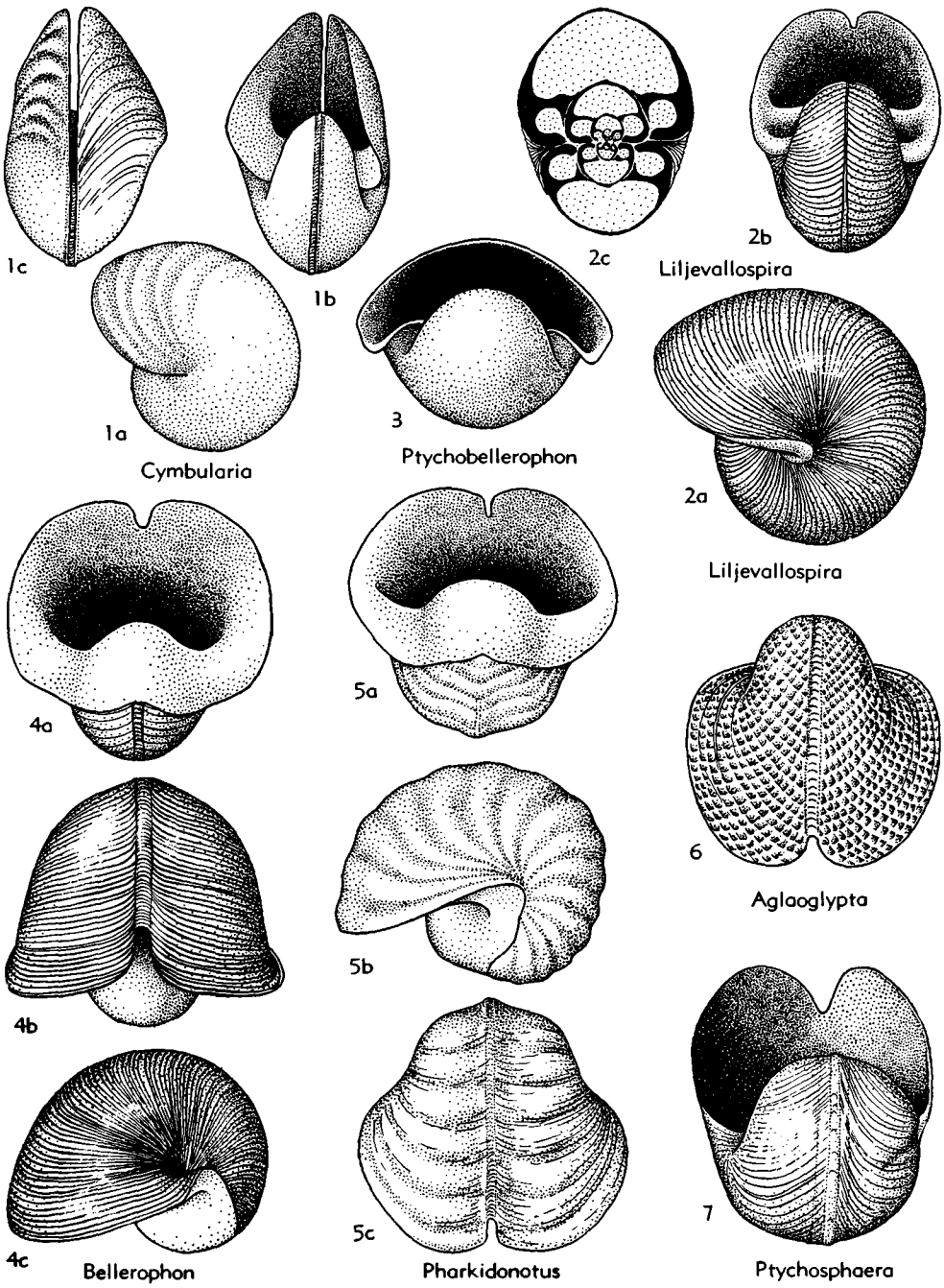


FIG. 102. Bellerophontacea (Bellerophontidae——Bellerophontinae) (p. *I*182-*I*183).

on upper side, lower side (base) flat or more or less protruding; with conspicuous channel, presumably exhalant in function, surrounding upper side within a ridge, and marked by a sinus in some forms; abandoned tip of helicocone not closed off by septa. *U.Cam.-Dev.*

These gastropods are inferred to be hyperstrophic, notwithstanding their apparently sinistral coiling, from the position of the channel (presumed to be exhalant) occupying a ridge or keel around what may be assumed to be the upper side. This inference is supported strongly by the operculum of *Maclurites,* which corresponds to that of a dextral gastropod (76) with a pair of retractor muscles. Members of this superfamily probably possessed paired ctenidia

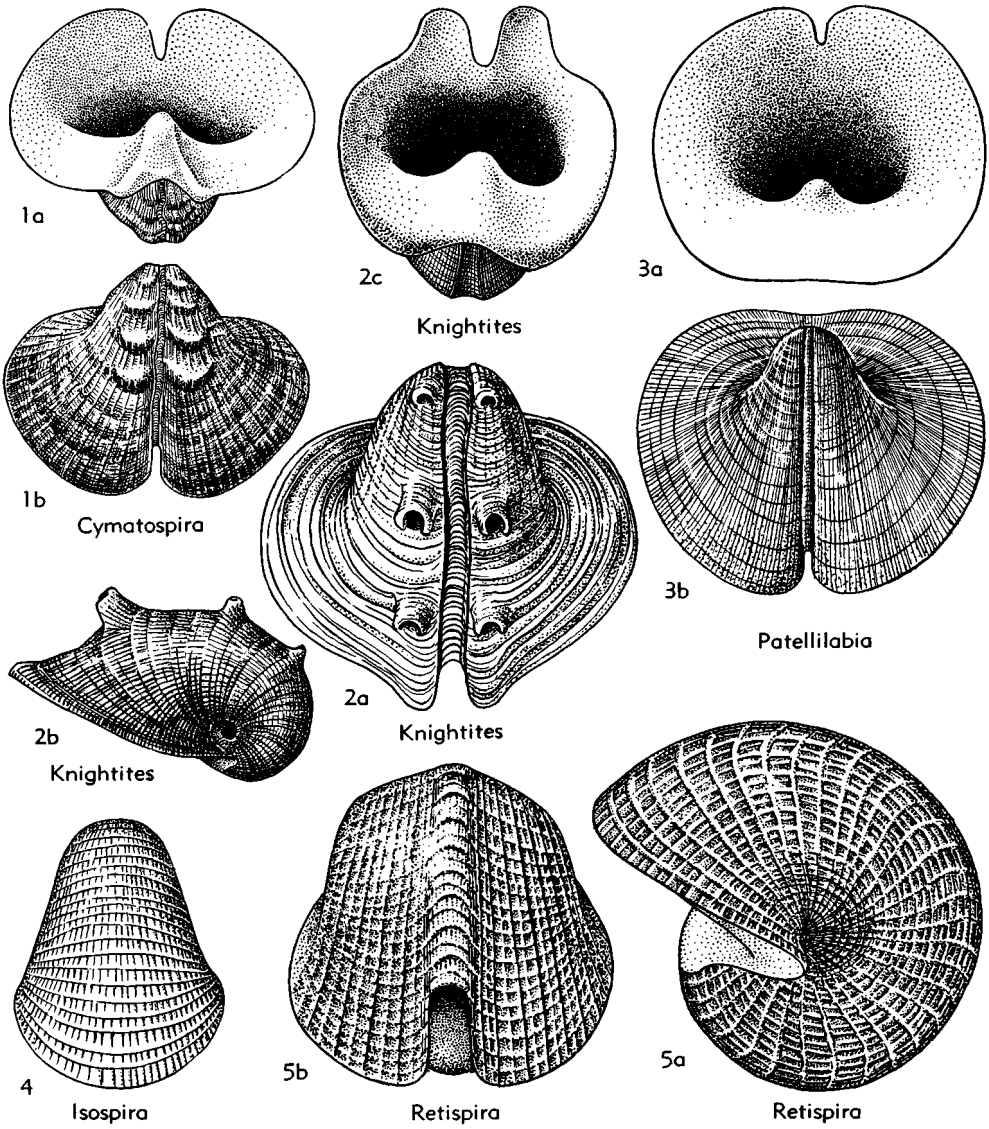


FIG. 103. Bellerophontacea (Bellerophontidae——Knightitinae; incertae sedis) (p. *1184*).

and other organs, like surviving Pleurotomariacea. The Macluritacea are thought, however, to have arisen from the Bellerophontacea as an independent group, distinct from the Pleurotomariacea.

Family ONYCHOCHILIDAE Koken, 1925

Relatively small, with base more or less protruding, like the spire of an orthostrophic gastropod. *U.Cam.-L.Dev.*

Subfamily ONYCHOCHILINAE Koken, 1925

[*nom. transl.* Knight, Batten & Yochelson, herein (*ex* Onychochilidae Koken, 1925)]

Basal "spire" high. *U.Cam.-L.Dev.*

Matherella Walcott, 1912 [*pro Billingsia* S.A.Miller, 1889 (*non* deKoninck, 1876, *nec* Foord, 1886)] [**Billingsia saratogensis* S.A.Miller, 1889]. Shell trochiform, anomphalous; outer lip opisthocline; surface with growth lines. *U.Cam.*, N.Am.-NE.Asia.——Fig. 104,*3*. **M. saratogensis* (Miller), N.Y.; ×4.

Matherellina Kobayashi, 1937 [**Matherella walcotti* Kobayashi, 1933; SD Knight, 1937]. Like *Matherella* but with sinus on outer lip close to basal angle. *L.Ord.*, NE.Asia.——Fig. 104,*5*. **M. walcotti* (Kobayashi), China; ×4.

Laeogyra Perner, 1903 [**L. bohemica*]. Like *Matherella* but with deeper sutures and transverse cords; not well known. *M.Ord.*, Eu.

Onychochilus Lindström, 1884 [**O. physa;* SD Cossmann, 1915] [=*Palaeopupa* Foerste, 1893; *Onycochilus* Cossmann, 1915 (obj.)]. Subtrochiform to pupiform; outer lip opisthocline; deeply phaneromphalous; with or without ornament. *M.Sil.*, N.Am.-Eu.——Fig. 104,*4*. **O. physa*, Gotl.; ×10.

Sinistracirsa Cossmann, 1908 [*pro Donaldia* Perner, 1903 (*non* Allaud, 1898)] [**Donaldia altera* Perner, 1903] [=*Boycottia* Tomlin, 1931 (obj.)]. Basal "spire" rather high; seemingly anomphalous; outer lip gently opisthocline, with sinus in upper margin; ornament numerous very fine spiral threads. *L.Dev.*, Eu.——Fig. 104,*2*. **S. altera* (Perner), Czech.; ×1.3.

Subfamily SCAEVOGYRINAE Wenz, 1938

[*nom. transl.* Knight, Batten & Yochelson, herein (*ex* Scaevogyridae Wenz, 1938)]

Basal "spire" low. *U.Cam.-M.Ord.*

Scaevogyra Whitfield, 1878 [**S. swezeyi;* SD Miller, 1889]. Hyperstrophic naticiform; umbilicus large and deep, with steep sides surrounded by sharp angulation that carries the exhalant channel; basal "spire" small. [Because the steinkern of this thick-shelled form was not recognized as such, a flaring aperture was attributed to the type species and the original error was exaggerated by Wenz, 7.] *U.Cam.*, N.Am.-NE.Asia.——Fig. 104,*6*. **S. swezeyi*, Wis.; ×1.3.

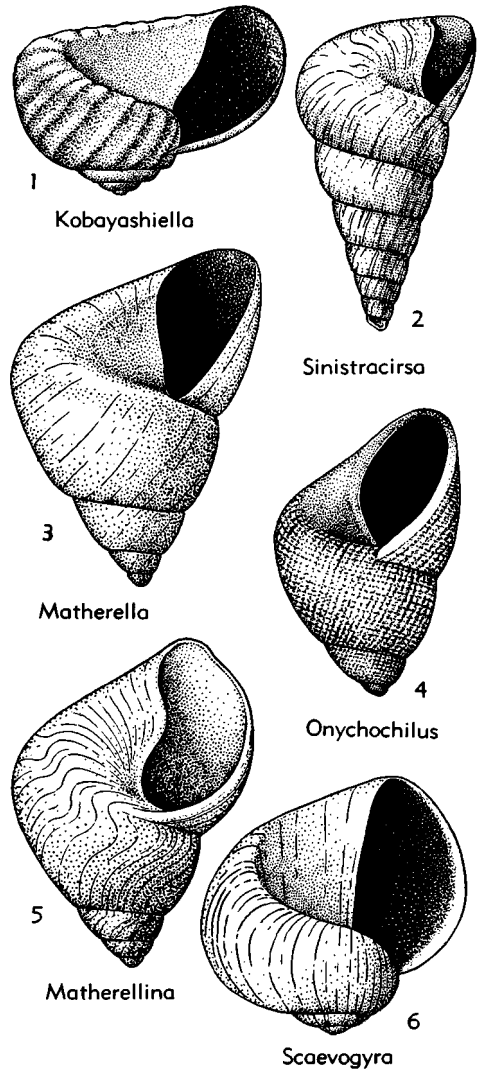


Fig. 104. Macluritacea (Onychochilidae——Onychochilinae, Scaevogyrinae) (p. *I*187).

Kobayashiella Endo, 1937 [**Straparollina circe* Walcott, 1905]. Much like *Scaevogyra* but with opisthocline collabral cords on base and whorl face and with blunter circumumbilical ridge. *U.Cam.*, NE.Asia.——Fig. 104,*1*. **K. circe* (Walcott), China; ×10.

Antispira Perner, 1903 [**A. praecox*]. Seemingly like *Scaevogyra* but with cancellate ornament; poorly known. *M.Ord.*, Eu.

Versispira Perner, 1903 [**V. contraria*]. Seemingly like *Scaevogyra* but steinkern of type species shows bore of final whorl blocked by a septum about 0.5

volution back from aperture; poorly known. *M. Ord.*, Eu.

?**Helicotis** KOKEN, 1925 [**Temnodiscus rugifer* KOKEN, 1897]. Periphery subangular; lip strongly opisthocline on outer surface, less so within umbilicus; ornament collabral cords; poorly known. *M.Ord.*, Eu.

Family MACLURITIDAE Fischer, 1885

[=Maclureidae CARPENTER, 1858 (*nom. correct.* KOKEN, 1925, *pro* Maclureadae and "Maclureade" CARPENTER, 1858); Macluriidae PILSBRY, 1888, ICZN pend.]

Relatively large; base flat or gently protruding. *L.Ord.-Dev.*

Lecanospira BUTTS, 1926 [**Ophileta compacta* SALTER, 1859; SD ULRICH & BRIDGE, 1931]. Discoidal, with flat base and wide umbilicus above; whorls with sharp crest; lip with deep angular sinus culminating at crest; ornament strongly opisthocline growth lines on upper part of outer and umbilical walls. *L.Ord.*, N.Am.

L. (Lecanospira). Upper sutures within deep angular grooves; umbilical slope of whorls flat or slightly concave; growth lines prosocyrt on base of whorls.——FIG. 105,*3*. **L. (L.) compacta* (SALTER), Que.; ×1.3.

L. (Barnesella) BRIDGE & CLOUD, 1947 [**B. lecanospiroides*]. Differs from *L. (Lecanospira)* in having shallower upper sutures, growth lines less prosocyrt on base, and umbilical slope of whorl

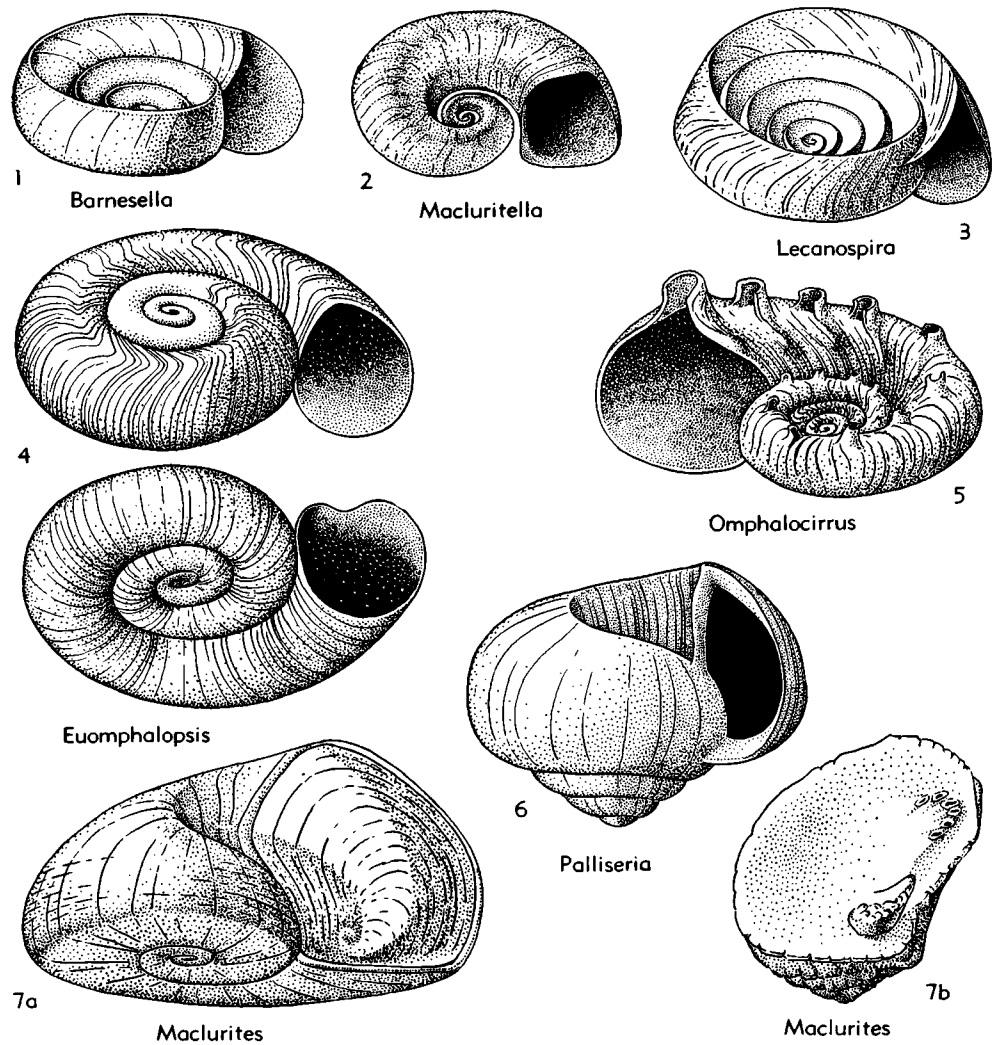


FIG. 105. Macluritacea (Macluritidae) (p. *I*188-*I*189).

sigmoid (9, p. 545).——Fig. 105,*1*. **L. (B.) lecanospiroides* (Bridge & Cloud), Tex.; ×1.3.

Macluritella Kirk, 1927 [**M. stantoni*]. Planispiral, with obscure angulation on upper whorl surface and shallow sinus at angulation. *L.Ord.*, N.Am.

M. (Macluritella). Whorls slightly disjunct, base flat.——Fig. 105,*2*. **M. (M.) stantoni*, Colo.; ×2.7.

M. (Euomphalopsis) Ulrich & Bridge, 1931 [**E. involuta*]. Whorls in contact, base slightly concave.——Fig. 105,*4*. **M. (E.) involuta*, Mo.; *4a,b*, oblique views from above and below, ×3.

Maclurites Lesueur, 1818 [**M. magna;* SD de Koninck, 1881] [=*Maclurita* deBlainville, 1823 (obj.); *Maclurea* Emmons, 1842 (obj.); *Maclureia* Bronn, 1848 (obj.); *Maclurina* Ulrich & Scofield, 1897]. Shell large, heavy, with flat base; upper surface strongly convex, with deep, steep-walled umbilicus; whorls with subangular crest, locus of a slight sinus; ornament growth lines and in some species spiral cords; operculum calcareous, paucispiral from nucleus, which lies near base toward parietal lip, nuclear part in some species protruding like a horn; inner surface with large projecting roughened apophysis for attachment of left retractor muscle and smaller roughened area above for right retractor muscle. *Ord.*, N.Am.-Eu.-NE.Asia.——Fig. 105,*7*. *M. logani* (Salter), M.Ord., Can.(Que.); *7a*, apertural view, operculum in place, ×0.7; *7b*, inner surface of operculum showing 2 muscle scars (right, below; left, above), ×0.7.

Palliseria Wilson, 1924 [**P. robusta*] [=*Mitrospira* Kirk, 1930]. Much like *Maclurites* but base protruding as domelike "spire"; operculum unknown. *M.Ord.*, N.Am.——Fig. 105,*6*. **P. robusta*. Low.M.Ord., Nev.; ×0.7.

Omphalocirrus Ryckholt, 1860 [**Euomphalus goldfussi* d'Archiac & deVerneuil, 1842; SD Cossmann, 1915] [=*Coelocentrus* Zittel, 1882 (obj.); *Polyenaulus* Etheridge, 1917 (obj.); *Arctomphalus* Tolmachov, 1926]. Like *Maclurites* in size and shape but genuinely sinistral, with shallower umbilicus and row of short spoutlike protrusions developed periodically along whorl crest. *Dev.*, N.Am.-Eu.——Fig. 105,*5*. **O. goldfussi* (d'Archiac & deVerneuil), M.Dev., Ger.; ×0.5.

Superfamily EUOMPHALACEA deKoninck, 1881

[*nom. transl.* Wenz, 1938 (*ex* Euomphalidae deKoninck, 1881)]

Shell mostly discoidal; orthostrophic or hyperstrophic; commonly with channel presumed to be exhalant occupying angulation on outer part of upper whorl surface; mostly widely phaneromphalous; shell wall relatively thick, with external prismatic layer of calcite which may be pigmented and internal layer of aragonite which is lamellar but not nacreous. *L.Ord.-U.Cret.*

Because the angulation on the outer part of the upper whorl surface carries a presumably exhalant channel, and in some genera even a short slit and selenizone with ample space on its inner side, it is reasonable to suppose that the ctenidia and other organs of euomphalaceans were paired, as in other primitive Prosobranchia. The superfamily seems to have been derived from the Macluritacea.

Family HELICOTOMIDAE Wenz, 1938

Spire slightly elevated; umbilicus relatively narrow; shoulder angulation generally a carina, with notch or short slit and selenizone in some forms; seemingly without septa. Operculum calcareous, wedge-shaped in some genera, unknown but probably corneous in others. *L.Ord., ?M.Jur. (Baj.)*

Orospira Butts, 1926 [**O. bigranosa*]. Spire a low cone; whorls narrow, numerous (about 10), with elevated carina at outer edge of upper whorl surface; short slit and arched selenizone at crest of carina, slit at culmination of deep angular sinus; outer whorl face rounded but sloping inward below; ornament elaborate (for early Paleozoic), with spiral cords on upper whorl surface and umbilicus, and transverse threads or cords forming tubercles where they cross spirals. [Small wedge-shaped calcareous opercula associated with some specimens probably belong to genus.]. *L. Ord.*, N.Am.——Fig. 106,*3*. **O. bigranosa*, Mo.; ×2.

Polhemia Cullison, 1944 [**P. taneyensis*]. Differs from *Orospira* in shape of whorls and nearly complete lack of collabral ornament; whorls with deep groove at upper suture adjoined by 2 carinae separated by concave zone, outer carina at upper-outer angulation, with shallow slit and convex selenizone; outer whorl face concave between upper-outer carina and sharp lower-outer angulation; base narrowly phaneromphalous, with low circumumbilical ridge; ornamented with growth lamellae above base, and on base with lamellae crossed by spiral threads. Operculum as in *Orospira* (25, p. 54). *L.Ord.*, N.Am.——Fig. 106,*2*. **P. taneyensis*, Mo.; ×2.

?Lophonema Ulrich in Purdue & Miser, 1916 [**Helicotoma peccatonica* Sardeson, 1896]. Much like *Polhemia* but angulations and carina seemingly rounded; poorly known. [When better known may prove to be senior synonym of *Polhemia.*] *L.Ord.*, N.Am.

Helicotoma Salter, 1859 [**H. planulata*]. [=*Palaeomphalus,* Koken, 1925]. Spire low,

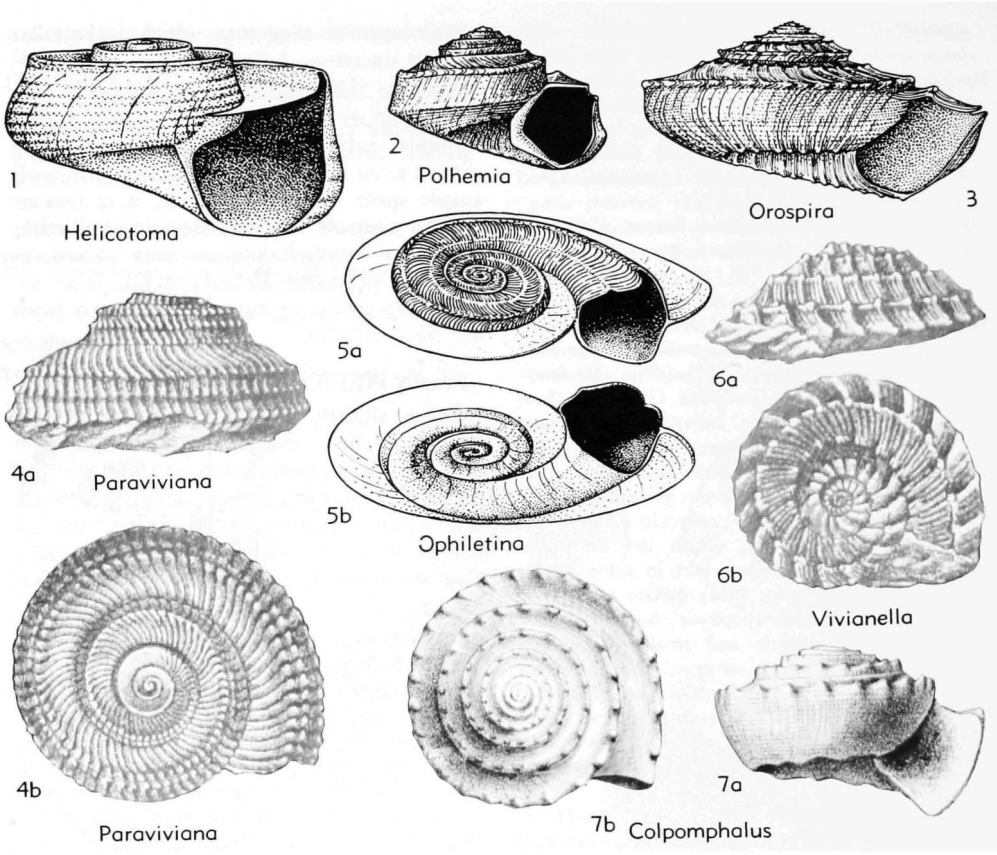


FIG. 106. Euomphalacea (Helicotomidae) (p. *I*189-*I*190).

gradate, with nearly horizontal ramp bordered at upper-outer angulation by a carina carrying a short slit that generates a convex selenizone; growth lines on sides strongly opisthocline above and prosocyrt. Operculum unknown. *L.Ord.-M.Ord.*, N.Am.-Eu.-NE.Asia-Austral.——FIG. 106, *1*. **H. planulata*, M.Ord., Can.(Que.); ×2.

Ophiletina ULRICH & SCOFIELD, 1897 [**O. sublaxa*]. Coiled approximately in a plane, last half whorl in contact only with flange of previous whorl; low carina at upper-outer angulation, with short slit and selenizone; last whorl bearing wide flange near middle of outer whorl face; ornament low sharp transverse lamellae. Operculum unknown. *M.Ord.*, N.Am.-Eu.——FIG. 106,*5*. *O. angularis* (ULRICH & SCOFIELD), Minn.; *5a,b*, oblique views from above and below showing peripheral flange, ×2.7.

?**Vivianella** COX, 1958 [*pro Viviana* KOKEN, 1896, *non* BIGOT, 1888] [**Viviana ornata* KOKEN, 1896]. Shell small, forming very depressed cone broadly truncated at apex owing to planispiral coiling of early whorls; upper surface of later whorls with prosocline collabral ridges and jagged median and peripheral carinae; base feebly convex, with broad umbilicus bordered by similar carina; aperture imperfectly known. *U.Trias.(Nor.)-M.Jur.(Baj.)*, Eu.——FIG. 106,*6*. **V. ornata* (KOKEN), U.Trias., Aus.; *6a,b*, ×7 (79).

?**Paraviviana** KUTASSY, 1940 [**Solarium gradatum* KOKEN, 1897]. Shell forming depressed cone broadly truncated at apex owing to planispiral coiling of early whorls; upper surface of later whorls with angulation delimiting broad, gently sloping ramp, second angulation at periphery; base and aperture imperfectly known; ornament of close, regular collabral ridges prosocline on ramp. *U.Trias.(Nor.)*, Aus.——FIG. 106,*4*. **P. gradata* (KOKEN); *4a,b*, ×4 (79).

?**Colpomphalus** COSSMANN, 1916 [**Straparollus altus* D'ORBIGNY, 1853]. Spire low; upper whorl surface concave or flat, extending to tuberculate periphery; outer whorl face more or less convex, inclined inward abapically to tuberculate angulation forming umbilical border; aperture subquadrangular, peristome continuous, angular at junction of columellar and basal lips. *L.Jur.(Lias.)-M.Jur.(Bathon.)*, Eu., N.Afr.——FIG. 106,*7*. *C. exsertus* (HUDLESTON), Baj., Eng.; *7a,b*, ×1.7 (59).

Family EUOMPHALIDAE de Koninck, 1881

[=Schizostomidae Eichwald, 1871 (ICZN pend.); Polytropidae Koken, 1925; Poleumitidae, Ecculiomphalinae Wenz, 1938]

Shell mostly discoidal with wide umbilicus, but varying in form through wide range; abandoned early part of whorls closed off by septa; presumed exhalant channel generally present within outer-upper angulation, rarely with short slit or selenizone; outer calcitic shell layer may be pigmented and in several genera foreign materials such as other shells may be cemented to outer surface. *L.Ord.-Trias., ?U.Cret.*

Lytospira Koken, 1896 [**Euomphalus angelini* Lindström, 1884; SD Perner, 1907]. Openly coiled, some species hyperstrophic; broadly angular sinus in outer lip culminating at low bluntly

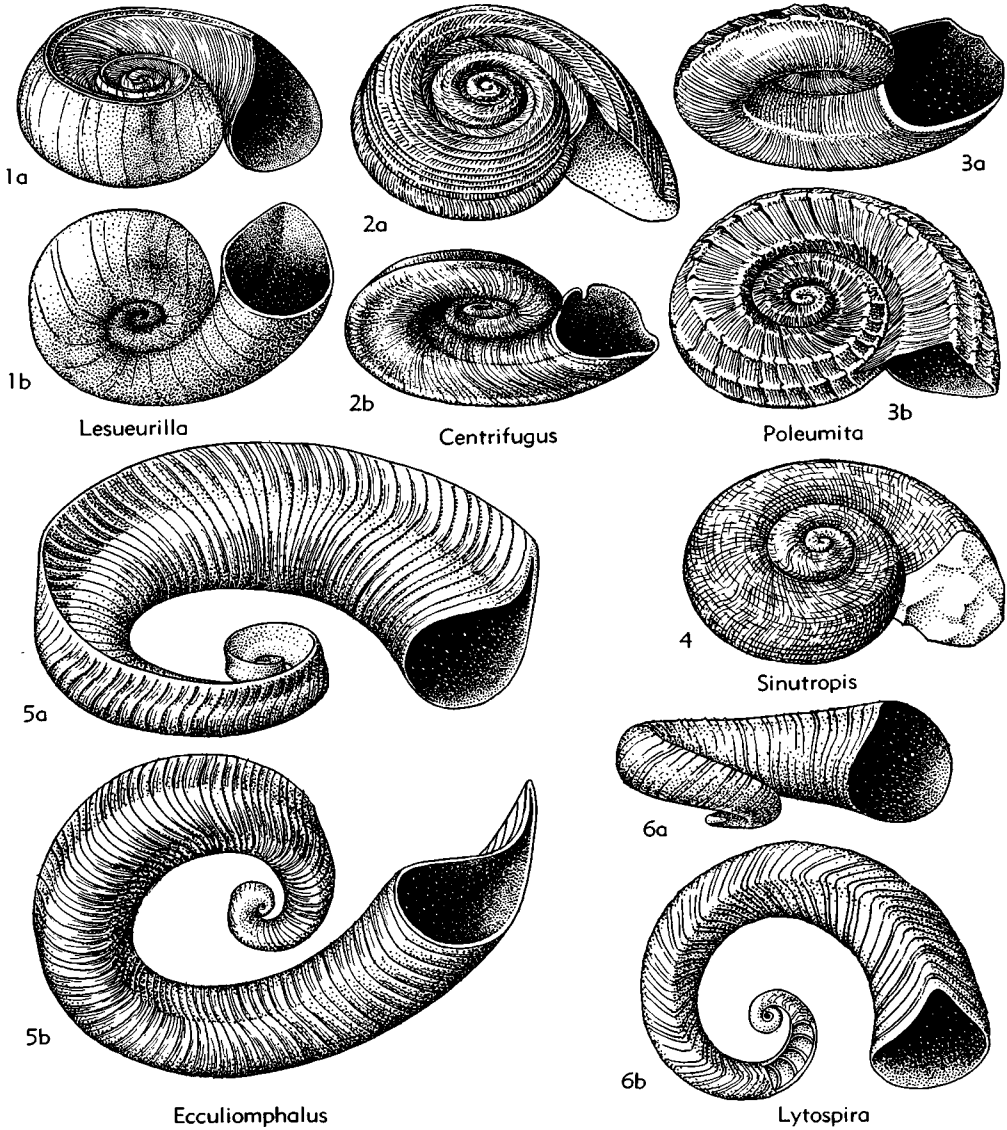


Fig. 107. Euomphalacea (Euomphalidae) (p. *I*191-*I*192).

angular spiral ridge near mid-line of upper surface; some species cement shells or other foreign substances to outer surface. *L.Ord.-M.Sil.*, N.Am.-Eu.——Fig. 107,*6*. **L. angelini* (Lindström), M. Ord., Swed.; *6a*, apertural view, ×1.3; *6b*, from above with window showing septa, ×1.3.

Ecculiomphalus Portlock, 1843 [**E. bucklandi*; SD S.A.Miller, 1889] [=*Eccyliomphalus* Agassiz, 1846 (obj.); *Eccyliopterus* Remelé, 1888]. Much like *Lytospira* but with high frill-like crest at upper-outer edge; surface with sharp collabral threads. [Commonly confused with *Lytospira*, especially when preserved as steinkerns.] *L.Ord.-Sil.*, N.Am.-Eu.-NE.Asia.——Fig. 107,*5*. **E. alatus* C.F.Roemer, M.Ord., Ire.; *5a*, oblique apertural view, ×1; *5b*, oblique from below, ×1.

Lesueurilla Koken, 1898 [**Maclurea infundibulum* Koken, 1896; SD Perner, 1903] [=*Lesuerella* Perner, 1903 (obj.); *Pachystrophia* Perner, 1903]. Hyperstrophic, with rounded base and shallow open umbilicus; early whorls tightly coiled but last whorl free; whorls high and sharply angular above, with narrow pseudoselenizone on crest of angulation, and rounded below. *Ord.*, N. Am.-Eu.——Fig. 107,*1*. **L. infundibulum* (Koken), M.Ord., Swed.; *1a,b*, oblique from above and below, ×1.3.

Poleumita Clarke & Ruedemann, 1903 [*pro Polytropis* deKoninck, 1881 (*non* Sandberger, 1874)] [**Euomphalus discors* J.Sowerby, 1814] [=*Polytropina* Donald, 1905 (obj.)]. Shape like *Straparollus (Euomphalus)*, but upper whorl surface bearing numerous collabral lamellae of 2 orders and faint revolving cords; upper-outer angulation with channel and small sinus over it; operculum unknown, probably corneous. [Differs from *Oriostoma*, with which it has been long confused, in closure of abandoned whorls by septa, in lacking a nacreous inner layer, and in having no calcareous operculum.] *L.Sil.*, N.Am.-Eu.——Fig. 107,*3*. **P. discors* (Sowerby), Gotl.; *3a,b*, oblique from below and above, ×0.7.

Centrifugus Bronn, 1834 [**C. planorbis*] [=*Inachus* Hisinger, 1837 (*non* Fabricius, 1798) (obj.); *Hisingeria* Ulrich & Scofield, 1897 (*pro Inachus* Hisinger, 1837) (obj.)]. Shell with nearly flat spire, widest at carina around base, with short narrow slit and selenizone not far from upper suture; 5 strong spiral cords above peripheral carina with weaker cord between each pair, spiral ornament on base faint. [Slit on upper whorl surface probably is exhalant opening.] *U.Sil.*, Eu. ——Fig. 107,*2*. **C. planorbis*, Gotl.; *2a,b*, oblique from above and below, ×0.7.

Sinutropis Perner, 1903 [**S. esthetica*; SD Perner, 1907]. Shape like *Straparollus (Euomphalus)*, but with rounder whorls and no upper-outer angulation; moderately deep rounded sinus culminates at position of angulation; ornamented with numerous fine spiral and collabral threads. *U.Sil.*, Eu.——Fig. 107,*4*. **S. esthetica*, Czech.; oblique from above, ×1.3.

Straparollus deMontfort, 1810 [**S. dionysii*]. Shape variable, with almost complete range from moderately high conispiral to discoidally hyperstrophic; channel (probably exhalant) or slight sinus on outer-upper angulation. [Restudy of original description shows that spelling *Straparolus* was a printing error subject to automatic correction.] *Sil.-M.Perm.*, cosmop.

S. (Euomphalus) J.Sowerby, 1814 [**E. pentangulatus*; SD Meek & Worthen, 1866] [=*Schizostoma* Bronn, 1834; *Phymatifer* deKoninck, 1881; *Liomphalus* Chapman, 1916; *Amphelissa* Etheridge, 1921; *Paromphalus* Grabau, 1936]. Subdiscoidal, with depressed to slightly elevated spire, whorls with channel-bearing angulation at outer-upper edge; sutures generally deep; base widely phaneromphalous; lower surface of whorls rounded to angular; commonly ornamented with fine collabral growth lines and faint spiral threads, some species with row of nodes on lower angulation or on both lower and upper. *Sil.-M.Perm.*, cosmop.——Fig. 108,*1*. **S. (E.) pentangulatus* Sowerby, L.Carb., Eng.; *1a,b*, oblique from above and below, ×1.

S. (Philoxene) Kayser, 1889 [**Euomphalus laevis* d'Archiac & deVerneuil, 1842]. Trochiform to discoidal, with wide umbilicus; whorls rounded; surface commonly with scars of attached shell fragments. *Dev.*, Eu.——Fig. 108,*2*. **S. (P.) laevis* (Archiac & Verneuil), M.Dev., Ger.; *2a,b*, oblique from above and below, ×1.7.

S. (Serpulospira) Cossmann, 1916 [*pro Serpularia* F.A.Roemer, 1843 (*non* Fries, 1829, *nec* Münster, 1840)] [**Serpularia centrifuga* F.A.Roemer, 1843]. Whorls rounded, last half whorl disjunct. *Dev.-U.Carb.*, Eu.——Fig. 108,*3*. **S. (S.) centrifugus* (F.A.Roemer), Dev., Ger.; ×1.3.

S. (Straparollus). Shell trochiform to discoidal, with deep, moderately wide umbilicus; whorls rounded but with slight shoulder that is locus of very shallow sinus. *Carb.(Miss.-Penn.)*, N. Am.-Eu.-Austral.——Fig. 108,*4*. **S. (S.) dionysii*, L.Carb., Belg.; *4a,b*, oblique from below and above, ×1.

S. (Amphiscapha) Knight, 1942 [**Straparolus (Euomphalus) reedsi* Knight, 1934]. Hyperstrophic discoidal, base flat, with spiral rib projecting very slightly beyond side, which is flat or slightly concave, to outer-upper margin where smooth or rugose ridge carried internal exhalant channel; upper whorl surface sloping inward (70, p. 488). *Penn.(U.Carb.)-L.Perm.*, N.Am.-S.Am.——Fig. 108,*10*. **S. (A.) reedsi* (Knight), M.Penn., Mo.; *10a,b*, oblique from above and below, ×1.3.

S. (Leptomphalus) Yochelson, 1956 [**S. (Leptomphalus) micidus*]. Much like *S. (Euomphalus)*, but with coil almost symmetrically discoidal and usual angulations of both upper and lower

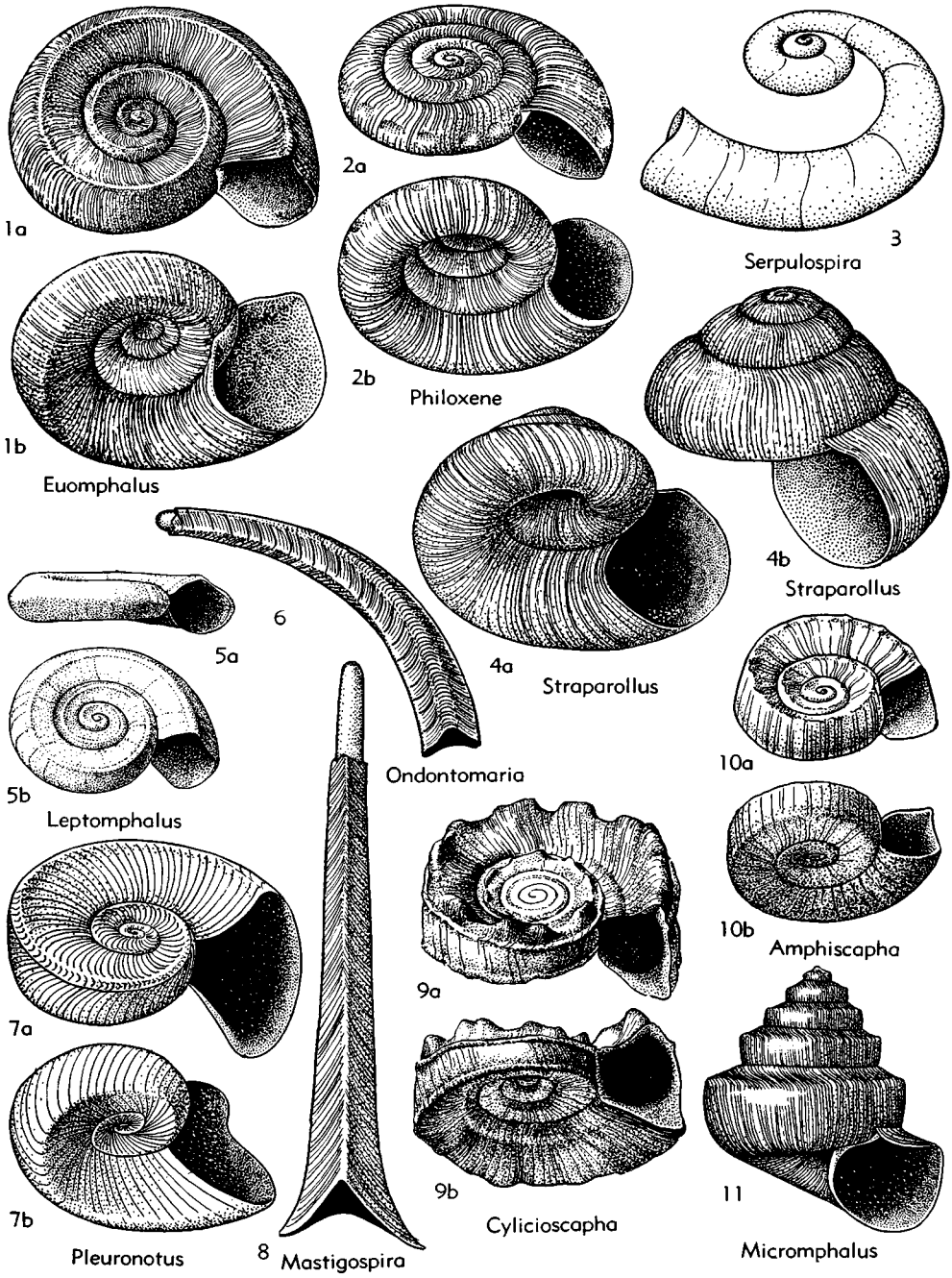


FIG. 108. Euomphalacea (Euomphalidae) (p. *I*192-*I*195).

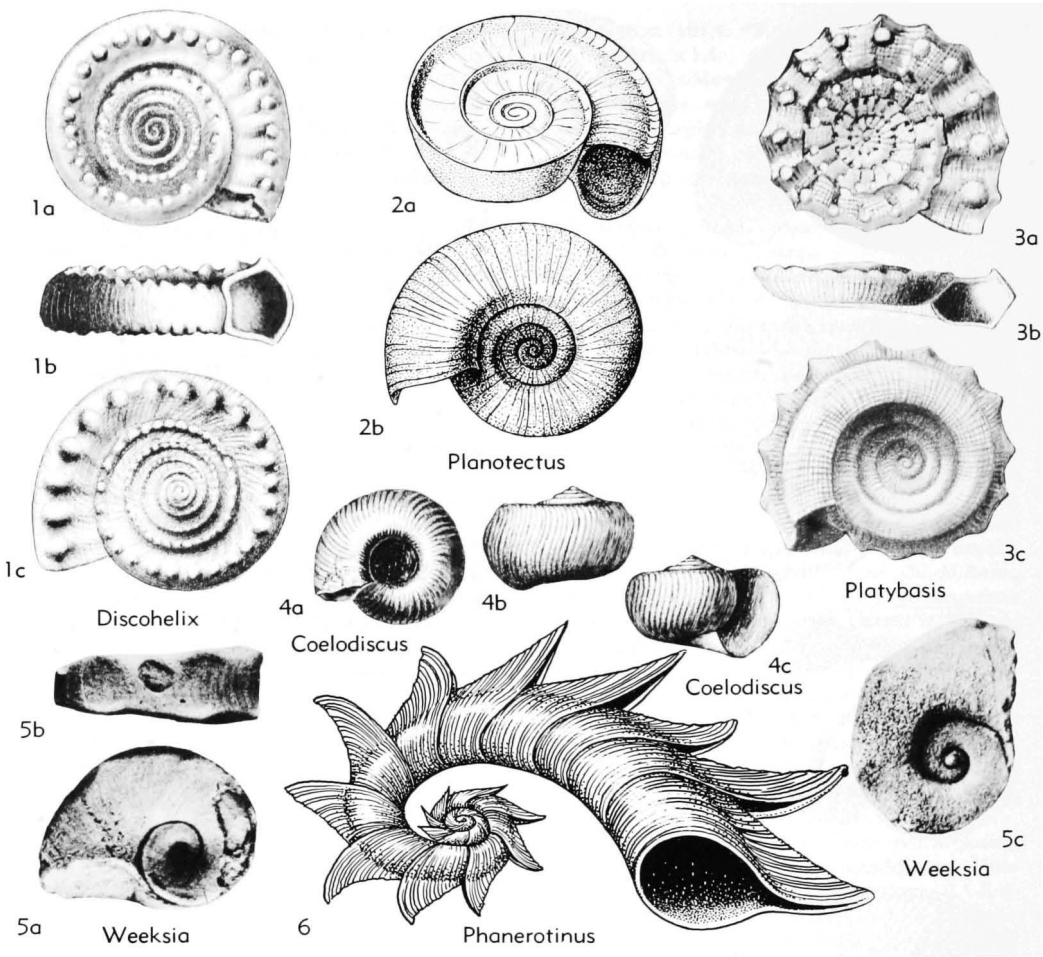


FIG. 109. Euomphalacea (Euomphalidae) (p. *I*194-*I*196).

whorl surfaces much subdued (154, p. 197). *M. Perm.,* N.Am.-Eu.-E.Asia.——FIG. 108,*5*. **S. (L.) micidus,* Tex.; *5a,b,* apertural view and oblique from above, ×1.3.

Pleuronotus HALL, 1879 [**Euomphalus decewi* BILLINGS, 1861]. Like *Straparollus (Euomphalus)* in shape, but whorls deeper and with strong angular sinus culminating at outer-upper angulation in shallow slit that generates selenizone. *Dev.,* N.Am.-Eu.-Austral.——FIG. 108,*7*. **P. decewi* (BILLINGS), M.Dev., Can.(Ont.); *7a,b,* oblique from above and below, ×0.7.

Mastigospira LAROCQUE, 1949 [**Hyolithes alatus* WHITEAVES, 1892]. Shell straight or gently curved, without coiling, roughly triangular in cross section; abandoned tip shut off by septa; upper surface with angulation which is culmination of a deep V-shaped sinus, a broader rounded sinus below; each side of aperture extended in a point (87, p. 114). *M.Dev.,* N.Am.——FIG. 108,*8*. **M. alatus* (WHITEAVES) Can.(Man.); from above, ×0.7 (87).

?Odontomaria C.F.ROEMER, 1876 [**O. elephantina*]. Not well known but possibly senior synonym of *Mastigospira. M.Dev.,* Eu.——FIG. 108, *6*. **O. elephantina,* Ger.; oblique from above, ×1 (123).

Micromphalus KNIGHT, 1945 [**M. turris*]. Trochiform, relatively high, gradate; narrowly phaneromphalous; growth lines prosocline on upper shoulder, orthocline below; with slight sinus on blunt angulation (72, p. 585). *M.Dev.-Miss.,* N. Am.——FIG. 108,*11*. **M. turris,* M.Miss., Ky.; ×2.

Phanerotinus J.DEC.SOWERBY, 1844 [**Euomphalus cristatus* PHILLIPS, 1836; SD DEKONINCK, 1881] [=*Phanerotina* PAETEL, 1875 (obj.)]. All but early whorls openly coiled; channel on anterior

face of large periodic leaflike extensions that protrude horizontally from upper part of outer whorl face. [Late Paleozoic open-coiled euomphalids lacking leaflife expansions, although commonly referred to this genus, are more properly assigned to *Straparollus (Serpulospira).*] *L.Carb.*, Eu.—— Fig. 109,*6*. **P. cristatus* (Phillips), Eng.; oblique from above, ×0.5.

Cylicioscapha Yochelson, 1956 [**Amphiscapha (Cylicioscapha] texana*]. Somewhat like *S. (Amphiscapha)* but with deeper umbilicus and with exhalant channel in supplemental, commonly noded angulation rising in adult above outer whorl as a spiral cord; with protruding basal cord as in *S. (Amphiscapha);* labrum projecting forward at primitive upper angulation and with sinus and channel at supplemental angulation (154, p. 199). *M.Penn.-M.Perm.*, N.Am.——Fig. 108,*9*. **C. texana* (Yochelson), U.Penn., Tex.; *9a,b,* oblique from above and below, ×1.3.

Planotectus Yochelson, 1956 [**P. cymbellatus*]. Upper whorl surface very gently arched within sharp carina; outer whorl face sloping inward to rounded basal surface; umbilical walls steep; labrum projecting forward at carina, with channel within (154, p. 200). *M.Perm.*, N.Am.—— Fig. 109,*2*. **P. cymbellatus,* Tex.; *2a,b,* oblique from above and basal view, ×1.5.

Discohelix Dunker, 1848 [**D. calculiformis*]. Discoidal, either upper or lower face (assuming dextrality) the more impressed; protoconch deviated but not heterostrophic; whorls subquadrate in cross section, barely overlapping; ornament collabral and in some shells spiral threads, tubercles at both angulations in most species. *M.Trias.-U. Cret.(Senon.),* cosmop.

D. (Discohelix). Growth lines gently opisthocyrt on outer whorl face. *M.Trias.-U.Cret.(Senon.),* cosmop. —— Fig. 109,*1*. *D. (D.) sinistra* (d'Orbigny), M.Lias., Fr.; *1a-c,* ×1 (110).

D. (Amphitomaria) Koken, 1897 [**Euomphalus cassianus* Koken, 1889]. Shell small; no ornament except growth lines, which are strongly prosocyrt on slightly concave outer whorl face and have small notches where they cross its 2 well-defined bordering carinae. *M.Trias.(Ladin.),* Eu.——Fig. 110,*6*. **D. (A.) cassiana* (Koken), S. Tyrol; *6a,b,* ×2 (196).

Anisostoma Koken, 1889 [*pro Platystoma* Hörnes, 1855 (*non* Meigen, 1803)] [**Platystoma suessi* Hörnes, 1855]. Shell and whorls as in *Discohelix* except that last whorl bends down through right angle just before circular aperture, labrum of which has broad, flat, kidney-shaped expansion almost as wide as base of shell, in plane of which it lies. *M.Trias.-U.Trias.*, Eu.——Fig. 110,*3*. **A. suessi,* U.Trias.(Nor.), Aus.; *3a-c,* ×2, ×3, ×2 (79).

Woehrmannia J.Böhm, 1895 [*W. böhmi* Kittl, 1899 (ICZN pend.)]. Shell small, discoidal; spire flat or protruding very slightly; upper surface of whorls bordered by smooth or denticulate carina, below which, on steep outer face of last whorl, are 1 or 2 further carinae; no other ornament except growth lines; umbilicus without bordering carina. *M.Trias.-U.Trias.*, Eu.——Fig. 110,*2*. *W. lineata* (Klipstein), U.Trias.(Carn.), S.Tyrol; *2a-c,* ×3 (89).

Nummocalcar Cossmann, 1896 [**Solarium poly-*

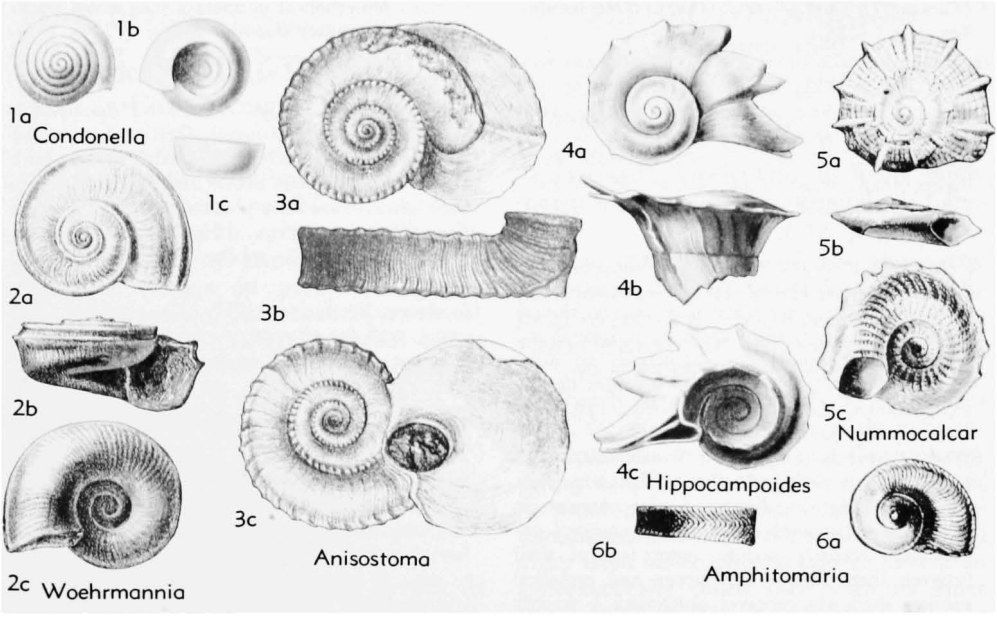


Fig. 110. Euomphalacea (Euomphalidae) (p. *1*195-*1*196).

gonium D'ARCHIAC, 1843]. Shell discoidal or with very slightly protruding spire; upper surface with regular transverse ribs ending at carinate periphery in angular projections or spines; these remain exposed by and produce undulations of suture on earlier whorls; intervals with fine cancellate ornament; umbilical border not carinate; aperture broader than high. *M.Jur.(Baj.)-U.Cret.(Senon.)*, Eu., N.Afr.

N. (Nummocalcar). Shell rather small; spire protruding slightly; whorl diameter increasing relatively rapidly; outer whorl face not delimited from base; umbilicus only about 0.3 of shell diameter, with crenulations at its border. *M.Jur.(Baj.)-U.Cret.(Senon.)*, Eu., N.Afr.——FIG. 110,*5*. **N. (N.) polygonium* (ARCHIAC), Bathon., Fr.; *5a-c*, ×2, ×2, ×1 (17).

N. (Platybasis) COSSMANN, 1916 [**Straparollus pulchellus* D'ORBIGNY, 1850]. Medium-sized, discoidal, whorl diameter increasing relatively slowly; ribs tuberculate; angulation separating outer whorl face from base, which appears flattened; umbilicus wide, without crenulations at border. *M.Jur.(Baj.)*, Eu.——FIG. 109,*3*. **N. (P.) pulchellus* (D'ORBIGNY), Baj., Fr.; *3a-c*, ×2.5 (111).

Hippocampoides WADE, 1916 [**H. serratum*]. Shell subcylindrical, whorl height proportionately large for family, whorl diameter increasing rapidly; spire protruding only slightly, whorls flat, with collabral rugae that may produce jagged projections on sharply carinate periphery; unornamented or with spiral striations; outer whorl face concave, sloping inward slightly abapically toward 2nd carina forming border of umbilicus. *U.Cret.(Campan.)*, Tenn.——FIG. 110,*4*. **H. serratus; 4a-c*, ×1.3 (226).

?**Coelodiscus** BRÖSAMLEN, 1909 [**Euomphalus minutus* ZIETEN, 1832]. Shell small, involute or with slightly protruding, obtuse spire; whorls evenly rounded, overlapping slightly, smooth or with parasigmoidal collabral threads; aperture ovate, higher than broad. *L.Jur.(L.Lias.)-M.Jur.(Baj.)*, Eu.——FIG. 109,*4*. *C. aratus* (TATE), L.Lias., Ger.; *4a-c*, ×7 (11).

?**Condonella** MCCLELLAN, 1927 [**C. suciensis*]. Rather small, discoidal; spire flat, of slowly increasing whorls; outer whorl face convex, sloping inward abapically, limited above by peripheral and below by circumumbilical angulation; no ornament except collabral threads; aperture imperfectly known. *U.Cret.*, N.Am.——FIG. 110,*1*. **C. suciensis*, San Juan I.; *1a-c*, ×1 (147).

?**Weeksia** STEPHENSON, 1941 [**Pseudomalaxis amplificata* WADE, 1926]. Shell discoidal; whorls increasing rapidly in diameter, subrectangular in cross section, smooth; upper and circumbasal angulations obscurely nodose, outer face of shell between them almost flat; upper and umbilical surfaces shallowly concave; protoconch a smooth button projecting above level of succeeding whorls. *U.Cret.*, N.Am.——FIG. 109,*5*. **W. lubbocki* STEPHENSON, Tex.; *5a-c*, ×2 (220).

Family OMPHALOTROCHIDAE Knight, 1945

[*nom. transl.* KNIGHT, BATTEN & YOCHELSON, herein (*ex* Omphalotrochacea KNIGHT, 1945)]

Shell trochiform, with broad sinus in upper part of outer lip and forward protrusion below; narrowly to widely phaneromphalous. *Dev.-M.Perm., ?U.Trias.*

This family is thought to have been derived from earlier euomphalids, possibly from close allies of *Centrifugus*. If this was so, the sinus high on the outer lip may be the morphological and functional homologue of the exhalant slit in that genus. Both *Centrifugus* and omphalotrochids have a protruding section of the lip low on the whorl face; commonly this is thickened and bears within it a more or less well-marked channel. This combination of features suggests that the Omphalotrochidae may have been in the process of losing the right ctenidium and adopting an independent left-to-right flow of ciliary currents in the mantle cavity. If this was so, the channel in the forward extension may have been inhalant.

Orecopia KNIGHT, 1945 [**Platyschisma? mccoyi* WALCOTT, 1884]. Base nearly flat, minutely phaneromphalous, surrounded by thick funicle; outer lip with broad rounded sinus above and forward projection at periphery; shell much thickened by secondary deposits within (72, p. 586). *Dev.*, N.Am.-Eu.——FIG. 111,*1*. **O. mccoyi* (WALCOTT), U.Dev., Nev.; ×1.6.

Omphalotrochus MEEK, 1864 [**Euomphalus (Omphalotrochus) whitneyi*]. Shell gradate, trochiform, with moderately wide umbilicus; lip with broad rounded sinus above and forward projection below, commonly showing internal channel. *Penn.(U.Carb.)-M.Perm.*, N.Am.-S.Am.-Eu.-Asia.——FIG. 111,*4*. **O. whitneyi* (MEEK), L.Perm., Calif.; ×1.3.

Discotropis YOCHELSON, 1956 [**D. publicus*]. Discoidal, with flat or gently rounded, phaneromphalous base and pair of prominent spiral ridges or carinae; shallow labral sinus above lower or peripheral carina, which forms salient (154, p. 203). *U.Penn.-M.Perm., ?U.Trias.* N.Am.-Eu.——FIG. 111,*2*. **D. publica*, M.Perm., Tex.; *2a,b*, apertural view and oblique from above, ×2.

Babylonites YOCHELSON, 1956 [**B. carinatus*]. Conical, with flat phaneromphalous base; sutures shallow; outer whorl face approximately conformable to sides of cone, gently concave for its upper 0.7 with concave or convex band above periphery; shallow labral sinus above forward-projecting

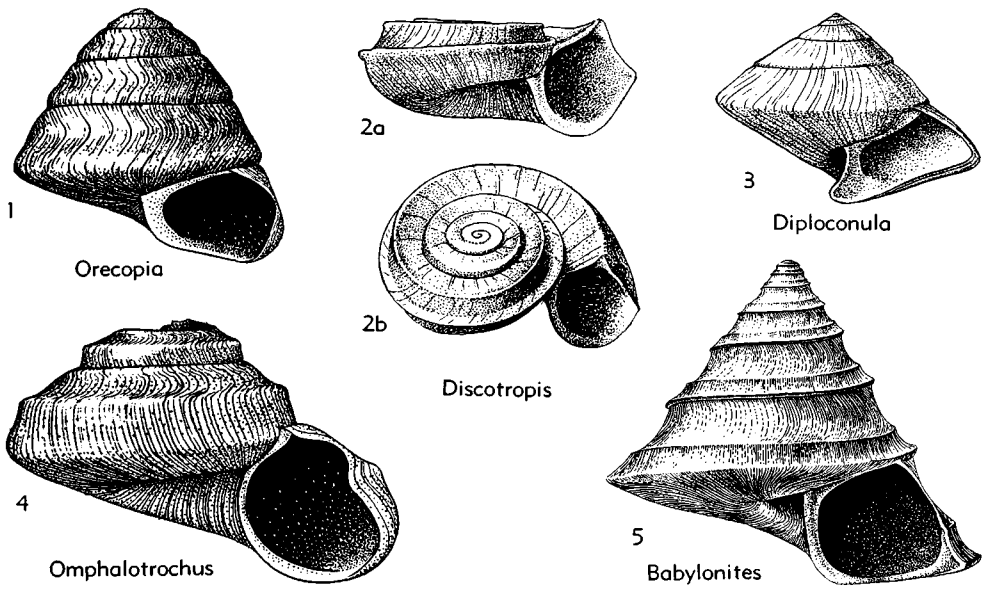


FIG. 111. Euomphalacea (Omphalotrochidae) (p. *I*196-*I*197).

periphery (154, p. 202). *M.Perm.*, N.Am.——FIG. 111,*5*. **B. carinatus*, Tex.; ×1.

Diploconula YOCHELSON, 1956 [**D. biconvexa*]. Spire and base conical, narrowly phaneromphalous; shell heavy; periphery subangular; labral sinus very shallow; angular umbilical funicle (154, p. 203). *M.Perm.*, N.Am.——FIG. 111,*3*. **D. biconvexa*, Tex.; ×1.3.

Suborder PLEUROTOMARIINA Cox & Knight, 1960

[=Fissibranchiata STOLICZKA, 1868; Zeugobranchia VON IHERING, 1876; Zygobranchia SPENGEL, 1881]

Shell commonly conispiral, more rarely discoidal, auriform, patelliform, or other shapes; mostly with exhalant notch, slit, trema, or series of tremata, generating a selenizone (except in patelliform genera with apical trema); outer shell layer calcitic, inner layers aragonitic and nacreous except in patelliform genera; operculum corneous and multispiral in conispiral, absent in patelliform, genera; ctenidia paired, right ctenidium (except in Fissurellacea) reduced to varying extent; epipodium present; pallial genital organs wanting; heart with 2 auricles, ventricle traversed by rectum; radula rhipidoglossate. *U.Cam.-Rec.*

In this group the inhalant current is drawn into the mantle cavity near the middle and the exhalant current is discharged through a labral emargination, which exists in most forms, or else through a trema or series of tremata in the shell wall.

Superfamily PLEUROTOMARIACEA Swainson, 1840

[*nom. transl.* WENZ, 1938 (*ex Pleurotomariidae* KING, 1850, *nom. correct. et transl. ex* Pleurotomariae SWAINSON, 1840)]

Shells mostly conispiral, but rarely discoidal or auriform; inner shell layer aragonitic, nacreous. Operculum, in living representatives, corneous, multispiral. *U.Cam.-Rec.*

This ancient line first appears in late Upper Cambrian strata and is preceded in the fossil record of the Gastropoda only by the Helcionellacea, the Bellerophontacea, and the questionable Pelagiellacea. The group has much in common with bellerophontaceans, for example, in nature of the exhalant emargination, and in three of the four surviving families the presence of actual or potential paired retractor muscles. Pleurotomariaceans in which the shell is conispiral differ from bellerophontaceans in having an asymmetrically coiled shell with its inner layers nacreous. The superfamily is thought

to be derived from the Bellerophontacea, retaining as primitive characters paired ctenidia and other organs. The Pleurotomariacea attained the acme of their development in Paleozoic time. They are thought to have given rise directly to a number of other superfamilies belonging to the Archaeogastropoda, several of which seem to have lost the right ctenidium independently; ultimately this group seems to have been the source of other orders.

Family SINUOPEIDAE Wenz, 1938

[*nom. transl.* KNIGHT, BATTEN & YOCHELSON, herein (*ex* Sinuopeinae WENZ, 1938)]

Shell trochiform, turbiniform, rotelliform, or naticiform; exhalant emargination in form of a U-shaped sinus. *U.Cam.-M.Perm.*

Subfamily SINUOPEINAE Wenz, 1938

Turbiniform or rotelliform; sinus wide, approximately at mid-height of labrum. *U. Cam.-U.Sil.*

Sinuopea ULRICH, 1911 [**Holopea sweeti* WHITFIELD, 1880]. Turbiniform, anomphalous, sutures deep; sinus relatively narrow, low on labrum. *U. Cam.-L.Ord.*, N.Am.——FIG. 112,*5*. **S. sweeti* (WHITFIELD), U.Cam., Wis.; ×1.3.

Horiostomella PERNER, 1903 [**H. otiosa*]. Like *Sellinema* but with lower spire, larger last whorl, and wider umbilicus. *U.Sil.*, Eu.——FIG. 112,*6*. **H. otiosa*, Czech.; ×2.7.

Sellinema PERNER, 1903 [**S. dive*; SD PERNER, 1907]. Turbiniform, narrowly phaneromphalous, with deep sutures; sinus very broad. *U.Sil.*, Eu. ——FIG. 112,*3*. **S. dive*, Czech.; ×4.

Subfamily PLATYSCHISMATINAE Knight, 1956

Rotelliform or naticiform; sinus at or above middle of labrum. *L.Ord.-M.Perm.*

Chepultapecia ULRICH in WELLER & ST. CLAIR, 1928 [**Raphistoma leiosomella* SARDESON, 1896]. Umboniform, sutures shallow; narrowly phaneromphalous; sinus culminating at middle of labrum. *L.Ord.*, N.Am.——FIG. 112,*1*. **C. leiosomella* (SARDESON), Minn.; *1a,b*, apertural view and oblique from above, ×4.

Umbospira PERNER, 1903 [**U. nigricans*; SD PERNER, 1907]. Low rotelliform, probably phaneromphalous; with faintly arched pseudoselenizone; surface glossy. *U.Sil.*, Eu.——FIG. 112,*8*. **U. nigricans*, Czech.; oblique from above, ×4.

Pycnotrochus PERNER, 1903 [**P. viator*; SD PERNER, 1907]. Trochiform, gradate, moderately large, with a narrow ramp; outer lip with sinus culminating at angulation of ramp; columellar lip thickened; broad concave callus filling umbilicus. [The only known specimens, the types, are too imperfect to form a basis for restoration.] *U.Sil.*, Eu.

Platyschisma M'COY, 1844 [**Ampullaria helicoides* J.DEC.SOWERBY, 1826; SD DEKONINCK, 1881]. Naticiform, narrowly phaneromphalous; sinus and faint pseudoselenizone slightly above mid-height of whorl face; columellar lip thin, slightly sinuous. *L.Carb.(Miss.)*, Eu.-N.Am.-Austral.——FIG. 112, *2*. **P. helicoides* (SOWERBY), Belg., ×0.7.

Colpites KNIGHT, 1936 [**Naticopsis monilifera* WHITE, 1880]. Naticiform, anomphalous; sinus above mid-height of whorl face; columellar and parietal lips thickened; surface glossy, with row of nodes just below upper suture. *Penn.(U.Carb.)-M.Perm.*, N.Am.-Eu.——FIG. 112,*7*. **C. monilifer* (WHITE), Penn., Mo.; ×2.7.

Subfamily TURBONELLININAE Knight, 1956

Shell turbiniform; sinus small, mostly low on labrum. *U.Sil.-L.Perm.*

Turbomaria PERNER, 1907 [**Pleurotomaria sepulta* PERNER, 1903]. Exhalant sinus small, low on labrum, columellar lip sinuous; fine spiral and collabral threads. *U.Sil.*, Eu.——FIG. 112,*9*. **T. sepulta* (PERNER), Czech.; ×2.7.

Leptozone PERNER, 1907 [**Pleurotomaria (Leptozone) esthetica*]. Like *Turbomaria* but sinus higher on labrum and with wash of shell material within funnel-shaped umbilicus. *L.Dev.*, Eu.——FIG. 112, *10*. **L. esthetica* (PERNER), Czech.; ×2.7.

Rhineoderma DEKONINCK, 1883 [**Pleurotomaria radula* DEKONINCK, 1843]. Trochiform, with broadly subangular periphery; with shallow labral notch generating broad ornamented selenizone between pair of threads on periphery; umbilicus narrow, funnel-shaped and smooth; spiral threads of several orders bearing small nodes where crossed by transverse threads. *L.Carb.(Miss.)*, Eu.-N.Am.—— FIG. 112,*11*. **L. radula* (DEKONINCK), Belg., ×2.

Turbonellina DEKONINCK, 1881 [**Trochus lepidus* DEKONINCK, 1843; SD KNIGHT, 1937]. Broadly beehive-shaped; sinus quite low on labrum, partly on base; spiral and collabral threads. *L.Carb.*, Eu. ——FIG. 112,*4*. **T. lepida* (DEKONINCK), Belg.; *4a,b*, oblique from above and below, showing aperture and sinus, ×2.

?**Keeneia** ETHERIDGE, 1902 [**K. platyschismoides*]. Large, rounded above, with rather flat base; sinus low, at peripheral angle; transverse threads. *L. Perm.*, Austral.——FIG. 112,*12*. **K. platyschismoides*, ×0.5.

Family RAPHISTOMATIDAE Koken, 1896

[*nom. correct.* KNIGHT, BATTEN & YOCHELSON, herein (*pro* Raphistomidae KOKEN, 1896)]

Shell lenticular, turbiniform, or gradate, with angular labral sinus culminating gen-

erally at periphery in a short slit, sinus, or notch that generates a selenizone. *U.Cam.-M.Perm.*

Subfamily OPHILETINAE Knight, 1956

Generally low-spired with wide umbilicus; labral sinus V-shaped, culminating at

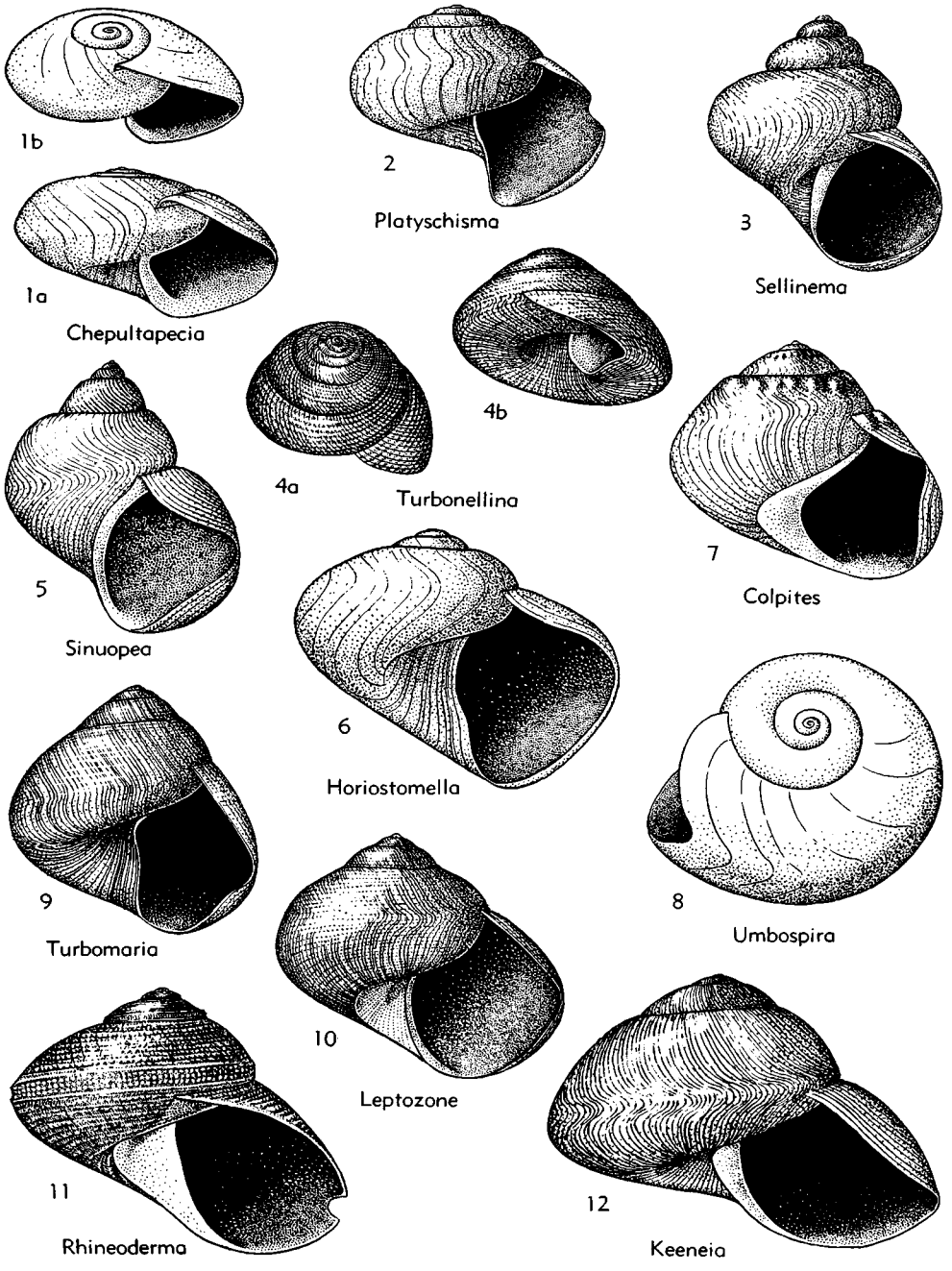


FIG. 112. Pleurotomariacea (Sinuopeidae——Sinuopeinae, Platyschismatinae, Turbonellininae) (p. 1198).

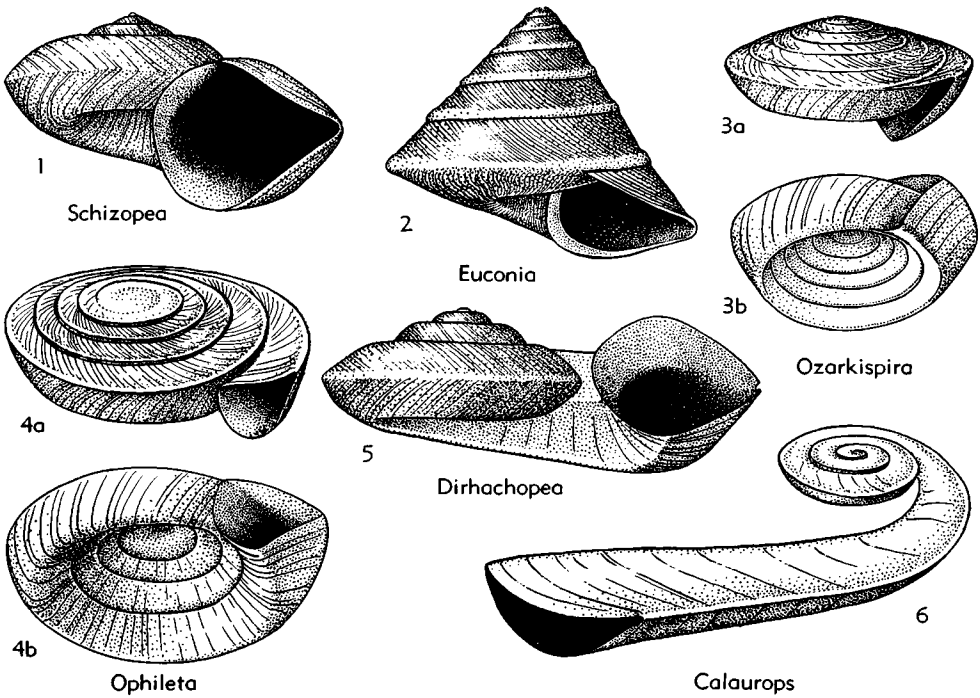


FIG. 113. Pleurotomariacea (Raphistomatidae——Ophiletinae) (p. I200).

periphery in short notch that generates an obscure selenizone. *U.Cam.-L.Ord.*

Schizopea BUTTS, 1926 [**S. washburnei*] [=*Roubidouxia* BUTTS, 1926; *Rhachopea* ULRICH & BRIDGE, 1931]. Spire low, widely phaneromphalous, sutures deep; sinus culminating at blunt angulation that forms periphery. *U.Cam.-L.Ord.*, N.Am.——FIG. 113,*1*. *S. typica* (ULRICH & BRIDGE), L.Ord., Mo.; ×1.

Dirhachopea ULRICH & BRIDGE, 1931 [**D. normalis*]. Spire low, widely phaneromphalous, last whorl disjunct; labral sinus culminating at blunt seemingly double-edged angulation that forms periphery, probably with short notch. *U.Cam.-L. Ord.*, N.Am.——FIG. 113,*5*. **D. normalis*, U. Cam., Mo.; ×2.

Euconia ULRICH in ULRICH & SCOFIELD, 1897 [**Pleurotomaria etna* BILLINGS, 1865; SD PERNER, 1907] [=?*Jarlopsis* HELLER, 1954 [1956] (55, p. 32)]. Trochiform, sutures shallow; sinus culminating at angular periphery just above upper suture, probably in short notch. *L.Ord.*, N.Am. ——FIG. 113,*2*. **E. etna* (BILLINGS), Newf.; ×1.3.

Ophileta VANUXEM, 1842 [**O. complanata;* SD S.A.MILLER, 1889]. With angular labral sinus culminating at periphery in notch that generates selenizone on upper side of peripheral angle. *L. Ord.*, N.Am.-NE.Asia.

O. (Ophileta) [=*Polygyrata* WELLER, 1903]. Whorls approximately as high as wide, umbilical sutures relatively deep. *L.Ord.*, N.Am.-NE.Asia. ——FIG. 113,*4*. **O. (O.) complanata*, Tex.; *4a,b*, aperture oblique from above and below, ×1.3.

O. (Ozarkispira) WALCOTT, 1924 [**O. leo*]. Whorls about twice as high as wide, umbilical slopes continuous. *L.Ord.*, N.Am.——FIG. 113,*3*. **O. (O.) leo* (WALCOTT), Can.(Alba.); *3a,b*, aperture oblique from above and below, ×2.7.

Calaurops WHITFIELD, 1886 [**C. lituiformis*] [=*Orthostoma* CONRAD, 1838 (*non* AUDINET-SERVILLE, 1834)]. First 3 or 4 whorls discoidal, with wide umbilicus and angular deep sinus culminating at periphery, seemingly generating a selenizone; last whorl disjunct, rodlike, with angular periphery bearing deep sinus continued into the extension; coiled whorls abandoned and filled solidly with secondary deposits that leave cast of interior of later part of shell with tapering pointed apex. *L.Ord.*, N.Am.——FIG. 113,*6*. **C. lituiformis*, Vt.; ×0.7.

Subfamily RAPHISTOMATINAE Koken, 1896

[*nom. correct. et transl.* KNIGHT, BATTEN & YOCHELSON, herein (*ex* Raphistomidae KOKEN, 1896)]

Base commonly narrow, anomphalous or narrowly phaneromphalous, upper surface more or less flattened; with deep V-shaped

labral sinus in most species, culminating in a shallow notch that generates a selenizone at periphery. *M.Ord.-U.Dev., ?L.Carb.*

Scalites EMMONS, 1842 [**S. angulatus*]. Resembles *Acteonina* in shape but much larger and wider, with broad ramp around low gradate spire terminating in sharp peripheral angulation; base extended, subconical; labrum with angular sinus above, culminating at periphery, where it may generate a selenizone. *M.Ord.*, N.Am.——FIG. 114. **S. angulatus*, Vt.; ×1.

Raphistoma HALL, 1847 [*non* RAFINESQUE, 1815, ICZN Op. 225] [**Maclurea striatus* EMMONS, 1842; SD DEKONINCK, 1881]. Upper surface nearly flat, base anomphalous or narrowly phaneromphalous; sinus culminating in notch that generates an angular selenizone forming periphery; upper lip sigmoid; ornamented by collabral cords. *M. Ord.-Sil.*, N.Am.-Eu.——FIG. 115,*2*. **R. striatum* (EMMONS), M.Ord., Vt.; *2a,b*, apertural view and from above, showing characteristic bends in growth lines, ×1.5.

Pararaphistoma VOSTAKOVA, 1955 [**Helicites qualteriatus* SCHLOTHEIM, 1820] [=*Pararaphistoma (Climacoraphistoma)* VOSTAKOVA, 1955 (144, p. 83)]. Shell lenticular to low-spired with "stair step" profile; widely phaneromphalous; growth lines sweeping back smoothly from suture, without a sigmoidal bend (144, p. 83). *Ord.*, Eu.-N. Am.

Buechelia C. SCHLÜTER, 1894 [**B. goldfussi*]. Shape like *Raphistoma* but with narrowing at base that suggests a canal. *M.Dev.*, Eu.-N.Am.——FIG. 115, *1*. **B. goldfussi*, Ger.; ×1.

Arizonella STOYANOW, 1948 [**A. allecta*]. Like *Buechelia* but without canal-like narrowing at base; spire slightly gradate (135, p. 789). *U.Dev.*, N. Am.——FIG. 115,*3*. **A. allecta*, Ariz.; ×1.3 (135).

?Scalitina SPRIESTERSBACH, 1919 [**S. montana*] [=*Ampulloscalites* WENZ, 1938 (147, p. 167)]. Turbiniform except for wide ramp above, terminating at sharp angle with shallow groove just below on side; columellar lip widely arcuate; sinus probably present on labrum but unknown. *Dev.-L.Carb.*, Eu.——FIG. 115,*4*. **S. montana*. M.Dev., Ger.; ×0.7.

Subfamily LIOSPIRINAE Knight, 1956

Shell lenticular, with moderately deep V-shaped sinus culminating in short slit that generates a convex selenizone mostly or entirely on its upper side. *?L.Ord., M.Ord.-M.Perm.*

Liospira ULRICH & SCOFIELD, 1897 [**Pleurotomaria micula* HALL, 1862; SD MCLEARN, 1942] [=*Eocryptaenia* KOKEN, 1925]. Surface glossy, without ornament; selenizone convex, forming periphery but largely on upper side; cryptomphalous. *?L.Ord., M.Ord.-Sil.*, N.Am.-Eu.-NE. Asia.——FIG. 116,*2*. **L. micula* (HALL), U.Ord., Ky.; ×4.

?Arastra STOYANOW, 1948 [*A. torquata*]. Shell thick, minutely phaneromphalous; base extending slightly above lower margin of selenizone, extension rhythmically bent downward to produce frilled periphery; surface undulating (135, p. 790). *U.Dev.*, N.Am.——FIG. 116,*1*. **A. torquata* Ariz.; ×2.

Trepospira ULRICH & SCOFIELD, 1897 [**Pleurotomaria sphaerulata* CONRAD, 1842]. Shell like *Liospira* except for row of nodes just below upper suture and variation in details; selenizone wholly on upper side of periphery. *Dev.-M.Perm.*, N.Am.-S.Am.-Eu.-N.Afr.

T. (Trepospira) [=*Kansana* TASCH, 1953 (137, Am.-S.Am.-Eu.-N.Afr.——FIG. 116,*4*. **T. (T.) sphaerulata* (CONRAD), U.Penn., Ill., ×2. p. 397)]. Subsutural nodes rounded, base cryptomphalous or anomphalous. *Dev.-M.Perm.*, N.

T. (Angyomphalus) COSSMANN, 1916 [**Euomphalus radians* DEKONINCK, 1843]. Subsutural nodes lengthened radially; umbilicus partly open, surrounded by narrow circumumbilical funicle. *L.Carb.*, Eu.——FIG. 116,*3*. **T. (A.) radians* (DEKONINCK), Belg.; ×2.

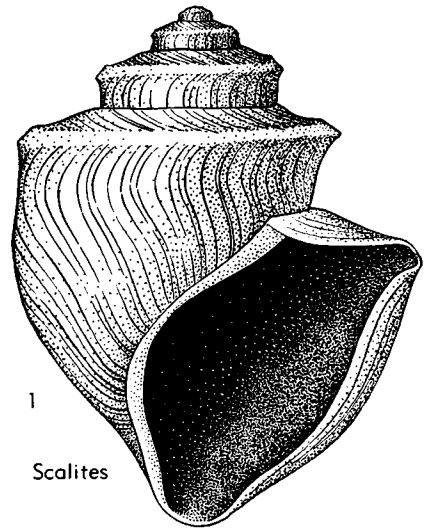


FIG. 114. Pleurotomariacea (Raphistomatidae——Raphistomatinae) (p. I201).

Subfamily OMOSPIRINAE Wenz, 1938

Shell gradate, with ramp; labral slit or sinus relatively wide, shallow, generating selenizone just within outer margin of ramp. *M.Ord.-L.Jur.(Lias.).*

Omospira ULRICH in ULRICH & SCOFIELD, 1897 [**O.*

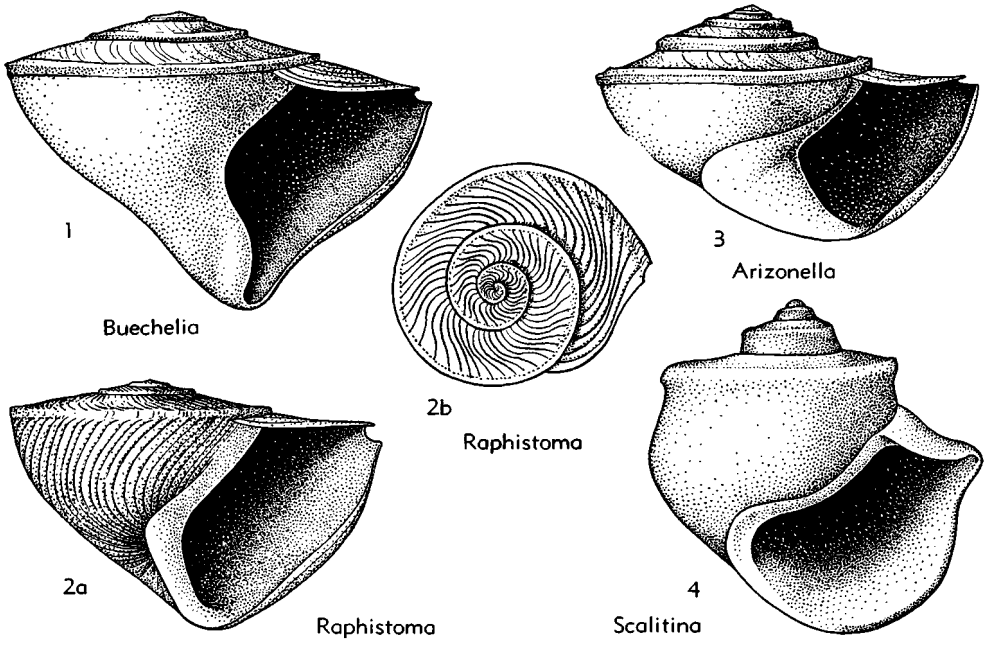


FIG. 115. Pleurotomariacea (Raphistomatidae——Raphistomatinae) (p. *I*201).

laticincta]. Relatively high-spired, anomphalous; selenizone about half width of ramp, without bordering threads, sloping downward and outward; sides below selenizone rounded. *M.Ord.-Sil.*, N.Am.-Eu.——FIG. 116,*9*. **O. laticincta*, M. Ord., Tenn.; ×1.

Baylea DEKONINCK, 1883 [**Trochus yvanii* LÉVEILLÉ, 1835] [=*Yvania* FISCHER, 1885 (obj.)]. Turbiniform; short labral slit on outer edge of sloping ramp, bordered by strong threads; ornamented primarily with spiral threads but with collabral threads and nodes in some species. *L. Carb.(Miss.)-M. Perm.*, N. Am.-Eu.-SE. Asia.——FIG. 116,*7*. **B. yvanii* (LÉVEILLÉ), L.Carb., Belg.; ×1.3.

Hypselentoma WELLER, 1929 [**Pleurotomaria perhumerosa* MEEK, 1872]. Like *Omospira* but with shallow groove below periphery and spiral threads on sides. *U.Penn.*, N.Am.——FIG. 116,*8*. **H. perhumerosa* (MEEK), Neb.; ×2.25.

Callistadia KNIGHT, 1945 [**C. bella*]. Relatively low-spired, narrowly phaneromphalous; selenizone bordered by cords; ornamented with revolving cords (72, p. 577). *Penn.-M.Perm.*, N.Am.-SE. Asia.——FIG. 116,*5*. **C. bella*, M.Perm., Tex.; ×2.7.

Sisenna KOKEN, 1896 [**Pleurotomaria turbinata* HÖRNES, 1855; SD COSSMANN, 1897]. Relatively low-spired, anomphalous or narrowly phaneromphalous, with spiral ridges, one delimiting broad, sloping ramp; collabral ornament almost confined to growth lines which are prosocyrt below ramp angle at which selenizone lies. *L.Trias.-L.Jur. (Lias.)*, cosmop.——FIG. 116,*6*. **S. turbinata*, U. Trias.(Carn.), Aus.; ×2 (79).

Family EOTOMARIIDAE Wenz, 1938

[*nom. transl.* KNIGHT, BATTEN & YOCHELSON, herein (*ex* Eotomariinae WENZ, 1938)]

Shell turbiniform to trochiform; labral slit invariably present, generating concave selenizone bordered by threads at approximately mid-height of whorl. *U.Cam.-L.Jur.(Lias.)*.

Subfamily EOTOMARIINAE Wenz, 1938

[=Ptychomphalinae, Ptychomphalininae WENZ, 1938]

Slit moderate to deep, umbilicus narrow or absent; ornament collabral and spiral elements, collabral dominant. *U.Cam.-L.Jur. (Lias.)*.

Tribe PTYCHOMPHALIDES Wenz, 1938

[*nom. transl.* KNIGHT, BATTEN & YOCHELSON, herein (*ex* Ptychomphalinae WENZ, 1938)] [=Ptychomphalininae WENZ, 1938]

Labral slit deep, selenizone flat or concave, commonly bordered by extended cords or flanges. *U.Cam.-L.Jur.(Lias.)*.

Taeniospira ULRICH & BRIDGE, 1931 [**T. eminencensis*]. Turbiniform; labral sinus V-shaped, culminating in moderately deep slit that generates concave selenizone bordered by low threads; narrowly phaneromphalous; ornamented with col-

labral threads that are strongly prosocline above selenizone and opisthocline below it. *U.Cam.*, N. Am.——Fig. 118,*2*. **T. eminencensis*, Mo.; ×1.

Mourlonia deKoninck, 1883 [**Helix carinatus* J. Sowerby, 1812] [=*Ptychomphalina* Fischer, 1885; *Cryptaulus* Foerste, 1923; *Promourlonia* Longstaff, 1924; *Foersteria* Tomlin, 1929 (*pro Cryptaulus* Foerste, 1923, *non* Bavay, 1903); *Eocryptaulina* Foerste, 1936 (*pro Foersteria* Tomlin, 1929, *non* Szépligeti, 1896); *Spiroraphella* Grabau, 1936]. Turbiniform; labral sinus relatively shallow but culminating in rather deep slit; ornament dominantly collabral but also spiral; growth lines strongly prosocline above selenizone and below it except for short distance at top; color pattern of wide transverse spots above selenizone may be preserved. *M.Ord.-L.Perm.*, N.Am.-Eu.-Asia-Austral.——Fig. 117,*1*. **M. carinata* (Sowerby), L.Carb., Eng.; ×0.7.

Oehlertia Perner, 1907 [**Pleurotomaria (Oehlertia) senilis*] [=*?Bembexia (Pleurotobembex)* Solle, 1956]. Trochiform, with moderately wide umbilicus; labral sinus shallow, culminating in fairly deep slit that generates a selenizone between pair of carinae; ornament as in *Mourlonia*. *L. Dev.*, Eu.——Fig. 117,*2*. **O. senilis* (Perner), Czech.; ×2.

Tropidostropha Longstaff, 1912 [**Pleurotomaria griffithii* M'Coy, 1844]. Shell large, with angular periphery carrying flat or convex selenizone between pair of lamellae; slit deep; growth lines gently prosocline above selenizone and, except next to it, almost vertical below; umbilicus narrow, funnel-shaped; an obscure spiral thread around lower surface; vertical lacunae in outer shell layers. *L.Carb.*, Eu.——Fig. 118,*4*. **T. griffithii* (M'Coy), Ire.; ×0.5.

Euconospira Ulrich in Ulrich & Scofield, 1897 [**Pleurotomaria turbiniformis* Meek & Worthen, 1861; SD Knight, 1937] [=*Trechmannia* Long-

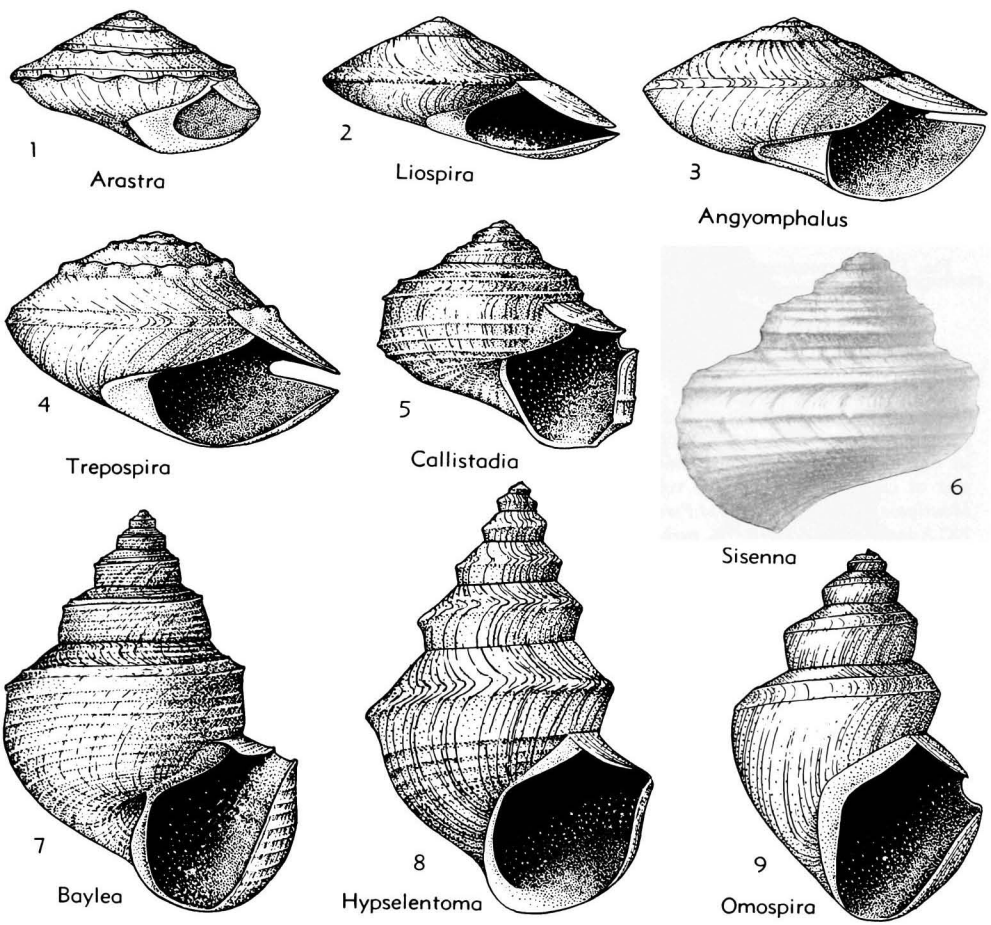


Fig. 116. Pleurotomariacea (Raphistomatidae——Liospirinae, Omospirinae) (p. *I*201-*I*202).

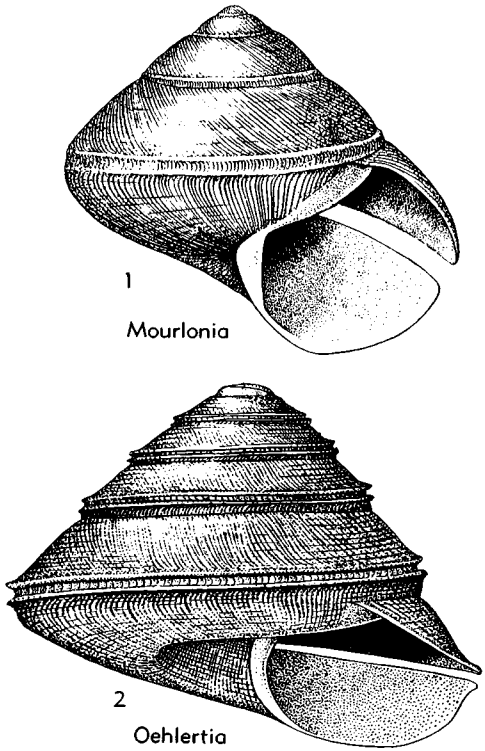


FIG. 117. Pleurotomariacea (Eotomariidae—Eotomariinae) (p. 1203).

STAFF, 1912; *Pernotrochus* H.CHRONIC, 1952 (14, p. 120)]. Trochiform, base moderately convex to slightly concave, anomphalous or with pseudumbilicus; labral sinus shallow, culminating in deep slit that generates a selenizone between pair of carinae; ornament and color pattern as in *Mourlonia*. *Miss.(L.Carb.)-M.Perm.*, N.Am.-Eu.-NC.Asia.——FIG. 118,*10*. **E. turbiniformis* (MEEK & WORTHEN), U.Penn., Ill.; ×2.7.

Spiroscala KNIGHT, 1945 [**S. pagoda*]. Trochiform, with sharply conical spire; selenizone bordered by conspicuous protruding cords; base nearly flat, narrowly phaneromphalous; ornament spiral and transverse, latter dominant (72, p. 574). *Miss.(L. Carb.)-M.Perm.*, N.Am.-Eu.-Austral.——FIG. 118, *3*. **S. pagoda*, U.Penn., Tex.; ×4.

Shwedagonia BATTEN, 1956 [**S. elegans*]. Turbiniform, with spire slightly to strongly coeloconoid; phaneromphalous; slit very narrow and deep, about 0.8 of final whorl in depth; selenizone narrow, deeply embedded, both slit and selenizone bordered below by broad smooth flat area with fine opisthocline growth lines, followed by a thread, thus simulating lower part of selenizone; ornament collabral growth lines or sharp threads and faint spiral threads (5, p. 43). *L.Perm.-M. Perm.*, cosmop.——FIG. 118,*1*. **S. elegans*, M. Perm., Tex.; ×5.3.

Rhaphistomella KITTL, 1891 [**Pleurotomaria radians* WISSMANN in MÜNSTER, 1841] [=*Raphistomella* DIENER, 1926 (obj.)]. Small, sublenticular, with obtuse spire, phaneromphalous, protruding periphery carrying selenizone; slit short; growth lines strongly prosocline above selenizone, prosocyrt below. *M.Trias.(Ladin.)-U.Trias.(Rhaetic)*, Eu.——FIG. 119,*1*. **R. radians* (WISSMANN), U. Trias.(Carn.), S.Tyrol; *1a,b*, ×3 (64).

Euzone KOKEN, 1896 [**E. alauna*; SD COSSMANN, 1897] [=*Polyelasma* COSSMANN, 1897 (obj.)]. Small-medium, globose-turbiniform, phaneromphalous, angulation bordering umbilicus; whorls few, convex; selenizone at periphery, slightly overlapped on earlier whorls, wide, raised, bordered by cords and with prominent wide-spaced lunulae; ornament strong collabral threads prosocline above selenizone, orthocline below. *M.Trias.(Anis.)-U. Trias.(Carn.)*, Eu.——FIG. 119,*2*. **E. alauna*, M. Trias.(Anis.), Aus.; *2a*, abapertural side, ×1; *2b*, growth lines, ×1.5 (79).

Luciellina KITTL, 1900 [**L. contracta*; SD DIENER, 1926]. Lenticular or biconical, anomphalous or cryptomphalous, with prominent carina forming periphery at mid-height; base strongly convex; ornament spiral cords; selenizone including peripheral carina and a band below it, hence hidden on spire. *M. Trias. (Ladin.)-U. Trias. (Carn.)*, Eu. (Hung.-Aus.).——FIG. 123,*1*. **L. contracta*, M. Trias.(Ladin.), Hung.;×3 (Kittl).

Ptychomphalus AGASSIZ, 1839 [**Helicina compressa* J.SOWERBY, 1813] [=*Cochlicarina* BROWN, 1843 (obj.); *Cryptaenia* EUDES-DESLONGCHAMPS, 1864]. Sublenticular, cryptomphalous, umbilicus obscured by groove-encircled callous coating; spire low, obtuse, base strongly and evenly convex; surface smooth except for faint spiral threads and small nodes adjoining adapical suture in some species; selenizone peripheral, more or less overlapped on spire whorls; slit short. *L.Jur.*, Eu.——FIG. 119,*3*. **P. expansus* (SOWERBY), L.Lias., Fr.; *3a,b*, apertural and basal views, ×1 (111).

Tribe EOTOMARIIDES Wenz, 1938

[*nom. transl.* KNIGHT, BATTEN & YOCHELSON, herein (*ex* Eotomariinae WENZ, 1938)]

Labral slit only moderately deep, selenizone concave between a pair of threads, commonly with its lower border forming shell periphery. *M.Ord.-M.Perm.*

Eotomaria ULRICH & SCOFIELD, 1897 [**E. canalifera* ULRICH in ULRICH & SCOFIELD, 1897] [=*Spiroraphe* PERNER, 1907]. Sublenticular, coeloconoidal, minutely phaneromphalous; deep sinus culminating in short slit that generates a selenizone just above periphery. *M.Ord.-Sil.*, N. Am.-Eu.-NE.Asia.——FIG. 118,*7*. **E. canalifera* ULRICH, M.Ord., Tenn.; ×1.

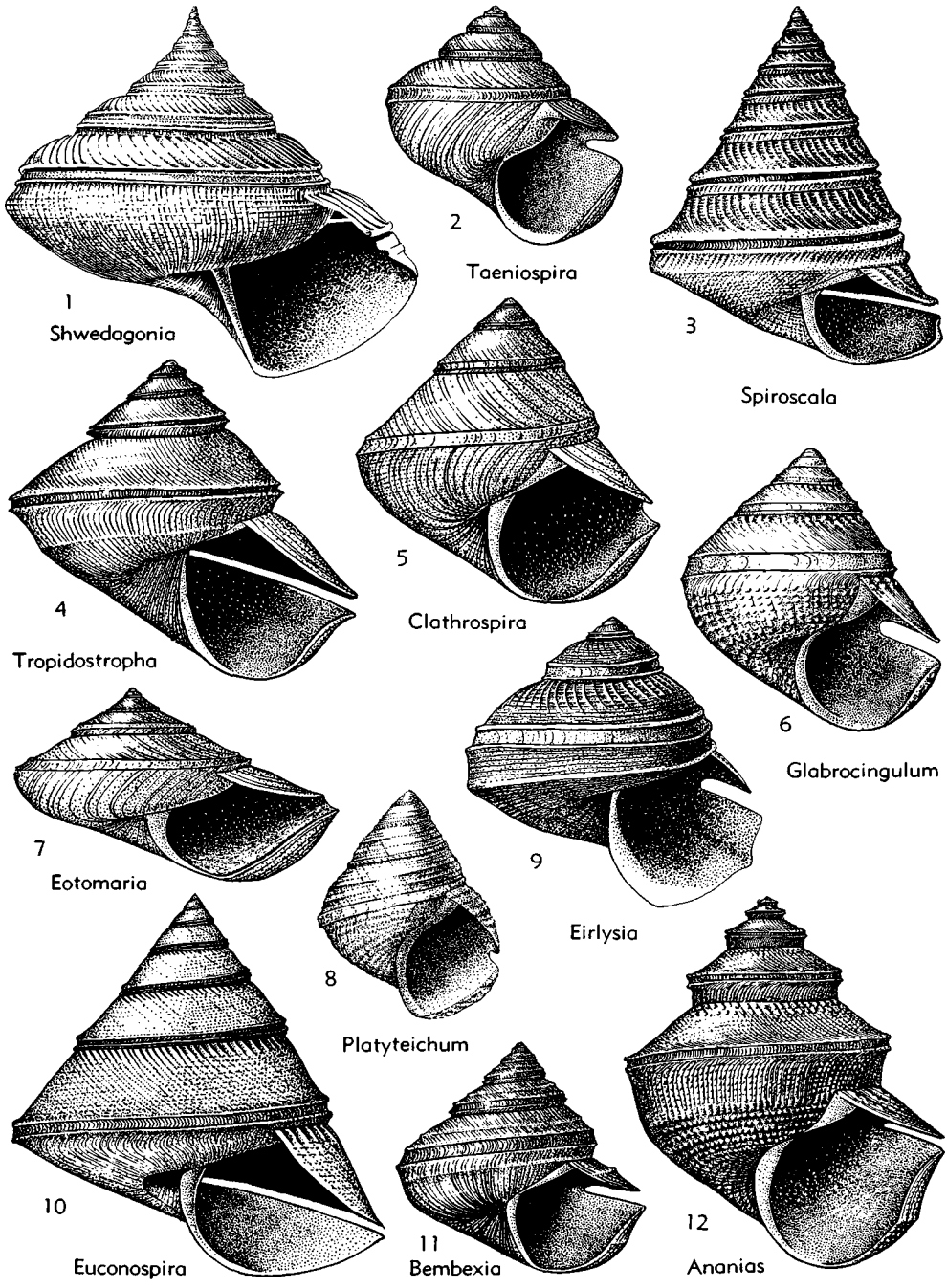


FIG. 118. Pleurotomariacea (Eotomariidae——Eotomariinae) (*1202-1206*).

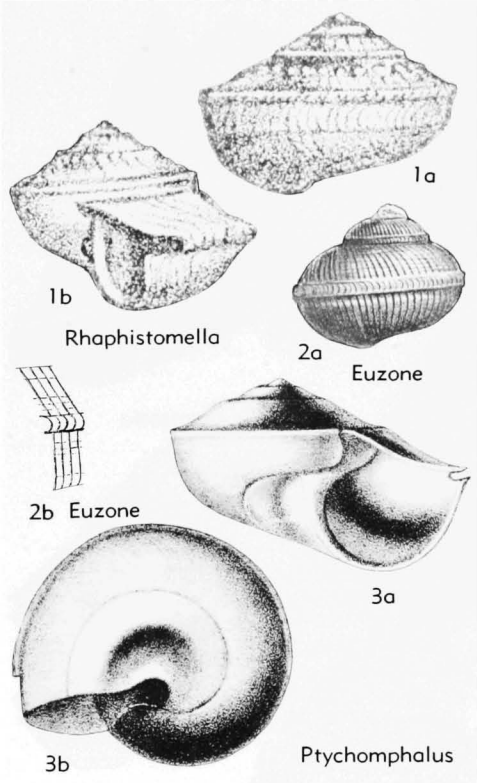


FIG. 119. Pleurotomariacea (Eotomariidae—— Eotomariinae) (p. *I*204).

Clathrospira ULRICH & SCOFIELD, 1897 [**Pleurotomaria subconica* HALL, 1847] [=*Palaeoschisma* DONALD, 1902]. Turbiniform, with conical spire and shallow sutures, narrowly phaneromphalous; growth lines strongly prosocline above selenizone and strongly opisthocline below it, but rounding to gently prosocline on base, outlining a moderately deep labral sinus that culminates in a short slit; selenizone bordered by fine threads; growth lines and lunulae periodically strengthened, very fine spiral threads numerous. *M.Ord.-Sil.*, N.Am.-Eu.——FIG. 118,*5*. **C. subconica* (HALL), M.Ord., N.Y.; ×2.

Bembexia OEHLERT, 1888 [**Pleurotomaria larteti* MUNIER-CHALMAS, 1876]. Turbiniform, slightly gradate, with moderately deep sutures, narrowly phaneromphalous to anomphalous; labral sinus moderately deep, selenizone concave between moderately strong threads; collabral lines or lirae and a spiral thread on upper whorl surface. *L.Dev.-L.Carb.(Miss.)*, Eu.-N.Am.——FIG. 118,*11*. **B. larteti* (MUNIER-CHALMAS), L.Dev., Fr.; ×1.

Glabrocingulum THOMAS, 1940 [**G. beggi*]. Turbiniform, spire varying from gradate to conical; conspicuous transverse and spiral threads with nodes at their intersections, ornament most prominent near upper suture and at base (140, p. 38). *L. Carb.(Miss.)-M.Perm.*, Eu.-E.Asia-N.Am.-S.Am.

G. (Glabrocingulum). Spire low conical, slightly gradate; many specimens with funicle in umbilicus. *L.Carb.(U.Miss.)-M.Perm.*, Eu.-E.Asia-N.Am.-S. Am.——FIG. 118,*6*. **G. (G.) beggi*, L.Carb., Scot.; ×2.

G. (Ananias) KNIGHT, 1945 [**Phanerotrema? welleri* NEWELL, 1935]. Gradate, some species closely resembling *Worthenia* and others *Glabrocingulum* s.s.; umbilicus without funicle (72, p. 573). *Miss.(L.Carb.)-Penn.(U.Carb.)*, N.Am.-Eu.-SE.Asia.——FIG. 118,*12*. **G. (A.) welleri* (NEWELL), U.Penn., Kan.; ×1.3.

Platyteichum CAMPBELL, 1953 [**P. costatum*]. Turbiniform, anomphalous or minutely phaneromphalous; ornamented with spiral threads and cords (12, p. 23). *L.Perm.*, Austral.——FIG. 118,*8*. **P. costatum*; ×1.

Eirlysia BATTEN, 1956 [**E. exquisita*]. Variably turbiniform, with rounded angulation surrounding flattish phaneromphalous base and gently concave selenizone between 2 threads slightly above mid-whorl; labral slit about 0.15 whorl deep; collabral and spiral ornament variously developed, the former commonly dominant (5, p. 44). *M. Perm.*, N.Am.——FIG. 118,*9*. **E. exquisita*, Tex.; ×2.7.

Subfamily AGNESIINAE Knight, 1956

Coiling sinistral or hyperstrophic. *L.Dev.-U.Trias.*

The protoconch in some species of *Agnesia* seems to be sinistral, like the teleoconch. The peculiar selenizone of this genus is known only in the type species. In *Hesperiella*, the inturned heterostrophic protoconch suggests hyperstrophy. Assuming that these genera are related, they are oriented for description as sinistral.

Hesperiella HOLZAPFEL, 1889 [**Pleurotomaria contraria* DEKONINCK, 1843; SD KNIGHT, 1937]. Pupiform, with protoconch coiling inward; selenizone low on whorls, gently arched; ornament collabral threads and cords. *L.Dev.-U.Carb.*, Eu.——FIG. 120,*1*. **H. contraria* (DEKONINCK), L.Carb., Belg.; *1a,b*, posterior and oblique view of apex, ×5.

Agnesia DEKONINCK, 1883 [**Pleurotomaria acuta* PHILLIPS, 1836]. Trochiform, with convex base; selenizone showing V-shaped lunulae with notch-within-slit pattern; ornament collabral and spiral threads. Protoconch of type species unknown. *L. Dev.-M.Perm.*, N.Am.-Eu.-SE.Asia.——FIG. 120,*2*. **A. acuta* (PHILLIPS), L.Carb., Eng.; ×2.

Enantiostoma KOKEN, 1896 [**Pleurotomaria perversa* HÖRNES, 1856]. Small, sinistral, turbiniform, broadly phaneromphalous; selenizone narrow,

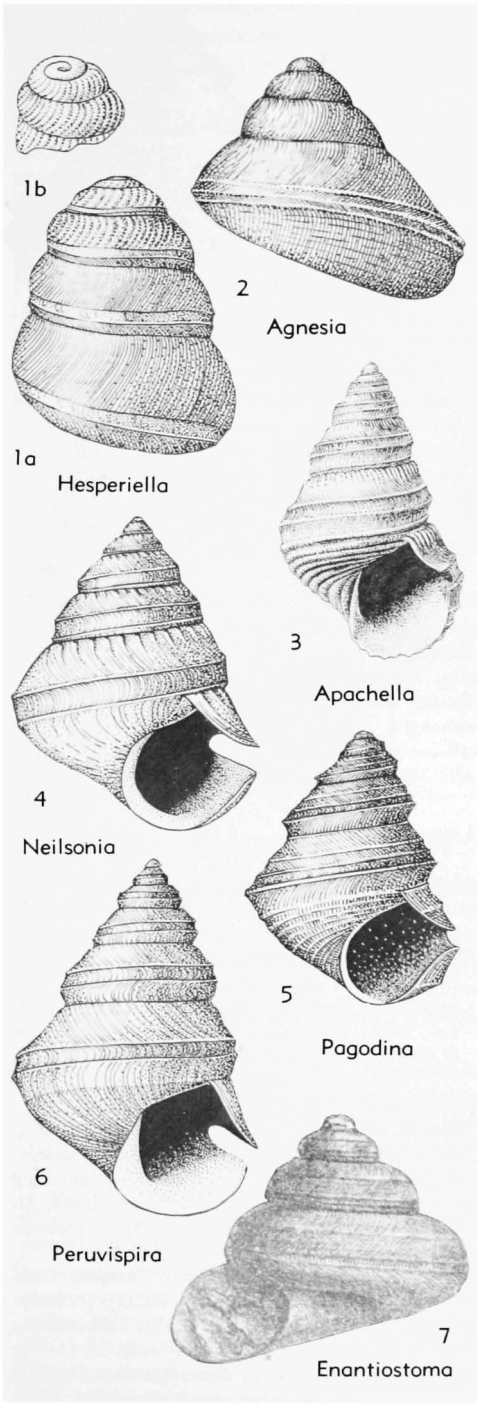


FIG. 120. Pleurotomariacea (Eotomariidae—— Agnesiinae) (p. *I*206-*I*207).

peripheral; ornament weak collabral and spiral threads, the former prosocline (having regard to sinistrality) above selenizone, opisthocline below it. *U.Trias.(Nor.),* Eu.——FIG. 120,*7*. **E. perversum,* Aus.; ×2.7 (79).

Subfamily NEILSONIINAE Knight, 1956

Shell relatively high-spired. *L.Carb.(Miss.)-U.Trias.*

Neilsonia THOMAS, 1940 [**N. roscobiensis*]. Selenizone relatively broad, located low on final whorl and just above sutures on spire; ornament collabral with tendency toward noding at upper end (140, p. 46). *L.Carb.(Miss.)-M.Perm.,* N.Am.-Eu.-SE. Asia.——FIG. 120,*4*. **N. roscobiensis,* L.Carb., Scot.; ×3.3.

Peruvispira, J.CHRONIC, 1949 [**P. delicata*]. Very small; selenizone on protruding carina; ornament growth lines (13, p. 146). *L.Perm.-M.Perm.,* S. Am.-N.Am.——FIG. 120,*6*. **P. delicata,* L.Perm., Peru; ×10.

Pagodina WANNER, 1942 [**P. typus*]. Somewhat gradate; selenizone just above angular periphery; ornament spiral (146, p. 166). *Perm.,* SE.Asia. ——FIG. 120,*5*. **P. typus,* E. Indies; ×3 (146).

Apachella WINTERS, 1956 [**A. translirata*]. Much like *Neilsonia* but with selenizone above middle of last whorl and well above suture on spire; ornament absent or various combinations of spiral and collabral; some species with a parietal tooth close to outer lip (151, p. 44). *L.Perm.-M.Perm.,* cosmop.——FIG. 120,*3*. **A. translirata,* M.Perm., Ariz.; ×4.

Pareuryalox HAAS, 1953 [**P. perornata*]. Littoriniform, narrowly phaneromphalous; whorls convex, not carinate; ornament minutely beaded spiral cords; selenizone wide, occupying almost all lower half of each spire whorl, with median beaded keel and another forming its upper border; inner lip reflected, almost hiding umbilicus. *U.Trias,* Peru. ——FIG. 202A,*2*. **P. perornata; 2a-d,* apertural, abapertural, apical, basal sides, ×3 (50).

Family LOPHOSPIRIDAE Wenz, 1938

[*nom. transl.* KNIGHT, BATTEN & YOCHELSON, herein (*ex* Lophospirinae WENZ, 1938)]

Shell with median labral sinus that generally culminates in a median angulation, and commonly with angulations both above and below; selenizone or pseudoselenizone convex; form of shell variable, whorls may be disjunct in late growth stages or throughout. *Ord.-M.Trias.*

Subfamily LOPHOSPIRINAE Wenz, 1938

Labral exhalant emargination generally a sharp V-shaped sinus, with or without a short notch. *Ord.-Sil.*

Many early Lophospirinae have homeo-

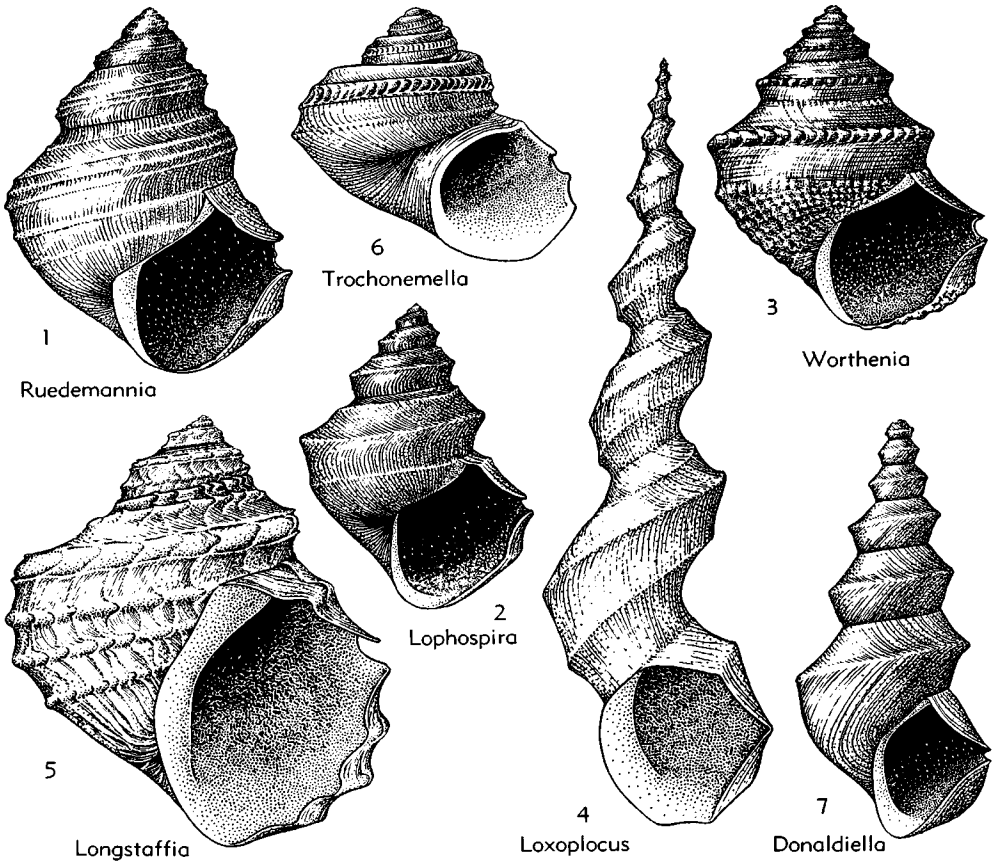


FIG. 121. Pleurotomariacea (Lophospiridae——Lophospirinae, Ruedemanniinae) (p. *I*208-*I*209).

morphic counterparts in the Trochonematidae. So close is the similarity that it is difficult to decide whether or not some should be separated in different families or superfamilies.

Loxoplocus FISCHER, 1885 [**Murchisonia tropidophora* WHITEAVES, 1884 (=*M. soluta* WHITEAVES, 1884)]. Sinus deep, angular; selenizone or pseudoselenizone convex. *Ord.-Sil.*, N.Am.-Eu.-NE.Asia.

L. (Lophospira) WHITFIELD, 1886 [**Murchisonia bicincta* HALL, 1847 (=*M. milleri* S.A.MILLER, 1877, *pro M. bicincta* HALL, *non* M'COY, 1844); SD OEHLERT, 1888] [=*Schizolopha* ULRICH in ULRICH & SCOFIELD, 1897; *Ptychonema* PERNER, 1903]. Turbinate, gradate; whorls mostly contiguous. *Ord.-Sil.*, N.Am.-Eu.-NE.Asia.——FIG. 121,*2*. **L. (L.) milleri* (MILLER), M.Ord., N.Y.; ×1.3.

L. (Loxoplocus). At least later whorls disjunct. *M.Ord.-Sil.*, N.Am.-NE.Asia.——FIG. 121,*4*. *L. (L.) solutus* (WHITEAVES), M.Sil., Ont.; ×0.7.

L. (Donaldiella) COSSMANN, 1903 [*pro Goniospira* DONALD, 1902 (*non* COSSMANN, 1895)] [**Goniospira filosa* DONALD, 1902] [=*Pagodispira* GRABAU, 1922]. Spire high, whorls mostly in contact. *M.Ord.-Sil.*, N.Am.-Eu.-NE.Asia.——FIG. 121,*7*. **L. (D.) filosa* (DONALD), U.Ord., Scot.; ×2.7.

Trochonemella OKULITCH, 1935 [**Lophospira*(?) *notabilis* ULRICH & ULRICH & SCOFIELD, 1897]. Shape like *Trochonema (s.s.)*, narrowly phaneromphalous; sinus relatively shallow, culminating in wide notch that gives rise to a selenizone. *M. Ord.*, N.Am.——FIG. 121,*6*. **T. notabilis* (ULRICH), Tenn.; ×1.3.

Longstaffia COSSMANN, 1908 [*pro Tubulosa* COSSMANN, 1908 (*non* SCHWEIGGER, 1820)] [**Pleurotomaria tubulosa* LINDSTRÖM, 1884]. Turbiniform; convex selenizone generated by deep notch (or shallow slit) on a carina somewhat above middle of labrum; several other spiral carinae or cords with shallow labral reentrants marked by transverse lamellae. *M.Sil.*, Eu.——FIG. 121,*5*. **L. tubulosa* (LINDSTRÖM), Gotl.; ×2.

Subfamily RUEDEMANNIINAE Knight, 1956

Exhalant emargination of labrum a true slit that generates a selenizone. *M.Ord.-M.Trias.*

In tracing *Ruedemannia* into the Devonian, a succession of species is found to approach *Worthenia* more and more closely. The latter genus, which appears in the Mississippian, converges in various characters with Carboniferous genera of the Eotomariidae (such as *Glabrocingulum*); indeed, some species of *G. (Ananias)* are distinguishable from *Worthenia* only by the absence of a convex crenulated selenizone.

Ruedemannia FOERSTE, 1914 [**Lophospira (?Seelya) lirata* ULRICH in ULRICH & SCOFIELD, 1897] [=*Coronilla* PERNER, 1907 (*non* BENEDEN, 1871)]. Turbiniform; slit short, selenizone wide, with median thread; spiral thread on slope above selenizone and 2 below. *M.Ord.-Dev.*, N.Am.-Eu. ——FIG. 121,*1*. **R. lirata* (ULRICH), U.Ord., Ky.; ×2.7.

Worthenia DEKONINCK, 1883 [**Turbo tabulatus* CONRAD, 1835] [=*Platyworthenia* H.CHRONIC, 1952 (14, p. 121)]. Shape like *Loxoplocus (Lophospira)* but highly ornamented with spiral and collabral threads; convex selenizone strongly crenulated; anomphalous or minutely phaneromphalous. *L.Carb.(Miss.)-M.Trias.*, cosmop.——FIG. 121,*3*. **W. tabulata* (CONRAD), U.Penn., Pa.; ×1.3.

Family LUCIELLIDAE Knight, 1956

More or less trochiform, with marginal frill and broad shallow labral notch just below frill generating a broad selenizone; ornament on upper whorl surface generally includes oblique strongly opisthocline threads or cords normal to prosocline growth lines. *Ord.-U.Carb.*

Rhombella BRIDGE & CLOUD, 1947 [**Roubidouxia umbilicata* ULRICH & BRIDGE in DAKE & BRIDGE, 1932]. Spire low conical, base nearly flat, with moderately wide umbilicus; labral sinus culminating at periphery in shallow notch that generates a selenizone; whorl section rhomboidal (9, p. 550). *L.Ord.*, N.Am.——FIG. 122,*2*. **R. umbilicata* (ULRICH & BRIDGE), Mo.; ×0.7.

Prosolarium PERNER, 1903 [**P. procerum*]. Oblique threads very fine; umbilicus with smooth concave callus; frill small, not fluted. *U.Sil.*, Eu.——FIG. 123,*3*. **P. procerum*, Czech.; ×1.3.

Epiptychia PERNER, 1907 [**Clisospira potens* PERNER, 1903]. Relatively high-spired, anomphalous; frill short, scalloped; ornament of prosocline, slightly imbricating growth lamellae with fine oblique threads between and normal to them.

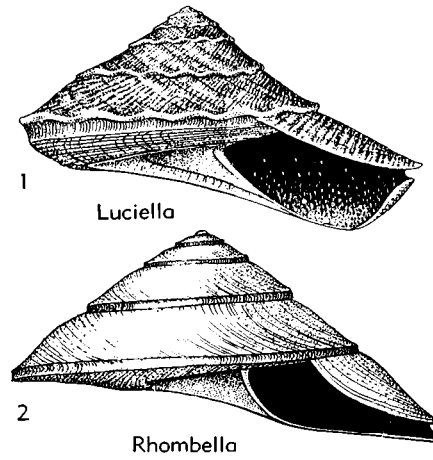


FIG. 122. Pleurotomariacea (Luciellidae) (p. *1209*).

L.Dev., Eu.——FIG. 123,*2*. **E. potens* (PERNER), Czech.; ×1.3.

Luciella DEKONINCK, 1883 [**Pleurotomaria eliana* DEKONINCK, 1843]. Frill fluted, spiral cords numerous on base between umbilical callus and selenizone, oblique threads on upper surface moderately coarse. *M.Dev.-U.Carb.(Penn.)*, Eu.-N.Am. ——FIG. 122,*1*. **L. eliana* (DEKONINCK), L.Carb., Belg., ×1.3.

Echinocirrus RYCKHOLT, 1860 [**Cirrus armatus* DE KONINCK, 1843] [=*Cirridius* DEKONINCK, 1881 (obj.)]. Like *Luciella*, but threads normal to growth lines are replaced by 3 series of coarse cords terminating at periphery in 3 rows of tubular openings. *L.Carb.*, Eu.——FIG. 123,*4*. **E. armatus* (DEKONINCK), Belg.; *4a,b*, from above and below, ×1.3.

Family PHANEROTREMATIDAE Knight, 1956

Well-marked selenizone bordered by sharp threads high on whorl; labral slit short; anomphalous. *M.Ord.-L.Dev.*

Brachytomaria KOKEN, 1925 [**Pleurotomaria baltica* DEVERNEUIL, 1845]. Turbiniform, gradate, with tapering anomphalous base and thickened columellar lip; ornament (in type species) comprising sharp lamellar collabral threads. *M.Ord.*, Eu.——FIG. 124,*1*. **B. baltica* (DEVERNEUIL), Est.; ×1.3.

Ulrichospira DONALD, 1905 [**U. similis*]. Like *Brachytomaria* but with higher, more attenuated spire. *L.Sil.*, Eu.——FIG. 124,*3*. **U. similis*, Eng.; ×3 (119).

Phanerotrema FISCHER, 1885 [**Pleurotomaria labrosa* HALL, 1860]. Shape and position of selenizone much as in *Brachytomaria* but with shallower sutures and larger last whorl; collabral

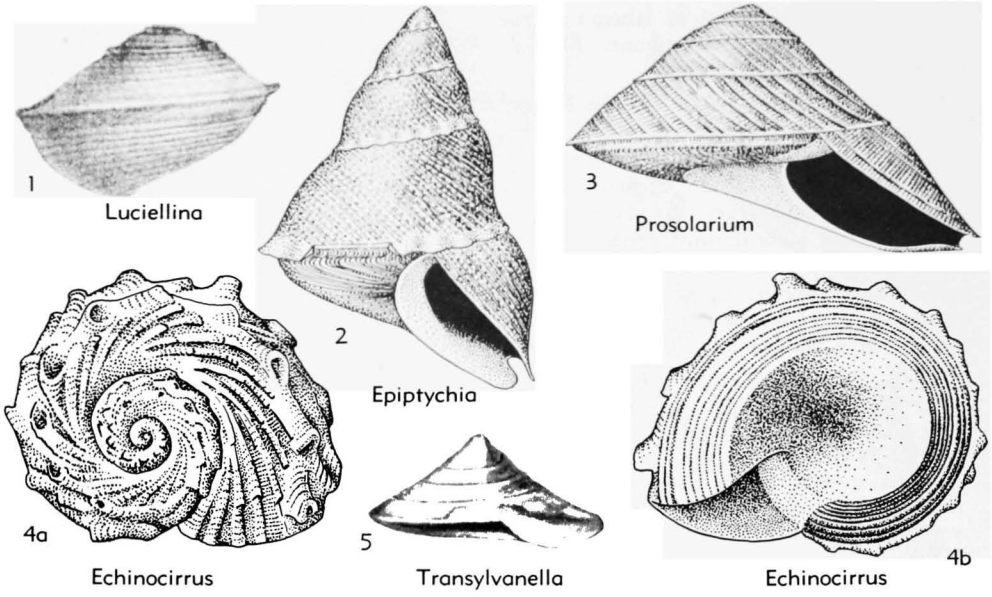


FIG. 123. Pleurotomariacea (Luciellidae, Eotomariilae, Family Uncertain) (p. *I*204, *I*209, *I*223).

lamellae or spiral cords, or both. *L.Sil.-L.Dev.*, N.Am.-Eu.-Austral.——FIG. 124,*2*. **P. labrosum* (HALL), L.Dev., N.Y.; ×0.7.

Family GOSSELETINIDAE Wenz, 1938

[*nom. transl.* KNIGHT, BATTEN & YOCHELSON, herein (*ex* Gosseletininae WENZ, 1938)]

Labral slit short, selenizone flat and generally without bordering threads. *M.Ord.-Trias.*

Subfamily GOSSELETININAE Wenz, 1938

Slit and selenizone narrow, above mid-whorl. *M.Ord.-Trias.*

Pseudocryptaenia KOKEN, 1925 [**Pleurotomaria lahuseni* KOKEN, 1897]. Rotelliform, small, phaneromphalous; outer lip with short notchlike sinus or slit, selenizone narrow and slightly raised at outer margin of upper whorl surface; ornament growth lines. *M.Ord.*, Eu.——FIG. 125,*1*. **P. lahuseni* (KOKEN), Est.; ×4 (80).

Stenoloron OEHLERT, 1888 [**Pleurotomaria (Stenoloron) viennayi*]. Turbiniform, phaneromphalous; narrow selenizone high on whorl face. *M.Sil.-L. Dev.*, Eu.——FIG. 125,*4*. **S. viennayi* (OEHLERT), L.Dev., Fr.; ×1 (108).

Platyloron OEHLERT, 1888 [**Pleurotomaria bishofi* GOLDFUSS, 1844]. Rotelliform, small, anomphalous; broad convex selenizone on upper whorl face. *M. Sil.-M.Dev.*, Eu.——FIG. 125,*3*. **P. bishofi* (GOLDFUSS), M.Dev., Ger.; ×4.

Umbotropis PERNER, 1903 [**U. albicans*]. Umboniform, with narrow umbilicus; slit and selenizone above mid-whorl; surface smooth, glossy. *L.Dev.*, Eu.——FIG. 125,*2*. **U. albicans*, Czech.; ×4.

?Triangularia FRECH, 1894 [**T. paradoxa*]. Conical triangular, with many narrow whorls and wide umbilicus; flat selenizone on upper whorl face. *L.Dev.*, Eu.——FIG. 125,*6*. **T. paradoxa*, Ger.; *6a,b*, apical and apertural views, ×2 (44).

Gosseletina FISCHER, 1885 [*pro Gosseletia* DE KONINCK, 1883 (*non* BARROIS, 1882)] [**Pleurotomaria callosa* DEKONINCK, 1843]. Turbiniform, anomphalous, with much thickened inner lip; slit short; narrow flat selenizone high on whorl face; surface of type species glossy but other species referred to genus have spiral and collabral ornament and are narrowly phaneromphalous. *?Dev., L.Carb.(Miss.)-Perm., ?Trias.*, Eu.-NC.Asia-N.Am. ——FIG. 125,*5*. **G. callosa* (DEKONINCK), L.Carb., Belg.; ×1.3.

Rufilla KOKEN, 1896 [**R. densecincta;* SD COSSMANN, 1897]. Small, globular, narrowly phaneromphalous; whorls evenly convex, smooth or with spiral ornament; selenizone rather broad, high on whorl side, with median spiral cord and bordered by two others; growth lines gently prosocyrt above selenizone, more strongly so below. *U.Trias. (Carn.)*, Eu.——FIG. 125,*7*. **R. densecincta*, Aus.; ×5 (79).

Subfamily COELOZONINAE Knight, 1956

Slit broad and short. *M.Ord.-L.Dev.*

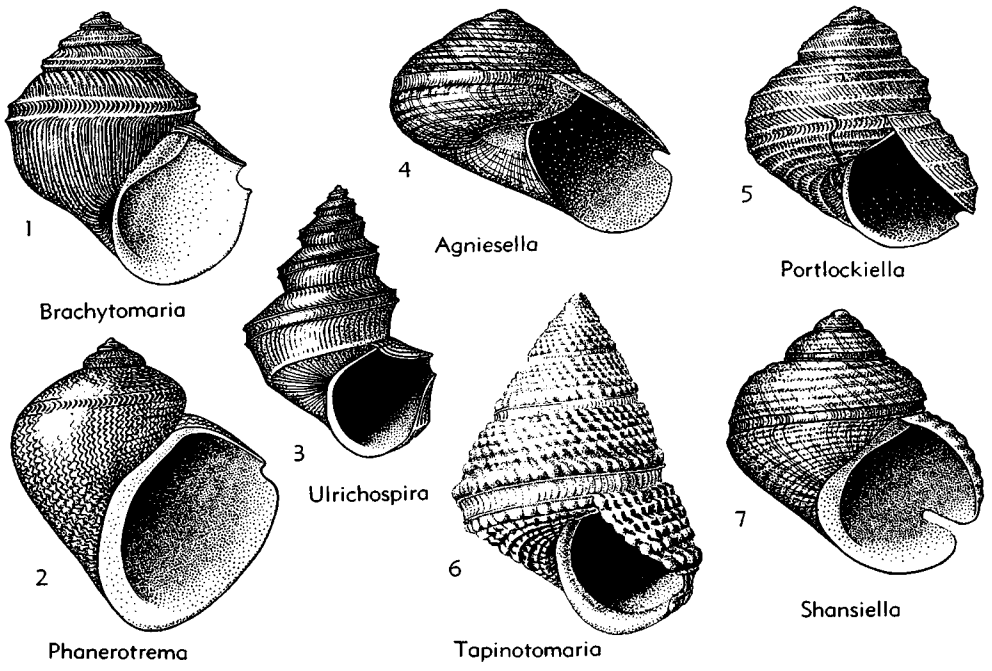


FIG. 124. Pleurotomariacea (Phanerotrematidae, Portlockiellidae) (p. *I*209, *I*212).

Tribe COELOZONIDES Knight, 1956

Selenizone broad, depressed. *M.Ord.-M. Dev.*

Latitaenia KOKEN, 1925 [**Pleurotomaria rotelloidea* KOKEN, 1896]. Rotelliform; slit and selenizone moderately high on whorl face; base rounded, narrowly phaneromphalous; ornament growth lines. *M.Ord.-U.Ord.*, Eu.——FIG. 126,*1*. **L. rotelloidea* (KOKEN), M.Ord., Norway; ×2.

Euryzone KOKEN, 1896 [**Helicites delphinuloides* SCHLOTHEIM, 1820; SD PERNER, 1907]. Widely trochiform with moderately wide umbilicus and deep sutures; slit and selenizone moderately high on whorl face; ornament faint spiral and transverse threads. *U.Ord.-M.Dev.*, Eu.-SE.Asia-N.Am. ——FIG. 126,*3*. **E. delphinuloides* (SCHLOTHEIM), M.Dev., Ger.; ×0.75.

Conotoma PERNER, 1907 [**Pleurotomaria (Clathrospira [Conotoma]) eximia*]. Trochiform, narrowly phaneromphalous; broad selenizone on low peripheral angle; ornament collabral and spiral threads, lunulae strong and widely spaced. *U.Sil.*, Eu.——FIG. 126,*7*. **C. eximia* (PERNER), Czech.; ×1.

Coelozone PERNER, 1907 [**Pleurotomaria (Coelozone) verna*]. Low trochiform, with somewhat flattened anomphalous base; selenizone just above periphery. *U.Sil.*, Eu.——FIG. 126,*6*. **C. verna* (PERNER), Czech.; ×1.3.

Tribe PLANOZONIDES Knight, 1956

Selenizone flush with surface or slightly raised; ornament fine obliquely spiral threads normal to growth lines. *M.Ord.-L. Dev.*

Cataschisma E.B.BRANSON, 1909 [**C. typa*] [=*Globispira* KOKEN, 1925]. Shell rounded; short broad slit and faint selenizone low on whorl face; narrowly phaneromphalous. *M.Ord.-M.Sil.* N.Am.-Eu.——FIG. 126,*4*. *C. exquisita* (LINDSTRÖM), M. Sil., Gotl.; ×5.3.

Pleurorima PERNER, 1907 [**Pleurotomaria (Pleurorima) migrans* (=*Pleurotomaria pragensis* KOKEN, 1889); SD COSSMANN, 1908]. Shell thin, turbiniform; selenizone on crest of broad ridge; ornament as for tribe but with spiral threads on selenizone; ?anomphalous. *U.Sil.*, Eu.——FIG. 126,*2*. **P. pragensis* (KOKEN), Czech.; ×0.7.

Planozone PERNER, 1907 [**P. ramificans*]. Turbiniform, anomphalous; selenizone wide, nearly flat, slightly elevated above surface and located above mid-whorl. *L.Dev.*, Eu.——FIG. 126,*5*. **P. ramificans*, Czech.; ×10.

Family EUOMPHALOPTERIDAE Koken, 1896

Lenticular to trochiform, phaneromphalous, with exhalant channel developed

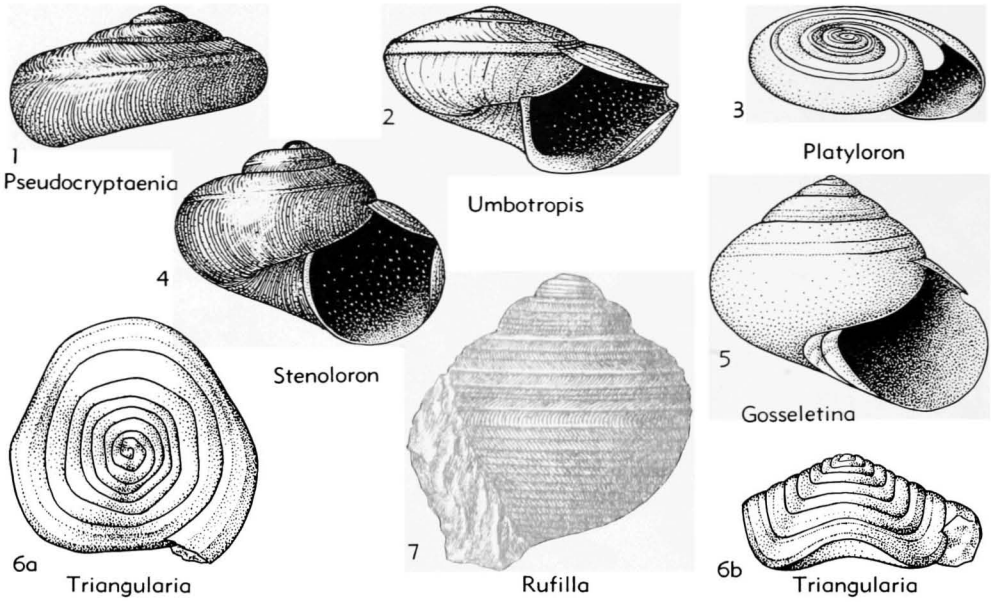


FIG. 125. Pleurotomariacea (Gosseletinidae——Gosseletininae) (p. *I*210).

within anterior edge of a more or less extensive frill or carina. *M.Sil.-U.Sil.*

Euomphalopterus C.F.ROEMER, 1876 [**Turbinites alatus* WAHLENBERG, 1821]. With channel-bearing frill; homologue of usual pleurotomarian lunulae appearing as series of narrow plates within frill and concave anterior face of last one forming exhalant channel; ornament numerous lamellar transverse threads. *M.Sil.-U.Sil.,* Eu.-N.Am.

E. (Euomphalopterus) [= *Evomphalopterus* FISCHER, 1885 (obj.); *Bathmopterus* KIRK, 1928]. Frill wide, pendent. *M.Sil.,* Eu.-N.Am.——FIG. 127,*2*. **E. alatus* (WAHLENBERG), Gotl.; ×0.7.

E. (Pleuromphalus) PERNER, 1903 [**P. seductor;* SD PERNER, 1907]. Frill a relatively narrow horizontal carina, undulating in some species. *U.Sil.,* Eu.——FIG. 127,*3*. **E. (P.) seductor* (PERNER), Czech.; ×1.3.

Crenilunula KNIGHT, 1945 [**Pleurotomaria limata* LINDSTRÖM, 1884]. Frill short, with exhalant channel replaced by median notch on distal end of lamellar lunulae (72, p. 582). *M.Sil.-U.Sil.,* Eu.——FIG. 127,*1*. **C. limata* (LINDSTRÖM), M. Sil., Gotl.; ×1 (90).

Family PORTLOCKIELLIDAE Batten, 1956

Turbiniform to trochiform, with notch or short labral slit giving rise to depressed selenizone low on whorl; spiral cords dominant, collabral threads also present. *Dev.-M.Perm.*

Agniesella COSSMANN, 1909 [*pro Pleuroderma* PERNER, 1907 (*non* TSCHUDI, 1837)] [**Pleurotomaria (Pleuroderma) aratula* PERNER, 1907]. Turbiniform with rounded whorls and gently arched selenizone; umbilicus moderately wide; growth lines gently prosocline above and below selenizone; ornament flat revolving cords. *L.Dev.,* Eu.——FIG. 124,*4*. **A. aratula* (PERNER), Czech.; ×1.3.

Portlockiella KNIGHT, 1945 [**P. kentuckyensis*] [=*Portlockia* DEKONINCK, 1881 (subj.) (*non* M'COY, 1846)]. Selenizone below line of suture; ornament spiral cords with wide concave interspaces and collabral threads (72, p. 579). *Miss. (L.Carb.),* N.Am.-Eu.——FIG. 124,*5*. **P. kentuckyensis,* M.Miss., Ky.; ×2.7.

Shansiella YIN, 1932 [**S. altispiralis*] [=*Latischisma* THOMAS, 1940 (140, p. 59)]. Turbiniform, anomphalous, whorls rounded; slit short, selenizone above line of suture but below mid-whorl; ornament dominantly spiral cords or threads. *L. Carb.(Miss.)-L. Perm.,* E. Asia-N. Am.-Eu.-N. Afr.——FIG. 124,*7*. *S. carbonaria* (NORWOOD & PRATTEN), M. Penn., Mo.; ×0.7.

Tapinotomaria BATTEN, 1956 [**T. rugosa*]. Turbiniform; slit a mere notch, selenizone low on whorl, concave, depressed; ornament dominantly spiral, finer collabral threads commonly forming nodes and even spines where crossing spiral elements, the latter commonly large and fasciculate (5). *L.Perm.-M.Perm.,* N.Am.——FIG. 124,*6*. **T. rugosa,* M.Perm., Tex.; ×5.3.

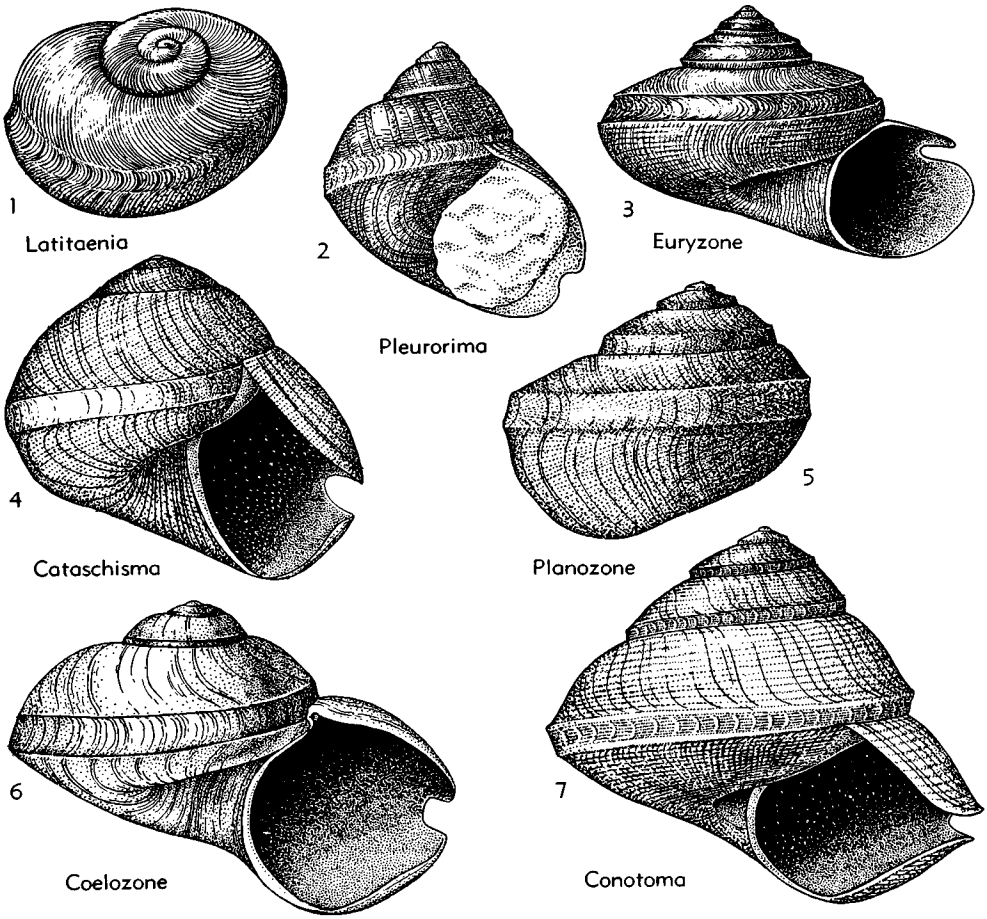


FIG. 126. Pleurotomariacea (Gosseletinidae——Coelozoninae) (p. *I*210-*I*211).

Family CATANTOSTOMATIDAE Wenz, 1938

[*nom. transl.* KNIGHT, BATTEN & YOCHELSON, herein (*ex* Catantostomatinae WENZ, 1938)]

Last whorl distorted and with highly specialized inhalant and exhalant openings. *M.Dev.*

Catantostoma SANDBERGER, 1842 [**C. clathratum*]. Ornament spiral and transverse cords; selenizone bordered by cords, concave, terminating at trema (?exhalant) that suggests a short slit; last 0.3 of whorl between trema and aperture without slit or selenizone, growing obliquely downward and backward around a circular inhalant opening with marked constriction of the aperture proper. [Unusual characters of last whorl may denote adaptation to stationary mode of life.] *M.Dev.*, Eu.—— FIG. 128,*1*. **C. clathratum*, Ger.; *1a*, side, showing both trema and inhalant orifice below; *1b*, side, showing ?exhalant trema; ×4.

Family PORCELLIIDAE Broili (*ex* Koken MS.), 1924

Coiling pseudo-isostrophic or euomphaloid but protoconch invariably dextral orthostrophic; with deep slit and narrow selenizone at or near mid-whorl; umbilici above and below about equal in some species; shell thin, ornamented with nodes and spiral and collabral threads. *Dev.-M.Jur.(Baj.)*.

Porcellia LÉVEILLÉ, 1835 [**P. puzo*; SD DEKONINCK, 1883]? [=*Tomoceras* WHITE & ST. JOHN, 1867; *Leveillia* NEWTON, 1891 (obj.); *Brittsoceras* MILLER, DOWNS, & YOUNGQUIST, 1949 (101, p. 603)]. With characters of family. [Pseudo-isostrophic species superficially resemble ammonites but are distinguished readily by their lack of septa, deep slit, and orthostrophic protoconch. The genus may represent an adaptation for free swimming.] *Dev.-U.Carb.(Penn.)*, *?Perm.*, Eu.-SE.

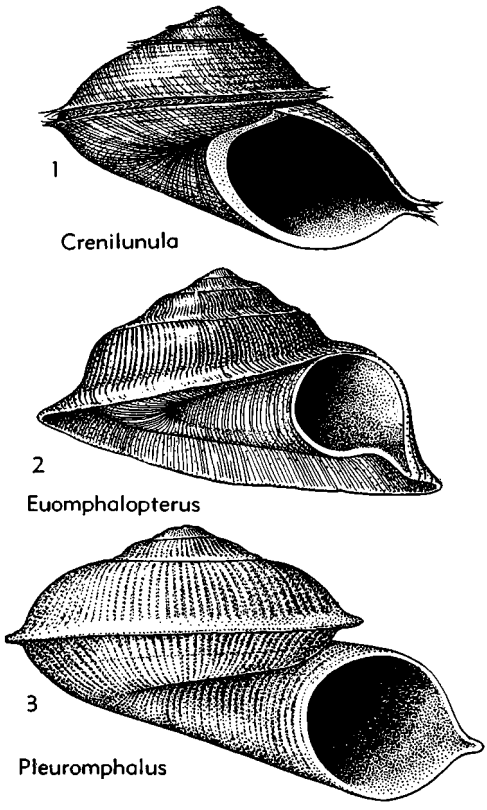


FIG. 127. Pleurotomariacea (Euomphalopteridae) (p. I212).

Asia-N.Am.——FIG. 129,*1*. **P. puzo*, L.Carb., Belg.; *1a-c*, from above, from below, and apertural, ×1.3.

Kokenella KITTL, 1891 [**Porcellia fischeri* HÖRNES, 1855] [=*Kokeniella* KOKEN, 1896 (obj.)]. Discoidal; ornament sigmoidal transverse riblets nodose at outer end and fine spiral threads; selenizone at mid-whorl. *M.Trias.(Anis.)-U.Trias.(Nor.)*, Eu.-Timor.——FIG. 129,*2*. **K. fischeri* (HÖRNES), U.Trias.(Nor.), Aus.; *2a,b*, apical and apertural views, ×0.7 (79).

Talantodiscus P.FISCHER, 1885 [**Pleurotomaria mirabilis* J.A.EUDES-DESLONGCHAMPS, 1849]. Discoidal with initial whorls protruding slightly; ornament tubercles on upper surface near periphery, sigmoidal transverse ribs on base, and sinuous spiral threads; selenizone above mid-whorl. *L.Jur.(M.Lias.)-M.Jur.(Baj.)*, Eu.——FIG. 129,*3*. **T. mirabilis* (EUDES-DESLONGCHAMPS), M.Lias., Fr.; *3a,b*, apical and side views, ×0.8 (111).

Family RHAPHISCHISMATIDAE Knight, 1956

Shell rotelliform, with deep narrow slit close to upper suture. *L.Carb.*

Rhaphischisma KNIGHT, 1936 [*pro Rotellina* DE KONINCK, 1881 (*non* AGASSIZ, 1846)] [**Rotellina planorbiformis* DEKONINCK, 1881]. Spire depressed, with lower lip reaching far inward and forming heavy callus that fills umbilicus. *L.Carb.*, Eu.——FIG. 129,*4*. **R. planorbiformis* (DEKONINCK), Belg.; *4a,b*, oblique from above and below, ×2.

Family PHYMATOPLEURIDAE Batten, 1956

Shell highly ornamented; moderately deep slit and selenizone somewhat below mid-whorl, selenizone slightly depressed below surface; parietal ornament partly or wholly resorbed within aperture in many species. *L.Carb.(Miss.)-Trias.*

Glyptotomaria KNIGHT, 1945 [**G. apiarium*]. Shape highly variable, turbiniform or high trochiform beehive-shaped to discoidal, base commonly flattened; sutures deep to linear; umbilicus wanting, or narrow to widely conical; constant ornament of sharp collabral and spiral lirae, former prosocline just above selenizone but orthocline below it and with broad sinus on base; selenizone depressed, bordered by cords, and bearing sharp regularly spaced lunulae; shallow sinus at upper

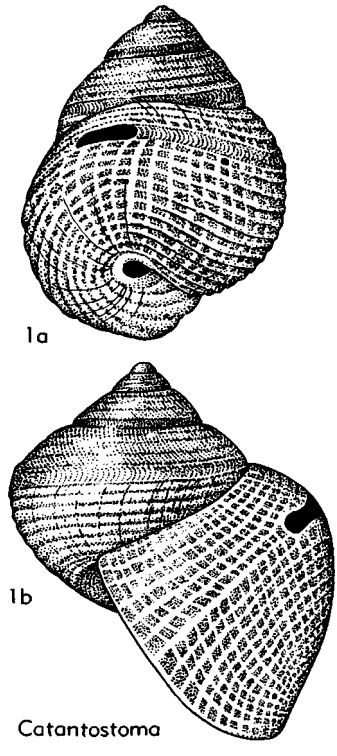


FIG. 128. Pleurotomariacea (Catantostomatidae) (p. I213).

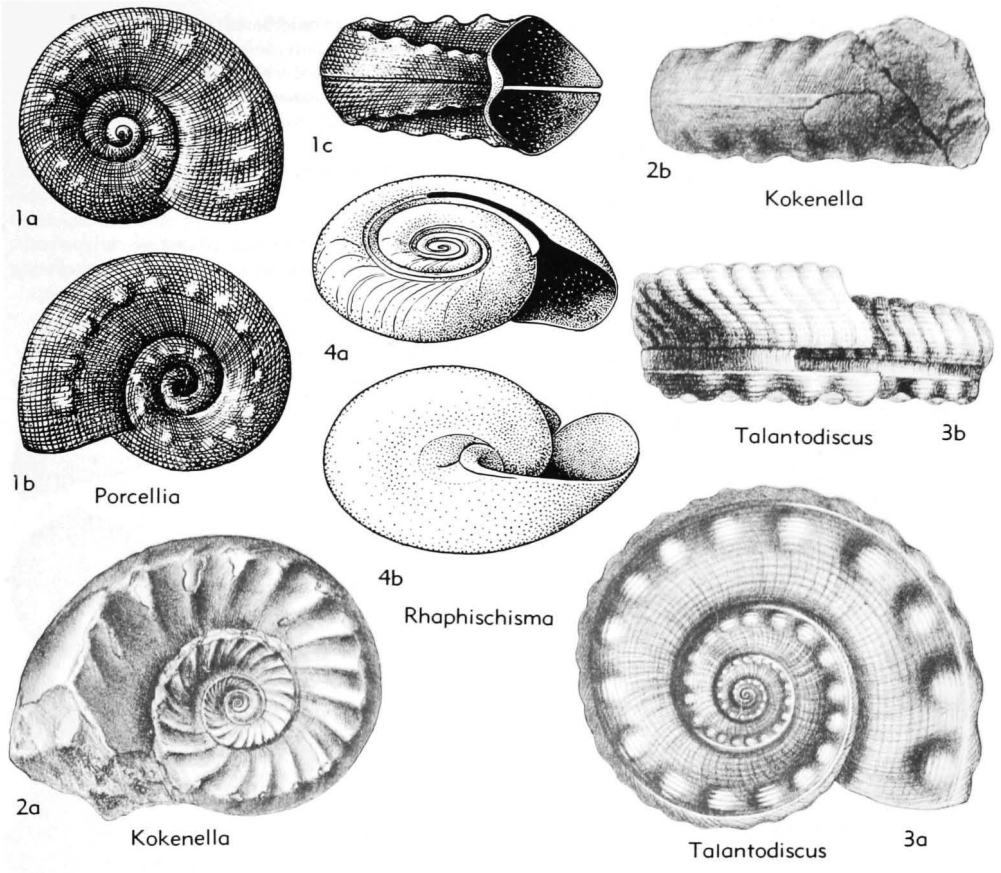


FIG. 129. Pleurotomariacea (Porcellidae, Rhaphischismatidae) (p. *I*213-*I*214).

end of columellar lip (72, p. 577). *Miss.-M.Perm.*, N.Am.

G. (Glyptotomaria). Trochiform to beehive-shaped or discoidal with flat base surrounded by rope-like fasciculation of spiral threads. *Penn.-M.Perm.*, N.Am.——FIG. 130,*10*. **G. (G.) apiarium*, U. Penn., Tex.; ×3.

G. (Dictyotomaria) KNIGHT, 1945 [**Pleurotomaria scitula* MEEK & WORTHEN, 1861]. Turbiniform, with moderately deep sutures and somewhat flat base (72, p. 576). *Miss.-Penn.*, N.Am.——FIG. 130,*8*. **G. (D.) scitula* (MEEK & WORTHEN), M. Penn., Mo.; ×4.

Borestus THOMAS, 1940 [**B. wrighti*] [=*Platypleurotomaria* WANNER, 1942 (146, p. 157)]. Gradate turbiniform, superficially resembling *Worthenia* but with depressed selenizone near mid-whorl and with shoulder on basal angulation sharp; ornament sharp spiral and transverse threads (140, p. 53). *L.Carb.(Miss.)-M.Perm.*, Eu.-SE. Asia-N.Am.-S.Am.——FIG. 130,*1*. **B. wrighti*, L.Carb., Scot., ×2.7.

Paragoniozona NELSON, 1947 [**P. nodolirata*]. Trochiform; selenizone depressed, low on whorl; sutures shallow; ornament of pustules that cover much of shell, including selenizone (105, p. 460). *Penn.(U.Carb.)*, N.Am.-SE.Asia.——FIG. 130,*2*. **P. nodolirata*. M.Penn., Tex.; ×4.

Phymatopleura GIRTY, 1939 [*pro Orestes* GIRTY, 1912 (*non* BLACKINSTONE & FRYER, 1880, *nec* REDTENBACHER, 1906)] [**Orestes nodosus* GIRTY, 1912]. Turbiniform or trochiform, with depressed selenizone above basal angulation; ornament sharp spiral and collabral threads with one or more spiral rows of nodes high on whorl face. *Penn.*, N.Am.——FIG. 130,*6*. **P. nodosus* (GIRTY), M. Penn., Okla.; ×5.

Callitomaria BATTEN, 1956 [**C. stanislavi*]. Turbiniform, gradate, minutely phaneromphalous, relatively wide vertical whorl face below wide ramp; flat selenizone occupying middle of whorl face and about half its width; ornament 2 spiral cords on ramp (at its lower edge and close to suture respectively) and about 6 sharp spiral cords on

base; sharp collabral threads on ramp and base in some species (5, p. 43). *M.Perm.*, N.Am.——Fig. 130,*9*. **C. stanislavi*, Tex.; ×2.7.

Discotomaria Batten, 1956 [**D. basisulcata*]. Shell rather flat with low gradate spire; whorls rising in steps; upper surface of whorl a concave shoulder or ramp; outer face vertical with projecting flange separating it from base; base beneath flange first sloping gently inward and then flattening abruptly to narrow umbilicus; slit about 0.25 whorl deep, selenizone occupying upper half of smooth band at middle of outer whorl-face; base with shallow sinus below flange; highly ornamented with spiral and collabral elements (5, p. 43). *U.Penn.-M.Perm.*, N.Am.——Fig. 130,*5*. **D. basisulcata*, M.Perm., Tex.; *5a,b*, apertural and umbilical views, ×4.

Eymarella Cossmann, 1897 [*pro Echetus* Koken, 1896 (*non* Krøyer, 1864)] [**Pleurotomaria subscalariformis* Hörnes]. Small, trochiform, with blunt apex due to discoidal coiling of early whorls, broadly phaneromphalous; ornament cancellating

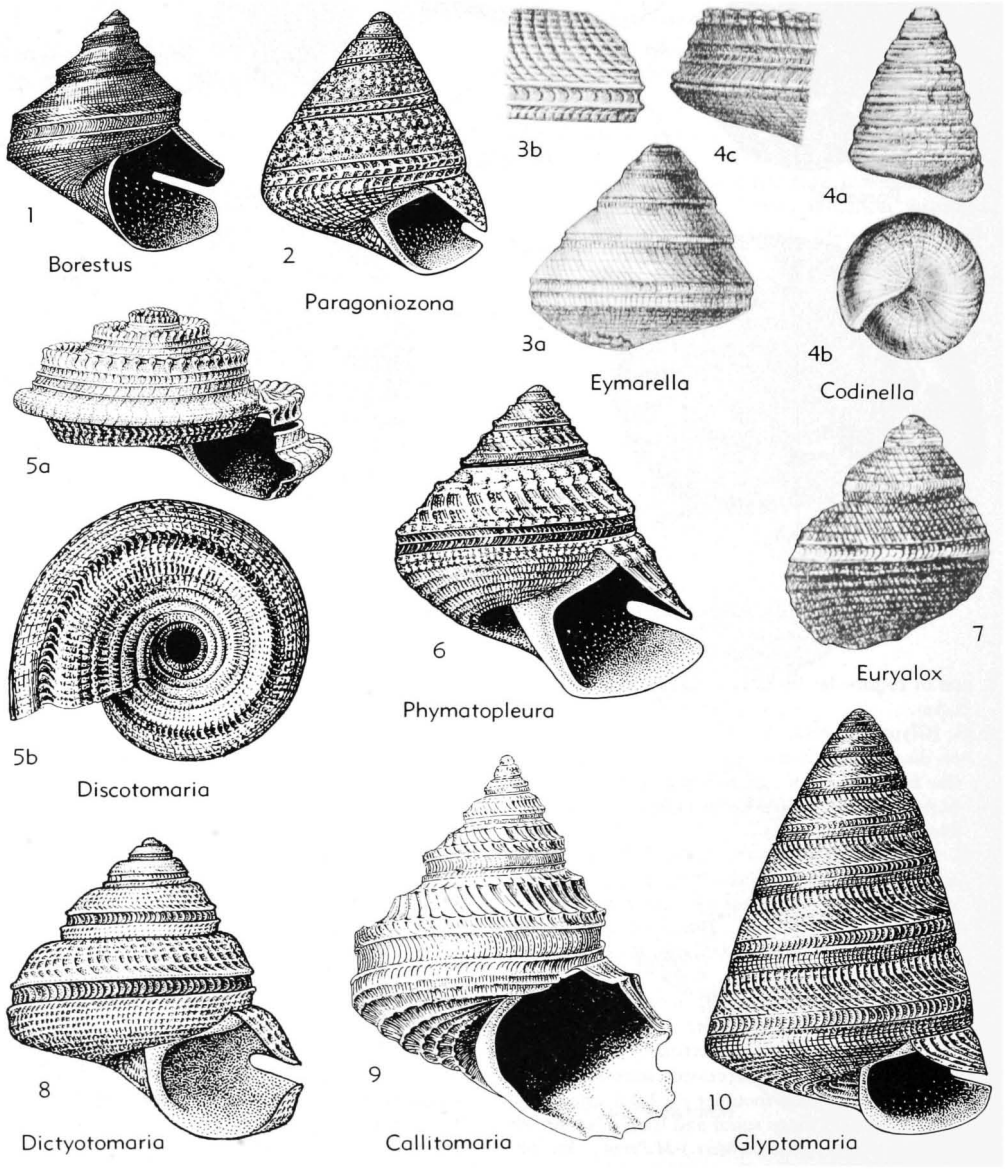


Fig. 130. Pleurotomariacea (Phymatopleuridae) (p. *I215-I217*).

collabral and spiral threads; selenizone impressed, at slightly flattened periphery, not overlapped on spire whorls. *M.Trias.(Ladin.)-U.Trias.(Nor.)*, Eu.——FIG. 130,*3*. **E. subscalariformis*, U.Trias. (Nor.), Aus.; *3a,b*, ×2.5; ×6 (79).

Euryalox COSSMANN, 1897 [*pro Sagana* KOKEN, 1896 (*non* WALKER, 1855)] [**Pleurotomaria juvavica* KOKEN, 1896]. Turbiniform, phaneromphalous, whorls evenly convex; ornament narrow cancellating spiral cords and collabral threads; selenizone peripheral, impressed, rather wide, bordered by spiral cords, and not overlapped on spire whorls; umbilical margin an angulation. *M.Trias.(Anis.)-U.Trias.(Nor.)*, Eu.-E.Indies(Timor).——FIG. 130, *7*. *E. geometrica* (KOKEN), U.Trias.(Carn.), Aus.; ×1.3 (79).

Codinella KITTL, 1899 [**Trochus generelli* STOPPANI, 1858]. Small, elevated, cyrtoconoid, anomphalous; base short; whorls flat or feebly convex, with weak spiral ornament; selenizone at midwhorl, growth lines prosocyrt below it, prosocline above; aperture small, much broader than high. *M.Trias.(Ladin.)*, Eu.——FIG. 130,*4*. **C. generelli* (KITTL), S.Tyrol; ×4, ×4, ×6 (66).

Family POLYTREMARIIDAE Wenz, 1938

[*nom. transl.* KNIGHT, BATTEN & YOCHELSON, herein (*ex* Polytremariinae WENZ, 1938)]

Exhalant emargination a labral slit or row of tremata; heavily thickened extension of columellar lip separated by a deep fissure from parietal lip, ornament spiral cords or threads. *L.Carb.-M.Perm.*

Polytremaria D'ORBIGNY, 1850 [**Pleurotomaria catenata* DEKONINCK, 1843]. With series of exhalant tremata; grooved extension of columellar lip curving around umbilicus. *L.Carb.*, Eu.——FIG. 131,*2*. **P. catenata* (DEKONINCK), Belg.; showing tremata and curved pulley-like inner lip; ×2.7.

Plocostoma GEMMELLARO, 1889 [**Pleurotomaria (Plocostoma) neumayri;* SD KNIGHT, 1937]. With narrow, probably short exhalant slit; selenizone narrow, borne by step high on outer whorl face; extension of parietal lip seemingly toothlike. *M. Perm.*, Eu.——FIG. 131,*6*. **P. neumayri* (GEMMELLARO), Sicily; protrusion on columellar lip broken; ×2.7.

Family LAUBELLIDAE Cox, n. fam.

Small, ovate-conical, elevated, narrowly phaneromphalous; with angular sinus high on labrum culminating in short slit that generates raised selenizone close to adapical suture; helicocone contracted and commonly bent upward near aperture. *M.Trias.*

Laubella KITTL, 1891 [**Pleurotomaria delicata* LAUBE, 1868; SD DIENER, 1926]. With characters of family; ornament spiral threads sometimes cancellated by collabrals. *M.Trias.(Ladin.)*, Eu.——FIG. 133,*1*. **L. delicata*, S.Tyrol; *1a,b*, ×6 (64).

Family SCHIZOGONIIDAE Cox, n. fam.

Small, turbiniform to almost discoidal; last whorl with flattened outer face bordered by carinae or angulations, one or both nodose; spire gradate; labral emargination shallow, at upper angulation. *M.Trias.-U. Trias.*

Schizogonium KOKEN, 1889 [**Pleurotomaria scalaris* MÜNSTER, 1841; SD DIENER, 1926]. Anomphalous to broadly phaneromphalous; both carinae well defined. *M.Trias.(Ladin.)*, Eu.——FIG. 132,*1*. **S. scalare*, S.Tyrol; ×4 (89).

Pseudoschizogonium KUTASSY, 1937 [**P. turriculatum*]. Depressed-turbiniform, phaneromphalous; selenizone nodose, with nodes continued by prosocline collabral ridges on horizontal upper whorl face. *U.Trias.(Carn.)*, Eu.——FIG. 133,*3*. **P. turriculatum*, Hung.; *3a-c*, ×1.5, ×1.5, ×5 (84).

Family ZYGITIDAE Cox, n. fam.

Small, depressed - turbiniform, broadly phaneromphalous, with domelike spire; selenizone broad, depressed, at periphery on last whorl and not overlapped on spire; nodose angulation at margin of umbilicus; aperture subquadrate, with straight columellar lip leaning toward axis; labral slit rather deep (about 0.12 of last whorl). *M.Trias.*

Zygites KITTL, 1891 [**Pleurotomaria delphinula* LAUBE, 1868 (*pro Delphinula cancellata* KLIPSTEIN, 1845, *non* KIENER, 1838-9)]. General surface and selenizone with ornament of cancellating spiral and collabral threads; also strong collabral folds on upper whorl face. *M.Trias.(Ladin.)*, Eu.——FIG. 133,*4*. **Z. delphinula* (LAUBE), S.Tyrol; *4a,b*, ×2 (64).

Family KITTLIDISCIDAE Cox, n. fam.

Small, depressed-turbiniform to lenticular, broadly phaneromphalous; relatively broad selenizone occupying whole of outer face, which is bordered by 2 prominent carinae. *M.Trias.*

Kittlidiscus HAAS, 1953 [*pro Schizodiscus* KITTL, 1891 (*non* HALL & CLARKE, 1888)] [**Pleurotomaria bronni* KLIPSTEIN, 1845 (=*P. plana* KLIPSTEIN, 1845, *non* MÜNSTER, 1844)]. Whorls with narrow shoulder; ornament collabral threads and spiral grooves on spire, spiral cords on base and umbilicus. *M.Trias.(Ladin.)*, Eu.——FIG. 133,*2*. **K. bronni* (KLIPSTEIN), S.Tyrol; *2a,b*, ×3 (64).

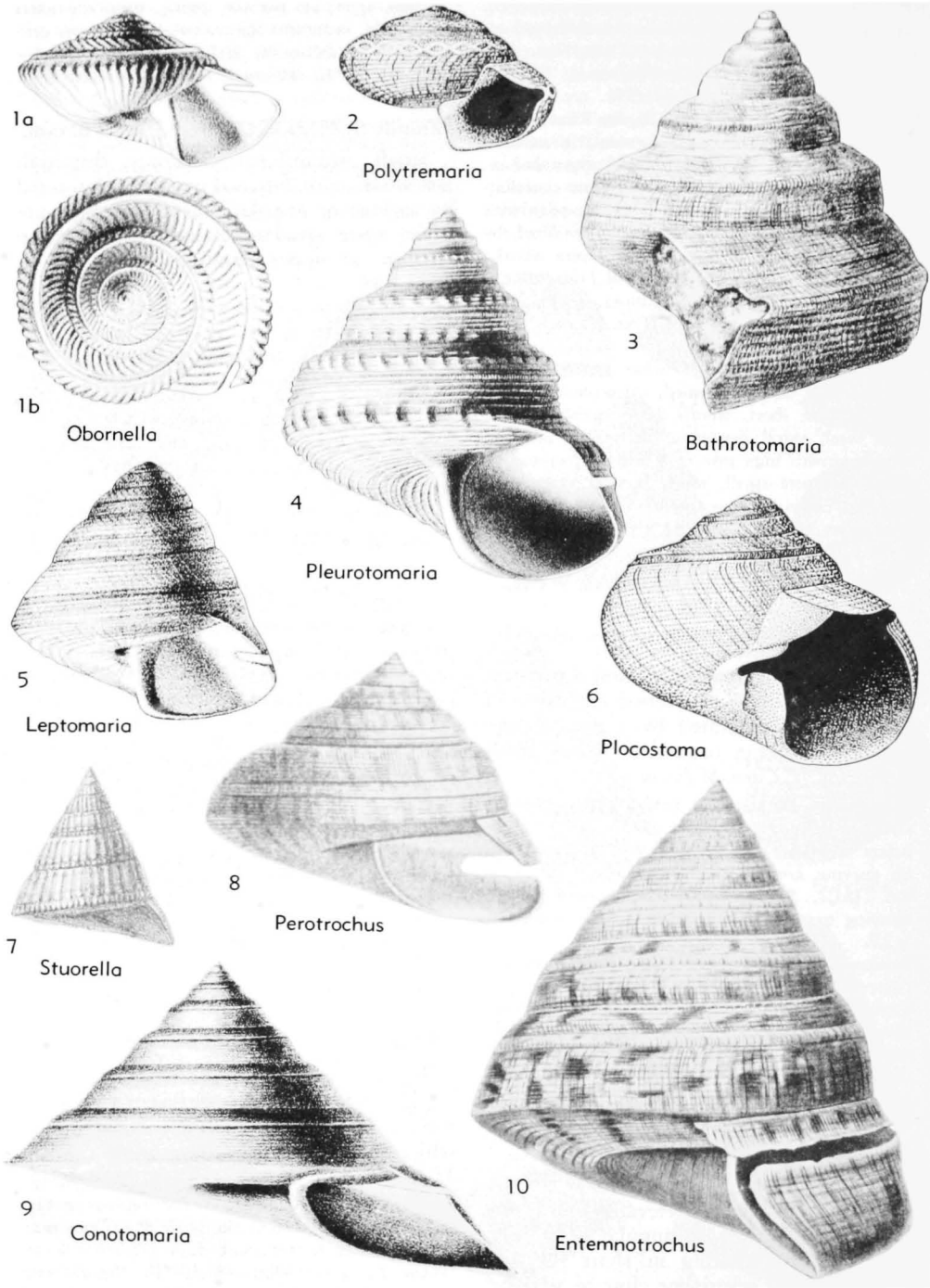


FIG. 131. Pleurotomariacea (Polytremariidae, Pleurotomariidae) (p. *I217-I220*).

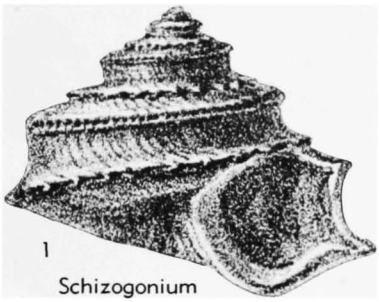


FIG. 132. Pleurotomariacea (Schizogoniidae) (p. *I*217).

Family TEMNOTROPIDAE Cox, n. fam.

Small, depressed turbiniform, some shells approaching auriform or neritiform, of few whorls increasing rapidly in diameter; labrum with slit generating selenizone occupying carina rather high on whorls, at angle of broad, gently sloping ramp; aperture very broad and oblique. *M.Trias.-U.Trias.*

Temnotropis LAUBE, 1870 [**Sigaretus carinatus* MÜNSTER, 1841]. Anomphalous or narrowly phaneromphalous; ornament spiral cords predominating over collabral threads; in some species further carinae below the one carrying selenizone. *M.Trias.(Ladin.)-U.Trias.(Carn.)*, Eu. —— FIG. 133,*5*. *T. carinata* (MÜNSTER), M.Trias.(Ladin.), S.Tyrol; *5a,b*, ×2 (89).

Family PLEUROTOMARIIDAE Swainson, 1840

[*nom. correct.* KING, 1850 (*ex* Pleurotomariae SWAINSON, 1840)]

Mostly medium-sized to large, trochiform; exhalant emargination a slit that generates selenizone on whorl face, in most genera at or near mid-whorl. *Trias.-Rec.*

Pleurotomaria DEFRANCE, 1826 [validation, ICZN pend.] [**Trochus anglicus* J.SOWERBY, 1818; SD S.P.WOODWARD, 1851] [=*Pleurotomarium* DE BLAINVILLE, 1825 (suppression, ICZN pend.)] Trochiform, moderately high to depressed, anomphalous to broadly phaneromphalous, gradate, with outer whorl face flattened, at least in earlier growth stages; selenizone moderately broad, near mid-whorl; ornament sinuous spiral cords with tubercles at shoulder and in some species at margin of base. *L.Jur.-L.Cret.(Apt.)*, cosmop.——FIG. 131,*4*. **P. anglica* (SOWERBY), L.Lias., Fr.; ×0.7 (111).

Bathrotomaria Cox, 1956 [**Trochus reticulatus* J. SOWERBY, 1821]. Trochiform, elevated to depressed, anomphalous to broadly phaneromphalous; whorls (at least in earlier growth stages) angulate, with usually broad ramp; second carina or angulation, just overlapped on spire, delimiting base; selenizone at ramp angle; ornament spiral threads commonly cancellated by collabral threads. *L.Jur.-U.Cret.(Senon.)*, cosmop.——FIG. 131,*3*. *B. reticulata* (J.SOWERBY), U.Jur.(Kim.), Eng.; ×0.8 (232).

Leptomaria E. EUDES-DESLONGCHAMPS, 1864 [**Pleurotomaria amoena* J. A. EUDES-DESLONGCHAMPS, 1849]. Conical or cyrtoconoid, anomphalous to broadly phaneromphalous; whorls weakly to strongly convex, not angular, last one rounded at periphery of convex base; selenizone at mid-whorl; ornament spiral threads that may be cancellated by collabral threads. *M.Jur.(Baj.)-U.Cret.(Dan.)*, cosmop.——FIG. 131,*5*. **L. amoena* (J.A.EUDES-DESLONGCHAMPS), M.Jur.(Baj.), Fr.; ×1.3 (111).

Stuorella KITTL, 1891 [**Trochus subconcavus* MÜNSTER, 1841]. Rather small, conical, anomphalous or narrowly phaneromphalous; whorls flat, last one with angular periphery and flattened base; selenizone narrow, just above periphery, between 2 spiral cords; ornament axial costellae ending in nodes above selenizone and crossed obliquely by prosocline growth threads. *M.Trias.(Ladin.)-U.Trias.(Carn.)*, Eu.——FIG. 131,*7*. **S. subconcava* (MÜNSTER), M.Trias.(Ladin.), S.Tyrol; ×3 (89).

Pyrgotrochus P.FISCHER, 1885 [**Pleurotomaria bitorquata* J.A.EUDES-DESLONGCHAMPS, 1849]. Conical or coeloconoid, anomphalous or narrowly phaneromphalous; whorls flat or concave, last one with swollen band, commonly tuberculate or puckered, at periphery of flattened base; band visible on spire whorls, which also bear spiral threads; selenizone broad, below mid-whorl. *L.Jur.-M.Cret.(Cenom.)*, cosmop.——FIG. 134,*2*. **P. bitorquatus* (J.A.EUDES-DESLONGCHAMPS, M. Lias, Fr.; ×1 (111).

Conotomaria Cox, 1959 [**Pleurotomaria mailleana* D'ORBIGNY, 1843]. Conical, anomphalous to broadly phaneromphalous; whorls flat or slightly sigmoidal in outline, periphery angular, may be bulging; selenizone at or above mid-whorl, quite close to suture in some species, not coinciding with an angulation; predominant ornament spiral cords. *M.Jur.(Baj.)-U.Cret.(Senon.)*, cosmop.—— FIG. 131,*9*. **C. mailleana* (D'ORBIGNY), M.Cret. (Cenom.), Fr.; ×1 (110).

Obornella Cox, 1959 [**Pleurotomaria plicopunctata* J.A.EUDES-DESLONGCHAMPS, 1849]. Low-turbiniform to sublenticular, phaneromphalous; base strongly convex; ornament close-spaced collabral costellae and spiral threads, former usually dominant; periphery commonly crenate; selenizone narrow, smooth, projecting, on upper whorl face near periphery; labral slit short. *L.Jur.(U.Lias.)-U.Jur.(Oxford.)*, Eu.——FIG. 131,*1*. **O. plicopunctata* (J.A.EUDES-DESLONGCHAMPS), M.Jur.(Baj.), Fr.; *1a,b*, ×1 (111).

Chelotia BAYLE in P. FISCHER, 1885 [**Pleurotomaria concava* DESHAYES, 1832]. Cyrtoconoid, rather

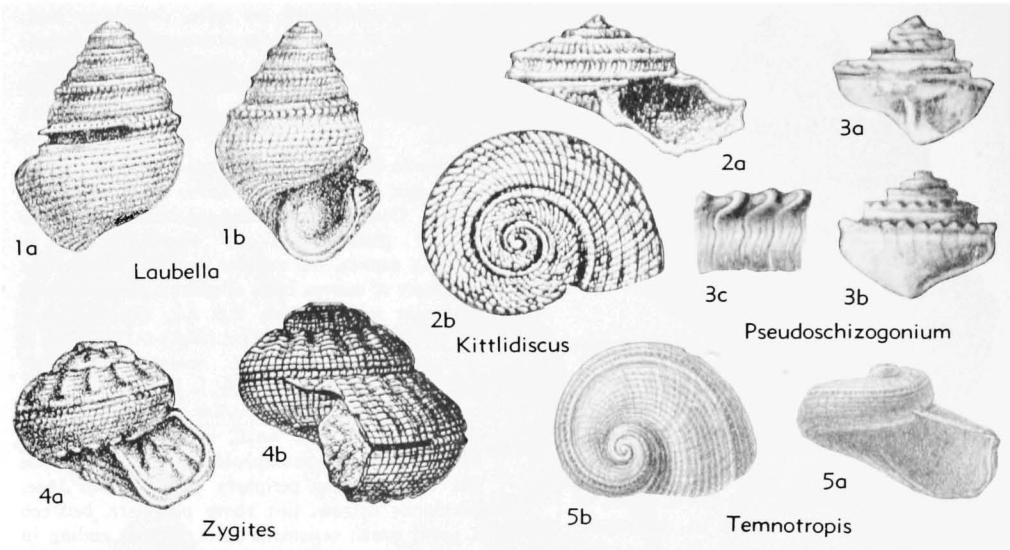


FIG. 133. Pleurotomariacea (Schizogoniidae, Laubellidae, Zygitidae, Kittlidiscidae, Temnotropidae) (p. *I217-I219*).

broadly phaneromphalous; whorls feebly convex, last one rounded at periphery of base; selenizone narrow, between 2 narrow spiral cords rather high on whorl, not easily seen between coarse, nodose spiral cords that constitute the ornament; labral slit narrow and very long, said to extend back for more than a whorl from aperture. *Eoc.,* Eu.

Perotrochus P.FISCHER, 1885 [**Pleurotomaria quoyana* FISCHER & BERNARDI, 1856]. Turbiniform, anomphalous, broader than high; whorls moderately convex, last one subangular at periphery of base; selenizone at or just below mid-whorl, moderately broad, flush, bearing obscure spiral threads; ornament fine cancellating spiral and collabral threads; labral slit extending around 0.1 of last whorl. *Oligo.-Plio.,* Eu.-Japan; *Rec.,* Japan-S.Afr.——FIG. 131,*8*. **P. quoyana* (FISCHER & BERNARDI), Rec., Carib.; ×1 (147).

Mikadotrochus LINDHOLM, 1927 [**Pleurotomaria beyrichi* HILGER, 1877]. Trochiform, narrowly phaneromphalous, whorls feebly convex, last one rounded or subangular at periphery of base; selenizone broad, flush, spirally grooved, below mid-whorl; ornament obscurely nodose spiral cords; labral slit broad, extending around 0.12 of last whorl or less, its upper margin produced beyond lower margin and merging into strongly prosocline, convex labrum. *Plio.-Rec.,* Japan.—— FIG. 134,*1*. **M. beyrichi* (HILGER), Rec.; ×0.7 (173).

Entemnotrochus P.FISCHER, 1885 [**Pleurotomaria adansoniana* CROSSE & FISCHER, 1861]. Trochiform, rather broadly phaneromphalous; whorls feebly convex or obtusely angular, last one angular at periphery of rather flattened base; selenizone moderately broad, above mid-whorl, with well-marked lunulae; ornament obscure spiral cords with collabral threads near suture; labral slit long, extending around 0.5 of last whorl or more. *Eoc.-Mio.,* Eu.-N.Am.; *Rec.,* Carib.-W.Pac. —— FIG. 131,*10*. **E. adansoniana* (CROSSE & FISCHER), Rec., Carib.; ×0.8 (147).

Family TROCHOTOMIDAE Cox, n. fam.

[=Ditremariinae WENZ, 1938]

Turbiniform; exhalant outlet an elongate elliptical trema, some shells with median constriction, generating selenizone on upper face of whorls; base with funnel-like depression affecting last whorl only; peristome discontinuous. *U.Trias.(Rhaet.)-U.Jur.*

Trochotoma J.A.EUDES-DESLONGCHAMPS, 1843 [**T. conuloides;* SD S.P.WOODWARD, 1851] [=*Ditremaria* D'ORBIGNY, 1843; *Rimulus* D'ORBIGNY, 1842 *(nom. nud.)*]. Columellar lip emerging from basal depression, strongly inclined, without denticulations; outer lip strongly prosocline. *U.Trias.(Rhaet.)-U.Jur.(Portland.),* Eu.

T. (Trochotoma). Spire moderately elevated, conical or gradate; selenizone above mid-whorl, at ramp angle when this is present; peripheral carina frequent, delimiting base; ornament spiral cords. *U.Trias.(Rhaet.)-U.Jur.(Portland),* Eu. —— FIG. 135,*1*. *T. bicarinata* (D'ORBIGNY), M.Lias., Fr.; *1a,b,* ×1 (111).

T. (Discotoma) HABER, 1934 [**Ditremaria amata* D'ORBIGNY, 1850]. Very depressed, whorls in-

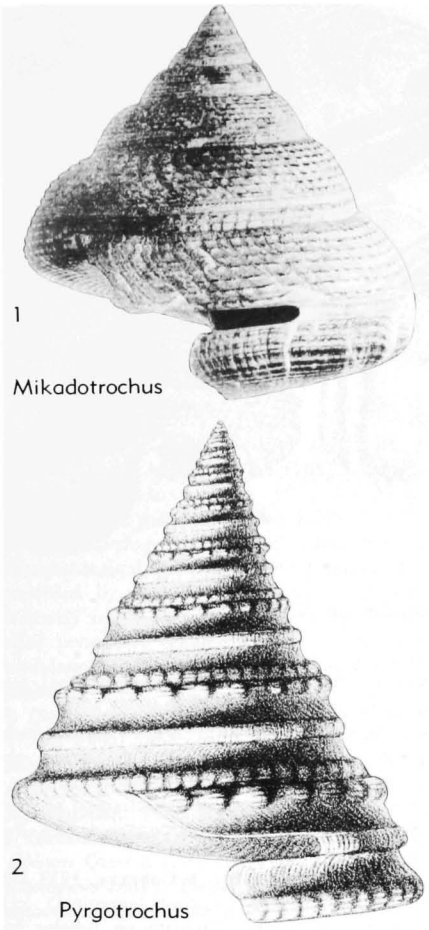


FIG. 134. Pleurotomariacea (Pleurotomariidae) (p. I219-I220).

creasing rapidly in diameter; ornament of upper face transverse folds crossed by spiral cords. *M.Jur. (Bathon.)-U.Jur.(Portland.),* Eu.——FIG. 135,*2*. **T. (Discotoma) amata* (D'ORBIGNY), *M.Jur. (Callov.),* Fr.; *2a,b,* ×1 (111).

Valfinia COX, 1958 [*pro Didymodon* P.FISCHER, 1885 (*non* BLAKE, 1863)] [**Trochus quinquecinctus* ZIETEN, 1832]. Like *Trochotoma (s.s.),* but with 1 or 2 blunt denticles on columellar lip; spiral cords beaded. *Jur.,* Eu.——FIG. 135,*3*. **V. thurmanni* (DELORIOL), U.Jur.(Kimm.), Fr.; *3a,b,* ×1.3 (111).

Family SCISSURELLIDAE Gray, 1847

[*nom. transl.* GRAY, 1857 (*ex* Scissurellina GRAY, 1847)]
[Help in preliminary organization of data was given by Miss GRACE JOHNSON and is here acknowledged.]

Shell small, porcelaneous except for thin nacreous layer within; few-whorled, turbinate to depressed; outer lip with slit or hole; operculum round, multispiral, with central nucleus (138, 147). *U.Cret.-Rec.*

Scissurella D'ORBIGNY, 1824 [**S. laevigata;* SD GRAY, 1847] [=*Schismope* JEFFREYS, 1856; *Woodwardia* CROSSE & FISCHER, 1861]. With open anal slit extending back from aperture, generating a selenizone.

S. (Scissurella). Spire flattened, selenizone on upper half of whorl. *U.Cret.-Rec.,* cosmop.——FIG. 136,*1*. **S. laevigata,* Rec., Medit.; *1a,b,* ×15 (213).

S. (Anatoma) WOODWARD, 1859 [**S. crispata* FLEMING, 1828] [=*Schizotrochus* MONTEROSATO, 1877 (obj.)]. Spire somewhat elevated; slit on middle portion of whorl, selenizone weak. *Plio.-Rec.,* cosmop.——FIG. 136,*4*. **S. (A.) crispata,* Rec., North Sea, ×10 (147).

Incisura HEDLEY, 1904 [**Scissurella lyttletonensis* SMITH, 1894]. Auriform, last whorl large; slit in outer lip short. *Rec.,* Australasia.

I. (Incisura). Whorls smooth. *Rec.,* N.Z.——FIG. 136,*3*. **I. (I.) lyttletonensis* (SMITH), Rec., N.Z., ×15 (147).

I. (Scissurona) IREDALE, 1924 [**Scissurella rosea* HEDLEY, 1904]. Early whorls with fine collabral riblets. *Rec.,* Australasia.

Sinezona FINLAY, 1927 [**Scissurella brevis* HEDLEY, 1904] [=*Schismope* AUCTT. (*non* JEFFREYS); =*Woodwardia* AUCTT. (*non* CROSSE & FISCHER)]. Slit closed at lip margin, leaving a foramen in outer lip. *Plio.-Rec.,* Eu.-N.Am.-Australasia.——FIG. 136,*2*. **S. brevis* (HEDLEY), Rec., N.Z.; ×15 (147).

Family HALIOTIDAE Rafinesque, 1815

[*nom. transl. et correct.* FLEMING, 1822 (*ex* Haliotidia RAFINESQUE, 1815, subfamily name)] [=Schismatobranchia GRAY, 1821]

Shell auriform, depressed, with spire more or less strongly excentric and protruding only slightly or not at all; aperture broad, occupying most of underside; to left of aperture a broad, smooth labial area, beyond which narrow base of shell is just exposed in some species; shell wall with spiral row of small tremata, commonly on tubular projections, which become infilled progressively during growth, the last few (5 to 9) remaining open and serving as exhalant outlets; interior nacreous; no operculum. *?Cret., Mio.-Rec.*

Records of *Haliotis* from the Cretaceous need confirmation. *H. antiqua* BINKHORST, 1861, from Maastricht, was thought by KAUNHOWEN (1898) to be a trochid. The type of *H. cretacea* LUNDGREN, 1894, from Sweden, needs re-investigation. *H. lomaen-*

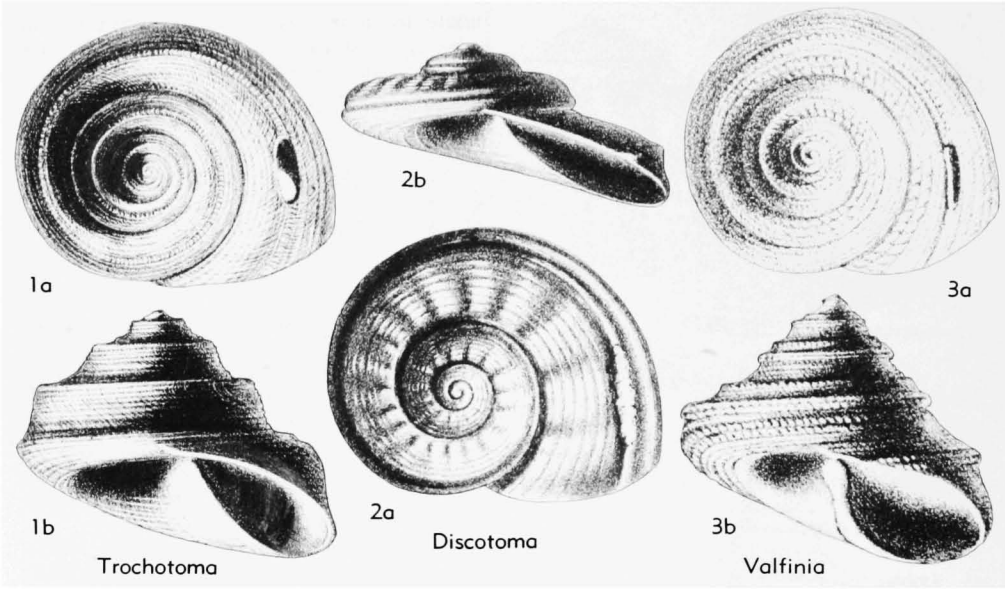


FIG. 135. Pleurotomariacea (Trochotomidae) (p. *I220-I221*).

sis ANDERSON, 1902, Chico Group of California, was rejected as a haliotid by WOODRING (1931) but accepted by VOKES (1935).

The researches of CROFTS (1929, 1937, 1955) on the anatomy and larval ontogeny of this family, and of YONGE (1947) on respiratory processes, are of great importance for the understanding of the Pleurotomariina. Only one genus, divided into several more or less intergrading subgenera, is here recognized, although generic rank has recently been claimed for *Exohaliotis,* on anatomical as well as conchological grounds.

Haliotis LINNÉ, 1758 [**H. asinina;* SD MONTFORT, 1810] [=*Teinotis* ADAMS & ADAMS, 1854 (obj.); *Haleotis* BINKHORST, 1861 (obj.); *Tinotis* FISCHER, 1885 (obj.)]. *?Cret., Mio.-Rec.,* cosmop.

H. (Haliotis). Shell elongate and narrow, with apex very eccentric, almost marginal; ornament of spiral cords, almost obsolete on latter half of last whorl except on abapical side of tremata. *Rec.,* IndoPac.——FIG. 137,*4*. **H. (H.) asinina,* Philippines; ×0.7 (213).

H. (Euhaliotis) WENZ, 1938 [**H. midae* LINNÉ, 1758]. Labial area in adult shell forming projecting flange, outer edge of which forms shell periphery; ornament of prominent wavy transverse lamellae. *Rec.,* S.Am., S.Afr.

H. (Exohaliotis) COTTON & GODFREY, 1933 [**H. cyclobates* PÉRON & LESUEUR, 1816]. Almost circular; spire more elevated than in other subgenera; ornament numerous nodose spiral cords and collabral rugae. *Rec.,* Austral.

H. (Marinauris) IREDALE, 1927 [**M. melculus;* SD WENZ, 1938]. Rather small for genus, apex not strongly excentric; no angulation at row of tremata; tremata large; ornament spiral cords on abapical side of tremata or on entire surface. *Rec.,* Austral.

H. (Notohaliotis) COTTON & GODFREY, 1933 [**H. naevosa* MARTYN, 1784 (not binominal) =*H. rubra* LEACH, 1814]. Tremata on tubular projections situated on angulation separating upper whorl surface from flat or concave outer face; ornament spiral cords and threads crossed by irregular transverse ribs oblique to collabral lines. *Mio.-Rec.,* Austral.——FIG. 137,*3*. **H. (N.) rubra* LEACH, Rec.; ×0.7 (213).

H. (Ovinotis) COTTON, 1943 [**H. ovina* GMELIN, 1791]. Tremata on tubular projections situated on angulation less pronounced than in *N. (Notohaliotis);* ornament knobby, transverse ribs oblique to collabral lines, and obscure spiral threads. *Mio.-Rec.,* IndoPac.-Austral.

H. (Padollus) MONTFORT, 1810 [**P. rubicundus* MONTFORT (*non Haliotis rubicunda* RÖDING, 1798) ?=*H. scalaris* LEACH, 1814, or perhaps *H. parva* LINNÉ, 1758] [=*Neohaliotis* COTTON & GODFREY, 1933]. With broad spiral rib on adapical side of tremata, corresponding groove on interior of shell, and prominent thin collabral lamellae on adapical side of rib; tremata on tubular projections on second rib, and commonly a row of frilly projections near periphery. *Rec.,*

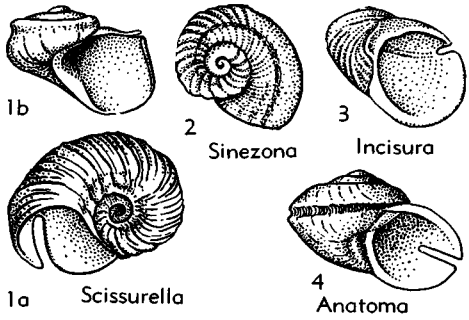


FIG. 136. Pleurotomariacea (Scissurellidae) (p. 1221).

Austral.-IndoPac.-S.Afr.——FIG. 137,*2*. *H. (P.) scalaris* LEACH, Austral.; ×0.5 (168).

H. (Paua) FLEMING, 1952 [**H. iris* MARTYN, 1784 (specific name validated ICZN)]. Of few whorls, cap-shaped, last whorl rising above level of submarginal apex; even convexity of surface modified by only slight angulation at row of tremata; labral area broad, its margin forming shell periphery; ornament collabral and oblique undulations, and spiral cords. *Mio.-Rec.*, N.Z.-Japan.

H. (Sanhaliotis) IREDALE, 1929 [**H. varia* LINNÉ, 1758]. Even convexity of surface interrupted by only slight angulation at row of tremata; ornament spiral cords, commonly nodose. *Mio.-Rec.*, IndoPac.-Calif.-Austral.-W.Afr.

H. (Schismotis) GRAY, 1856 [**S. excisa*=**Haliotis albicans* QUOY & GAIMARD, 1834, ?=*H. laevigata* DONOVAN, 1808]. Large; whorls evenly convex, smooth except for almost obsolete spiral striae; tremata small, flush. *Rec.*, Austral.

H. (Sulculus) ADAMS & ADAMS, 1854 [**H. incisa* REEVE, 1846; SD COSSMANN, 1918]. Small to medium-sized; tremata on angulation separating upper whorl surface from concave outer face; ornament spiral striae or cords and (in some specimens) irregular transverse ridges or nodes. *Mio.-Rec.*, Medit.E.Atl.-Japan-N.Z.——FIG. 137,*1*. *H. (S.) tuberculata* LINNÉ, Rec., Guernsey; *1a,b*, abapertural and apertural sides, ×1 (213).

PLEUROTOMARIACEA
Family UNCERTAIN

?Ceratopea ULRICH, 1911 [**C. keithi*]. Genus known from its relatively large heavy horn-shaped operculum with inner end pitted for muscle attachment, in some showing evidence of a pair of retractor muscles; outer side with blunt angulation that probably corresponds to a peripheral angulation of shell, upper surface set off from parietal surface by a rounded ridge and sharp change of direction of growth lines; inner surface sharply rounded and lower surface gently arched, with growth lines broadly concave toward shell. [Small wedge-shaped calcareous opercula that differ in form from the type species of *Ceratopea* have been referred to this genus but they seem more likely to belong to *Orospira* or undescribed relatives of it.] *L.Ord.*, N.Am.-Eu.——FIG. 138,*1*. **C. keithi*, Va.; *1c,d*, views of operculum from below and above; *1b*, view showing peripheral carina; *1a*, oblique view into attachment pit; all ×1.

Spirotomaria KOKEN, 1925 [**Pleurotomaria rudissima* KOKEN, 1897]. Turbiniform; narrowly phaneromphalous; labrum gently prosocline and convex above selenizone and also below except close to selenizone; numerous spiral threads. *M. Ord.*, Eu.——FIG. 138,*6*. **S. rudissima* (KOKEN), Est.; ×1 (80).

Ptychozone PERNER, 1907 [**Worthenia aberrans* PERNER, 1903]. Turbiniform, with inconspicuous broad selenizone high on rounded outer whorl face; sharp spiral threads and growth lines. *U.Sil.*, Eu.——FIG. 138,*4*. **P. aberrans* (PERNER), Czech.; ×2.7.

Platyconus PERNER, 1907 [**Pleurotomaria (Platyconus) incumbens*]. Trochiform, with relatively low spire and rounded anomphalous base; selenizone roundly convex; fairly strong transverse and spiral cords, former prosocline above and below selenizone. *U.Sil.*, Eu.——FIG. 138,*5*. **P. incumbens* (PERNER), Czech.; ×1.

Gyroma OEHLERT, 1888 [**Pleurotomaria baconnierensis*]. Turbiniform, narrowly phaneromphalous; with broad selenizone and seemingly short slit; spiral and collabral threads. [When better known this genus may prove to be the same as *Ptychozone* PERNER.] *L.Dev.*, Eu.——FIG. 138,*3*. **P. baconnierensis* (OEHLERT), Fr.; ×3.7 (108).

Trachybembix J.BÖHM, 1895 [**Pleurotomaria junonis* KITTL, 1894; SD DIENER, 1926] [=*Trachybembyx* DIENER, 1926 (obj.)]. Rather small, turbiniform, variably phaneromphalous; base strongly convex; last whorl with 3 carinae, one juxtasutural, one median, 3rd at margin of base and in some shells overlapped on spire; collabral lines or ridges present in some; narrow selenizone between 2 ridges said to be carried by median carina. [The presence of this selenizone is not obvious in published figures and needs verification; if there is no selenizone, the genus should be removed from the Pleurotomariacea.) *M.Trias. (Ladin.)*, Eu.——FIG. 138,*2*. **T. junonis* (KITTL), S.Tyrol.; ×1.5 (65).

Transylvanella KUTASSY, 1937 [**T. acmaeiformis*]. Low trochiform, broadly phaneromphalous, sharply carinate at periphery; spire coeloconoid, its whorls flat, with spiral cords; selenizone just above periphery; aperture low, oblique. *U.Trias.(Carn.)*, Eu.——FIG. 123,*5*. **T. acmaeiformis*, Hung.; ×1.5 (84).

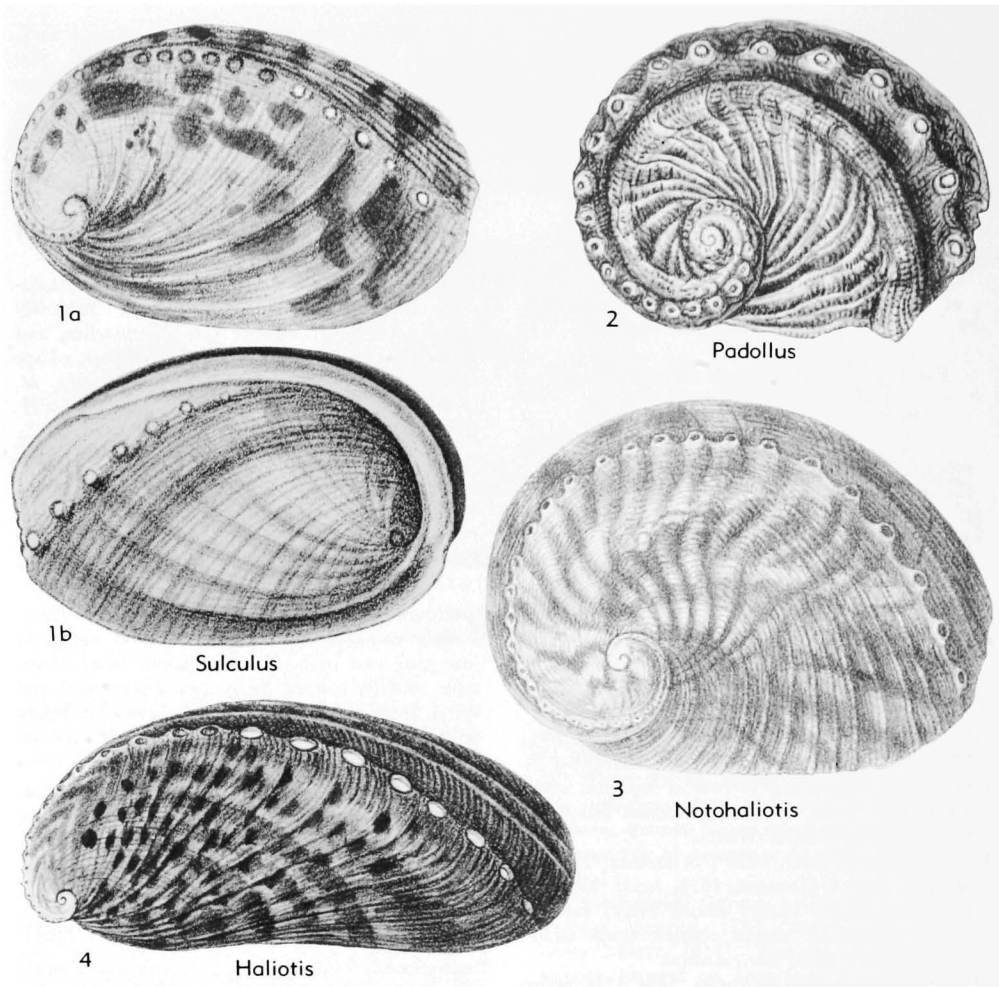


FIG. 137. Pleurotomariacea (Haliotidae) (p. *I222-I223*).

Superfamily TROCHONEMATACEA Zittel, 1895

[*nom. transl.* KNIGHT, BATTEN & YOCHELSON, herein (*ex* Trochonematidae ZITTEL, 1895)]

Turbiniform, with channel at labrum within a spiral angulation about midway between sutures or higher on whorl, or with shallow sinus at about the same position; ornament spiral angulations, threads or cords, or rows of nodes, with collabral threads or growth lines; shell with nacreous lining. *M.Ord.-M.Perm.*

The Trochonematacea and Trochonematidae have usually been made a catchall for several heterogeneous groups of fossil gastropods of the Paleozoic and Mesozoic, but are here greatly reduced. According to either conception, they include only extinct forms. Inferences as to their anatomy and phylogeny can, therefore, be made only from shell features and from apparently related forms that appear more readily understandable.

In Middle and Late Ordovician time, species of trochonematacean genera (some as yet undescribed) resembled in remarkable detail those of the contemporary pleurotomariacean family Lophospiridae. It is, therefore, thought that the Trochonematacea were derived from the latter family. They differ chiefly in that the deep labral sinus or slit of the Lophospiridae is replaced by

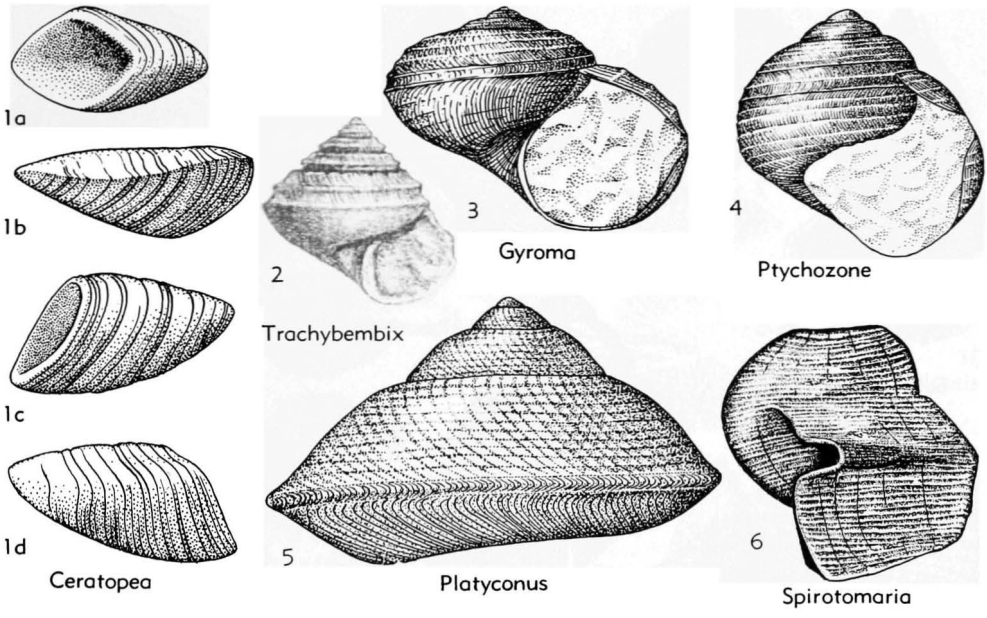


FIG. 138. Pleurotomariacea (Family Uncertain) (p. *I223*).

an internal channel in a homologous position. It seems very possible that the more primitive trochonemataceans retained paired ctenidia, as was almost certainly true of the Lophospiridae, but that the right-hand ctenidium was lost in later genera, the anal tube moving to the right and the channel or sinus in the lip becoming vestigial.

Family TROCHONEMATIDAE Zittel, 1895

With characters of superfamily. *M.Ord.-M.Perm.*

Proturritella KOKEN, 1889 [**P. gracilis*] [*Gonionema* KOKEN, 1896; *Pseudeunema* COSSMANN, 1899 (*pro Gonionema* KOKEN, 1896); *Nematotrochus* KOKEN, 1925]. With subangular labral sinus culminating on median of 3 spiral carinae; narrowly phaneromphalous; ornament cancellate. *M.Ord.*, Eu.——FIG. 139,*6*. **P. gracilis*, Swed.; ×2.7.

Trochonema SALTER, 1859 [**Pleurotomaria umbilicata* HALL, 1847]. Turbiniform to aciculate, with a major spiral angulation having channel within; later whorls disjunct in some forms. *M.Ord.-L. Dev.*, N.Am.-Eu.-NE.Asia.

T. (Trochonema). Turbiniform; narrowly phaneromphalous; with 4 spiral angulations; sutures channeled. *M.Ord.-U.Ord.*, N.Am.-Eu.-NE.Asia.——FIG. 139,*7*. **T. (T.) umbilicatum* (HALL), M.Ord., Can.(Que.); ×2.

T. (Eunema) SALTER, 1859 [**Eunema strigillatum*]. Much like *Trochonema (s.s.)* but with high spire. *M.Ord.-U.Sil.*, N.Am.-Eu.——FIG. 139,*1*. **T. (E.) strigillatum* (SALTER), M.Ord., Can.(Que.); ×1.3.

T. (Trochonemopsis) MEEK, 1872 [**Trochonema tricarinata*]. Much like *Trochonema (s.s.)* but with 3 spiral angulations; suture not channeled. *L.Dev.*, N.Am.——FIG. 139,*2*. **T. (T.) tricarinatum* (MEEK), L.Dev., Ohio; ×1.3.

Amaurotoma KNIGHT, 1945 [**Pleurotomaria subsinuata* MEEK & WORTHEN, 1861]. Turbiniform, with shallow sinus high on labrum; ornament of spiral cords and collabral threads (72, p. 583). *Miss.-Penn.*, N.Am.——FIG. 139,*4*. **A. subsinuata* (MEEK & WORTHEN), M.Penn., Ill.; ×5.

Cyclobathmus KNIGHT, 1940 [**Trepospira haworthi* BEEDE, 1907]. Turbiniform, gradate; broad shallow sinus in lip above shoulder angulation; ornament of spiral cords. (68, p. 314). *M.Perm.*, N. Am.-Eu.-NC.Asia.——FIG. 139,*3*. **C. haworthi* (BEEDE), M.Perm., Tex.; ×8.

?Cyclites KNIGHT, 1940 [**Pleurotomaria multilineata* GIRTY, 1908, =*Wortheniopsis depressa* BEEDE, 1907]. Low, turbiniform, slightly gradate; channel within shoulder angle; ornament of spiral cords or threads (68, p. 310). *M.Perm.*, N. Am.-NC.Asia-SC.Asia-SE.Asia.——FIG. 139,*5*. *C. depressus* (BEEDE), Tex.; ×6.

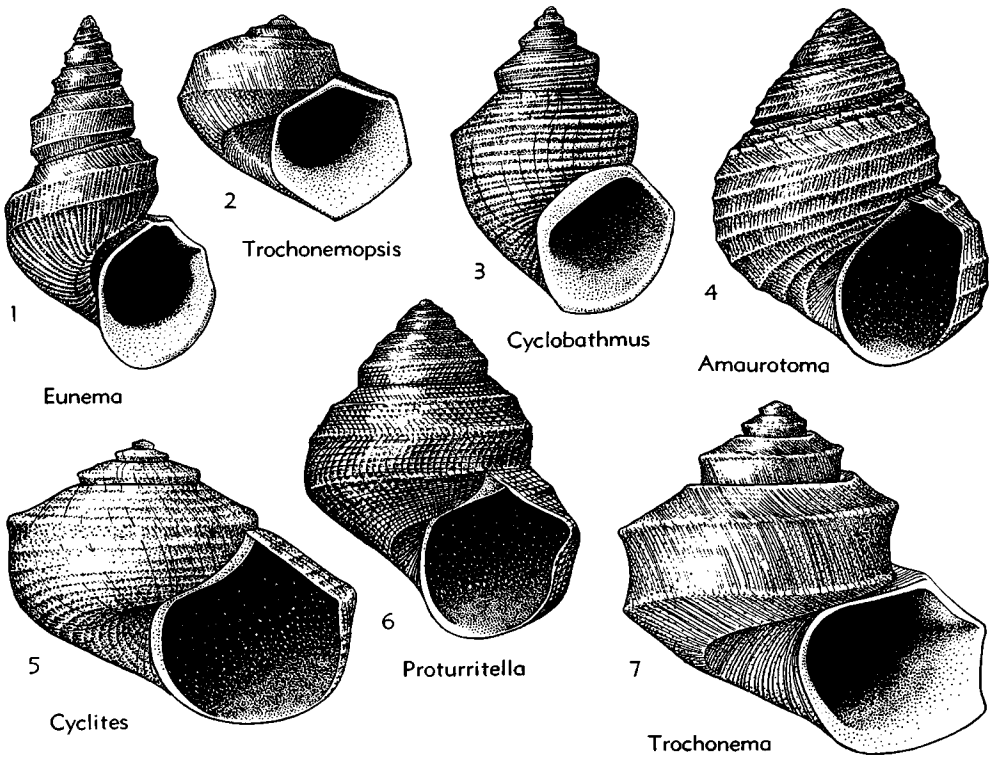


FIG. 139. Trochonematacea (Trochonematidae) (p. *I225*).

Superfamily FISSURELLACEA Fleming, 1822

[*nom. transl.* COX, 1959 (*ex* Fissurelladae FLEMING, 1822)] [Help in preliminary organization of data, given by Miss GRACE JOHNSON, is here acknowledged]

Shell conical, porcelaneous; protoconch spiral; with perforation, slit, notch, or emargination for passage of exhalant current; muscle scar horseshoe-shaped, open anteriorly (138, 147). *Trias.-Rec.*

Family FISSURELLIDAE Fleming, 1822

[*nom. correct.* D'ORBIGNY, 1839 (*pro* Fissurelladae FLEMING, 1822)]

With characters of superfamily. *Trias.-Rec.*

Subfamily EMARGINULINAE Gray, 1834

[*nom. transl.* COSSMANN, 1888 (*ex* Emarginulidae GRAY, 1834)]

Apex present in most forms; when wholly removed by perforation, apex replaced by projecting shelf within; slit anterior to apex. *?Trias., Jur.-Rec.*

Emarginula LAMARCK, 1801 [**E. conica*] [=*Emarginulus* MONTFORT, 1810 (obj.); *Imarginula* GRAY, 1821 (obj.)]. Slit of varying extent; apex varying in position; no septum within. *?M.Trias., L.Jur.-Rec.*, cosmop.

E. (Emarginula). Slit long and narrow, selenizone depressed between two ribs; shell short-ovate, elevated; ornament radial riblets cancellated by collabral threads. *?M.Trias., Rec.*, Eu.-N.Am.-S.Am.-Australasia.——FIG. 140,*1*. **E. (E.) conica*, Rec., Eng.; *1a-c*, ×3 (184).

E. (Altomarginula) HABER, 1932 [**E. desnoyersi* J.A.EUDES-DESLONGCHAMPS, 1842]. Very elevated, with apex pointing to rear and located above margin; slit deep, selenizone in well-impressed groove; ornament radial threads. *M.Jur.(Bathon.)*, Eu.——FIG. 140,*7*. **E. (A.) desnoyersi*, Fr.; ×3 (147).

E. (Arginula) PALMER, 1937 [**E. arata* CONRAD, 1933]. Larger than *E. (Emarginula)*, slit broader and shorter, selenizone not depressed between two ribs. *M.Eoc.*, SE.USA.

E. (Entomella) COSSMANN, 1888 [**E. clypeata* LAMARCK, 1803]. Apex near posterior margin, slit short and broad, selenizone not on a rib. *Eoc.*, Eu.——FIG. 140,*3*. **E. (E.) clypeata*, Eoc., Fr., *3a-c*, ×3 (215).

E. (Semperia) CROSSE, 1867 [**S. paivana*; SD COSSMANN, 1888]. Juvenile shells as in *E. (Emar-*

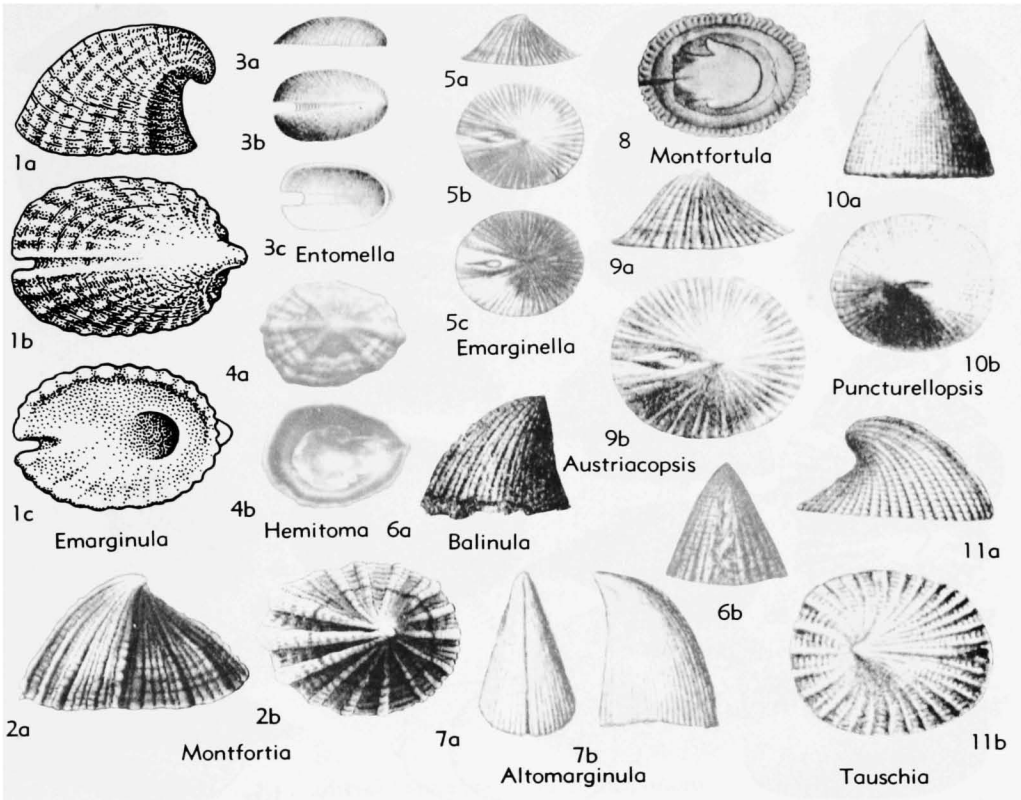


FIG. 140. Fissurellacea (Fissurellidae——Emarginulinae (p. *I226-I228*).

ginula) but adults with slit closed at margin, forming a perforation on anterior slope. *Eoc.-Rec.*, Eu.

E. (Subzeidora) IREDALE, 1924 [**E. connectens* THIELE, 1924]. Apex posterior, incurved; slit very long. *Rec.*, S.Pac.

E. (Tauschia) HABER, 1932 [**E. orthogonia* TAUSCH, 1890]. Like *Emarginula (s.s.)* but with raised riblike selenizone. *L.Jur.*, Eu.-Afr.——FIG. 140,*11*. **E. (T.) orthogonia* TAUSCH, L.Lias., S.Tyrol; *11a,b*, ×1.5 (147).

Austriacopsis HABER, 1932 [**Rimula austriaca* HÖRNES, 1853]. Patelliform, apex not far from median; exhalant outlet an elongate trema between apex and middle of anterior margin. *Jur.*

A. (Austriacopsis). Not greatly elevated; trema pyriform, midway between apex and anterior margin, tapering anteriorly to narrow slit; ornament moderately strong radial ribs. *Jur.(Lias.-Portland.)*, Eu.——FIG. 140,*9*. **A. (A.) austriaca* (HÖRNES), L.Lias., Aus.; 9a,b, ×1.5 (147).

A. (Puncturellopsis) HABER, 1932 [**Fissurella acuta* J.A.EUDES-DESLONGCHAMPS, 1842]. Elevated; trema elliptical, near apex; ornament radial threads. *M.Jur.(Baj.-Bathon.)*, Eu.——FIG. 140,*10*. **A. (P.) acuta* (J.A.EUDES-DESLONGCHAMPS), M.Jur.(Bathon.), Fr.; *10a,b*, ×1.5 (147).

A. (Balinula) DACQUÉ (*ex* HABER, MS.), 1933 [**Emarginula? triontina* GRECO, 1899]. Elevated; trema pyriform, elongate, near anterior margin; ornament cancellate. *M.Jur.(Aalen.-Baj.)*, Eu.——FIG. 140,*6*. **A. (B.) triontina* (GRECO), M. Jur.(Aalen.), Italy; *6a,b*, ×4.5 (189).

Clypidina GRAY, 1847 [**Patella notata* LINNÉ, 1767]. Conical, surface with fine radiating ribs; apex not recurved; anterior notch short.

C. (Clypidina). Internal groove on anterior slope weak or wanting. *Rec.*, S.Pac.

C. (Montfortula) IREDALE, 1915 [**Emarginula rugosa* QUOY & GAIMARD, 1834] [=*Plagiorhytis* FISCHER, 1885 (*non* CHAUDOIR, 1848)]. Internal groove distinct. *Plio.-Rec.*, Australasia.——FIG. 140,*8*. **C. (M.) rugosa* (QUOY & GAIMARD), Rec., Austral., ×1 (147).

Emarginella PILSBRY, 1891 [**Emarginula cuvieri* AUDOUIN, 1826]. Shell coarsely latticed; mantle partially enveloping shell. *Rec.*, E.Afr.-E.Indies.——FIG. 140,*5*. **E. cuvieri* (AUDOUIN), Rec., Red Sea; ×1 (147).

Emersonia HABER, 1932 [**Cemoria costata* EMERSON, 1870]. Small, cap-shaped, with posteriorly

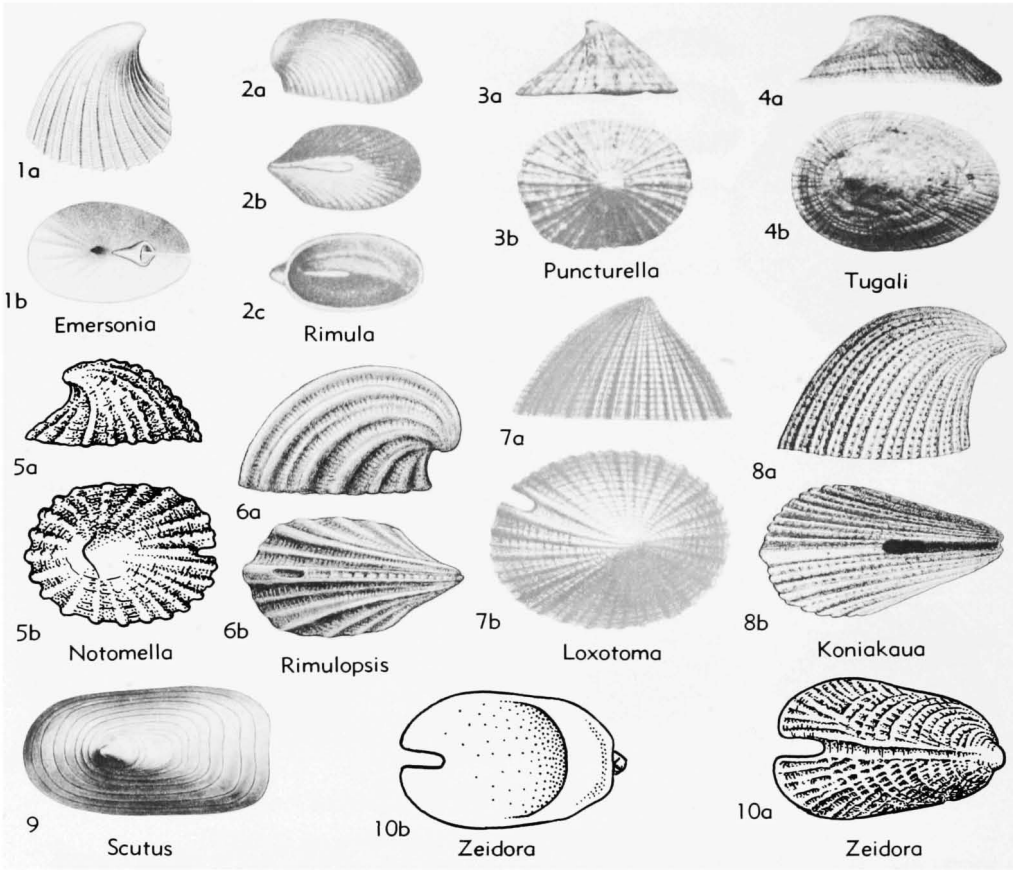


FIG. 141. Fissurellacea (Fissurellidae——Emarginulinae) (p. *I228-I230*).

pointing, hooklike, almost terminal apex; narrow exhalant slit extending halfway to apex from anterior margin and funnel-shaped internal plate towards apex from extremity of slit; ornament radial riblets of 2 orders, collabral threads in intervals. *L.Jur.*, Eu.——FIG. 141,*1*. **E. costata* (EMERSON), M.Lias., Ger.; exterior, interior showing septum, *1a,b*, ×4 (181).

Hemitoma SWAINSON, 1840 [**Patella tricostata* SOWERBY, 1823, *ex* HUMPHREY MS (*non* GMELIN, 1791) =*P. octoradiata* GMELIN, 1791] [=*Subemarginula* GRAY, 1847 (obj.); *Siphonella* ISSEL, 1869 (*non* HAGENOW, 1851)]. Shell low to moderately elevated, but not conical; internal groove distinct, with a short slit or notch anteriorly. *Eoc.-Rec.*, Eu.-N.Am.-S.Am.-S.Pac.

H. (Hemitoma). With several symmetrically arranged heavy ribs; selenizone not forming a stout ridge; posterior slope not concave. *Rec.*, Carib.——FIG. 140,*4*. **H. (H.) octoradiata* (GMELIN), Rec., W.Indies; *4a,b*, ×1 (147).

H. (Montfortia) RÉCLUZ, 1843 [**Emarginula australis* QUOY & GAIMARD, 1834; SD IREDALE, 1915]. Selenizone forming stout ridge; anterior slope convex, posterior concave behind apex. *Eoc.-Rec.*, Eu.-N.Am.-S.Am.-S.Pac.——FIG. 140,*2*. *H. (M.) australis* (QUOY & GAIMARD), Rec., Austral., ×1 (147).

H. (Montfortista) IREDALE, 1929 [**M. excentrica*]. With concentric latticing. *Rec.*, Austral.

Loxotoma FISCHER, 1885 [**Emarginula neocomiensis* D'ORBIGNY, 1843]. Like *Emarginula (s.s.)* but asymmetrical, selenizone and marginal exhalant slit forming an acute angle with mid-line of shell. *U.Jur.(Portland.)-Eoc.*, Eu. —— FIG. 141,*7*. **L. neocomiensis* (D'ORBIGNY), L.Cret.(Neocom.), Fr.; *7a,b*, ×2 (110).

Notomella COTTON, 1957 [**Emarginula candida* A. ADAMS, 1852] [=*Entomella* COTTON, 1945 (*non* COSSMANN, 1888)]. Resembling *Emarginula*, ovate, depressed-conical, apex recurved; anal slit long and narrow. *Tert.-Rec.*, Australasia-IndoPac.——FIG. 141,*5*. **N. candida* (A.ADAMS), Rec., E.Indies; *5a,b*, ×2 (216).

Puncturella LOWE, 1827 [**Patella noachina* LINNÉ, 1758] [=*Cemoria* LEACH, 1852 (*non* RISSO,

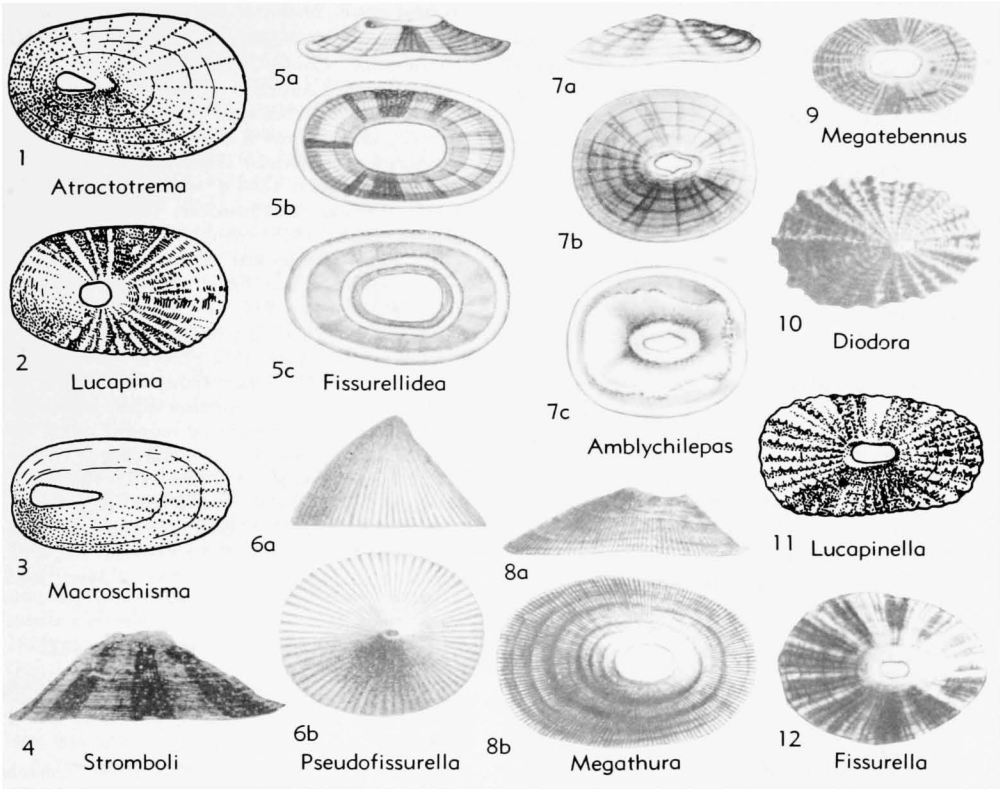


FIG. 142. Fissurellacea (Fissurellidae——Diodorinae, Fissurellinae) (p. *I*230-*I*231).

1826); *Sipho* BROWN, 1827 (*non* FABRICIUS, 1823); *Vacerra* IREDALE, 1924 (*non* GODMAN, 1900)]. Conical, with perforation on anterior slope or near apex entering conduit or curved shelly plate within; internal groove and selenizone weak or wanting. *Eoc.-Rec.*

P. (Puncturella). Perforation near summit, apex recurved, persistent in adult. *Oligo.-Rec.,* Eu.-N.Pac.——FIG. 141,*3*. **P. noachina* (LINNÉ), Rec., Norway; *3a,b,* ×2 (147).

P. (Altrix) PALMER, 1942 [**Fissurella altior* MEYER & ALDRICH, 1886] [=*Folia* PALMER, 1937 (*non* LOHMAN, 1892)]. Apex truncated by a constricted perforation; internal septum thin. *M.Eoc.,* SE.USA.

P. (Cranopsis) A.ADAMS, 1860 [**C. pelex*] [=*Rimulanax* IREDALE, 1924]. Perforation at middle of anterior slope; internal groove visible. *Plio.-Rec.,* Eu.-IndoPac.

P. (Fissurisepta) SEGUENZA, 1863 [**F. papillosa;* SD WOODRING, 1928]. Perforation at apex; internal septum strong; no internal groove; surface sculpture weak. *Mio.-Rec.,* Eu.-W.Atl.-IndoPac.-Australasia.

P. (Rixa) IREDALE, 1924 [**Glyphis watsoni* BRAZIER, 1894]. Apex truncated, closed posteriorly by internal shelf. *Rec.,* Austral.

Rimula DEFRANCE, 1827 [**R. blainvilli;* SD GRAY, 1847] [=*Rimularia* WALDHEIM, 1834 (obj.)]. Apical whorls present, inclined to right; perforation on anterior slope, long and narrow; no internal septum. *Cret.-Rec.,* Eu.-N.Am.-S.Am.-Indo-Pac.——FIG. 141,*2*. **R. blainvilli,* Eoc., Fr.; *2a-c,* ×5 (147).

Rimulopsis HABER, 1932 [**Emarginula goldfussi* ROEMER, 1836]. Small, cap-shaped, apical region narrow, extending well beyond posterior margin, apex slightly recurved; ornament symmetrical radial ribs and collabral threads. Elliptical trema on anterior slope. *Jur.,* Eu.

R. (Rimulopsis). Anterior slope with broad median rib bearing selenizone and small trema placed some distance from anterior margin. *Jur.(Lias.-Portland.),* Eu.——FIG. 141,*6*. **A. deslongchampsi* (COSSMANN), M.Jur.(Bathon.), Eng.; *6a,b,* ×6 (104).

R. (Koniakaua) DACQUÉ, 1933 (*ex* HABER MS) [**Rimula multistriata* ZITTEL, 1873]. Trema midway between apex and margin; selenizone in deep groove. *U.Jur.(Tithon.),* Eu.——FIG. 141,*8*.

**R. (K.) multistriata* (ZITTEL), Czech.; *8a,b,* ×5 (157).

Scutus MONTFORT, 1810 [**S. antipodes*] [=*Parmophorus* DEBLAINVILLE, 1817 (obj.); *Parmophora* DESMAREST, 1859 (obj.); *Parmaphora* BOWDICH, 1822 (obj.); *Scutum* SOWERBY, 1842 (obj.); *Aviscutum* IREDALE, 1940]. Depressed, oblong, apex not absorbed; selenizone wanting; muscle scar near margin. *Eoc.-Rec.,* Eu.-Austral.-IndoPac.

S. (Scutus). Shell large, truncate anteriorly, smooth. *Mio.-Rec.,* Eu.-IndoPac.-Australasia.——FIG. 141,*9.* **S. (S.) antipodes,* Rec., SE.Austral.; ×0.5 (147).

S. (Nannoscutum) IREDALE, 1937 [**N. forsythi*]. Shell small, stout, with strong concentric linear sculpture. *Rec.,* Australasia.

S. (Proscutum) FISCHER, 1885 [**Parmophorus compressus* DESHAYES, 1861]. Small, thin, narrow, anterior border rounded. *Eoc.,* Eu.

Tugali GRAY in DIEFFENBACH, 1843 [**T. elegans,* =*Emarginula parmophoidea* QUOY & GAIMARD, 1834] [=*Tugalia* GRAY, 1847 (obj.)]. Surface radiate-cancellate; apex entire, posterior, recurved; margin crenulate within, sinuate anteriorly. *Mio.-Rec.,* Australasia-IndoPac.-Antarct.

T. (Tugali). Apex at posterior third. *Mio.-Rec.,* IndoPac.-Australasia.——FIG. 141,*4.* **T. (T.) parmophoidea* (QUOY & GAIMARD), Rec., N.Z.; *4a,b,* ×0.7 (147).

T. (Parmophoridea) WENZ, 1938 [**Tugalia antarctica* STREBEL, 1907] [=*Parmaphorella* STREBEL, 1907 (*non* MATTHEW, 1886)]. Apex above posterior margin; selenizone short. *Rec.,* Antarct.

Zeidora A.ADAMS, 1860 [**Z. calceolina*] [=*Crepiemarginula* SEGUENZA, 1880; *Legrandia* BEDDOME, 1883 (*non* HANLEY, 1872)]. Apex posterior, recurved; selenizone on anterior slope, with elevated edges and anterior slit; septum within on posterior margin. *Plio.-Rec.,* Eu.-W.Atl.-Pac.-RedSea.

Z. (Zeidora). Internal septum broad. *Plio.-Rec.,* Eu.-W.Atl.-Pac.——FIG. 141,*10.* **Z. calceolina,* Rec., Japan; *10a,b,* ×4 (191).

Z. (Nesta) H.ADAMS, 1870 [**N. candida*]. Septum weak. *Rec.,* Red Sea.

Subfamily DIODORINAE Wenz, 1938

Shell conical, apex perforate; perforation bounded by callus within that is truncate posteriorly; muscle scar open anteriorly, with hook-shaped terminations (3). *Jur.-Rec.*

Diodora GRAY, 1821 [**Patella apertura* MONTAGU, 1803 = *P. graeca* LINNÉ, 1758] [=*Fissuridea* SWAINSON, 1840; *Glyphis* CARPENTER, 1857 (*non* AGASSIZ, 1843); *Capiluna* GRAY, 1857; *Monodilepas* FINLAY, 1927]. Ornament cancellate; margin in a single plane, crenulate within. *U.Cret.-Rec.,* Afr.-N.Am.-S.Am.-Pac.-Austral.

D. (Diodora). Perforation oval, at apex. *U.Cret.-Rec.,* Afr.-N.Am.-S.Am.-W.Pac.-S.Pac. —— FIG. 142, *10.* **D. (D.) graeca* (LINNÉ), Rec., Medit.; ×1 (147).

D. (Austroglyphis) COTTON & GODFREY, 1934 [**D. lincolnensis* COTTON, 1930]. Perforation rectangular. *Rec.,* Austral.

D. (Elegidion) IREDALE, 1924 [**D. audax*] [=*Eligidion* COTTON & GODFREY, 1945 *(errore)*]. Perforation on anterior slope. *Rec.,* Austral.

Megathura PILSBRY, 1890 [**M. californica* = *Fissurella crenulata* G.B.SOWERBY, 1825] [=*Macrochasma* DALL, 1915 (obj.)]. Large, perforation large, oval; muscle scar faint; surface radiately striate; inner margin finely crenulate. *Plio.-Rec.,* Japan-W.N.Am.——FIG. 142,*8.* **M. crenulata* (SOWERBY), Rec., Calif.; *8a,b,* ×3 (147).

Pseudofissurella HABER, 1932 [**Fissurella corallensis* BUVIGNIER, 1852]. Small, rather high, apex just posterior to median, perforation small, with slight posterior slant; ornament fine rounded radial riblets. *Jur.,* Eu.——FIG. 142,*6.* **P. corallensis* (BUVIGNIER), U.Jur.(Raurac.), Fr.; *6a,b,* ×7.5 (147).

Stromboli BERRY, 1954 [**Fissurella beebei* HERTLEIN & STRONG, 1951]. Perforation slanting, slightly in front of apex. *Rec.,* C.Am.——FIG. 142,*4.* **S. beebei* (HERTLEIN & STRONG), Rec., W.Mex., ×0.5 (192).

Subfamily FISSURELLINAE Fleming, 1822

Exhalant perforation at or near apex, bordered within by a rounded callus (2). *Eoc.-Rec.*

Fissurella BRUGUIÈRE, 1789 [**Patella nimbosa* LINNÉ, 1758; SD LAMARCK, 1799] [=*Fissurellus* DEMONTFORT, 1810 (obj.)]. Apex nearly central, inner margin of shell smooth or weakly crenulate. *Oligo.-Rec.,* Eu.-N.Am.-C.Am.-S.Am.

F. (Fissurella). Shell with border dark internally. *Eoc.-Rec.,* Eu.-Atl.-Pac.——FIG. 142,*12.* **F. nimbosa* (LINNÉ), Rec., W.Indies; ×0.7 (147).

F. (Balboaina) PEREZ-FARFANTE, 1943 [**Patella picta* GMELIN, 1791] [=*Balvoina* CARCELLES, 1951 *(errore); Balboina* PEREZ-FARFANTE, 1952 *(errore)*]. Like *F. (Fissurella)* but larger, internal callus broader. *Rec.,* southern S.Am.

F. (Carcellesia) PEREZ-FARFANTE, 1952 [**F. (C.) doellojuradoi*]. Perforation with a small tooth on either side. *Rec.,* S.Am.

F. (Clypidella) SWAINSON, 1840 [**Patella pustula* GMELIN, 1791 (*non* LINNÉ, 1758) = *F. punctata* FISCHER, 1857]. Depressed, saddle-shaped, ends elevated; perforation in front of middle; margin somewhat crenulate. *Rec.,* Atl.-W.Indies.

F. (Cremides) ADAMS & ADAMS, 1854 [**F. alabastrites* REEVE, 1849; SD COSSMANN & PEYROT, 1917]. Perforation central, shell with well-developed radial ribs; inner margin crenulate. *Oligo.-Rec.,* N.Am.-C.Am.

Amblychilepas PILSBRY, 1890 [**Fissurella trapezina* G.B.SOWERBY, 1835 = *F. javanicensis* LAMARCK, 1822] [=*Sophismalepas* IREDALE, 1924]. Saddle-

shaped, shell elevated at ends; hole large; margins of shell thickened, not crenulate. *Rec.*, S.Atl.-S. Pac.——FIG. 142,*7*. **A. javanicensis* (LAMARCK), Rec., Austral.; *7a-c*, ×1 (147).

Atractotrema COSSMANN, 1888 [**Fissurella grata* DESHAYES, 1861]. Small, perforation in front of apex, obovate; sculpture faint. *Eoc.*, Eu.——FIG. 142,*1*. **A. grata* (DESHAYES), Eoc., Fr.; ×3 (177).

Cosmetalepas IREDALE, 1924 [**Fissurella concatenata* CROSSE & FISCHER, 1864] [=*Profissurellidea* WENZ, 1938]. Thin, depressed, surface with small rounded pits; perforation large, oblong. *Mio.-Rec.*, Austral.

Fissurellidea D'ORBIGNY, 1841 [**F. megatrema* = *Fissurella hiantula* LAMARCK, 1822]. Depressed, margin with a thickened rim, perforation large. *Eoc.-Rec.*, Eu.-Afr.-S.Am.-Austral.

F. (Fissurellidea). With fine radial riblets; perforation central. *Eoc.-Rec.*, Eu.-S.Am.-Austral. ——FIG. 142,*5*. **F. (F.) hiantula* (LAMARCK), Rec., Arg.; *5a-c*, ×1 (147).

F. (Pupillaea) G.B.SOWERBY, 1835 [**Fissurella aperta* G.B.SOWERBY, 1825] [=*Pupilia, Papillaea* "GRAY" of authors, spelling errors]. Marginal rim depressed; perforation eccentric. *Plio.-Rec.*, S.Am.-S.Afr.

Lucapina G.B.SOWERBY, 1835, *ex* GRAY MS [**Fissurella cancellata* G.B.SOWERBY, 1835 (*non* GRAY, 1825) = *Foraminella sowerbii* SOWERBY, 1835 *ex* GUILDING MS] [=*Foraminella* SOWERBY, 1835 *ex* GUILDING MS (obj.); *Chlamydoglyphis* PILSBRY, 1890]. Inner margin not thickened, finely crenulate. *Mio.-Rec.*, W.Indies-W.N.Am.——FIG. 142, *2*. **L. sowerbii* (SOWERBY), Rec., Fla.; ×1.5 (2).

Lucapinella PILSBRY, 1890 [**Clypidella callomarginata* DALL, 1872, *ex* CARPENTER MS; SD PILSBRY, 1891]. Apex subcentral, large perforation; crenulate within at each end, posterior margin slightly elevated. *Oligo.-Rec.*, W.Indies-N.Am.-S. Am.——FIG. 142,*11*. Rec., Calif.; ×1.5 (213).

Macroschisma G.B.SOWERBY, 1839, *ex* GRAY MS [**Patella macroschisma* SOLANDER, 1786, *ex* HUMPHREY MS] [=*Macrochisma* GRAY, 1840; *Machrochisma* SWAINSON, 1840 (obj.)]. Shell long and narrow, perforation near posterior margin. *Rec.*, Australasia-SW.Pac.-IndianO.

M. (Macroschisma). Perforation long-triangular, wide end near posterior margin. *Rec.*, IndianO.-SW.Pac.——FIG. 142,*3*. **M. macroschisma* (SOLANDER), Rec., Austral.; ×1.5 (219).

M. (Dolichoschisma) IREDALE, 1940 [**M. producta* A.ADAMS, 1854]. With broad raised ridge from perforation to anterior margin. *Rec.*, Australasia.

M. (Forolepas) IREDALE, 1940 [**M. tasmaniae* G.B.SOWERBY, 1862]. Shell and perforation broader than in *M. (Macroschisma)*. *Rec.*, Australasia.

Megatebennus PILSBRY, 1890 [**Fissurellidea bimaculata* DALL, 1872]. More elevated than *Fissurellidea*. *Plio.-Rec.*, W.N.Am.-Austral.——FIG. 142,*9*. **M. bimaculatus* (DALL), Rec., Calif., ×1 (147).

Suborder PATELLINA von Ihering, 1876

[*nom. transl.* COX & KNIGHT, herein (*ex* Patelloidea VON IHERING, 1876)] [=Cyclobranchia (GOLDFUSS, 1820, *partim*) GRAY, 1821; Docoglossa TROSCHEL, 1866; Onychoglossa SARS, 1878; Phyllidiobranchia LANKESTER, 1883; *hétérocardes* PERRIER, 1889; Heterocardia BERNARD, 1890]

Shell conical or cap-shaped, bilaterally symmetrical, without perforation or marginal notch, without internal septum; muscle attachment scar semicircular or horseshoe-shaped, open on anterior side; outer shell layer calcitic, inner layers aragonitic, iridescent in some but not nacreous; no operculum; living forms with single bipectinate ctenidium or with circlet of small branchiae beneath mantle margin or with neither; pallial genital organs wanting; heart with single auricle, ventricle not traversed by rectum; radula long, docoglossate, **teeth clawlike, number in each row small,** exercising effective rasping stroke during outward protraction of odontophore. [Habitat littoral zone, clinging to rocks.] *?M.Sil.-L.Trias., M.Trias.-Rec.*

Superfamily PATELLACEA Rafinesque, 1815

[*nom. transl.* THIELE, 1925 (*ex* Patellidae, *nom correct.* GRAY, 1834, *pro* Patellaria RAFINESQUE, 1815)]

With characters of suborder. *?M.Sil.-L. Trias., M.Trias.-Rec.*

?Family METOPTOMATIDAE Wenz, 1938

Shell patelliform or helcioniform; muscle scar horseshoe-shaped with anterior opening not closed by pallial line, scar broadest at anterior end; nature of inner shell layers and of possible coiled protoconch imperfectly known. *M.Sil.-M.Perm.*

The Metoptomatidae are seemingly represented by undescribed species and genera occurring as far back as early Middle Ordovician time. Their derivation is uncertain, but it seems probable that they arose from the early pleurotomarian stem or even from the still more primitive bellerophonts. No direct evidence can be cited to indicate that this family was docoglossate but, on the other hand, there is not yet enough evidence to establish it as a superfamily unrelated to but convergent with the Patellacea.

Palaeoscurria PERNER, 1903 [**P. calyptrata;* SD COSSMANN, 1904]. Externally resembling *Lepetopsis* but musculature entirely unknown. [Existence of supposed muscle scars described and figured

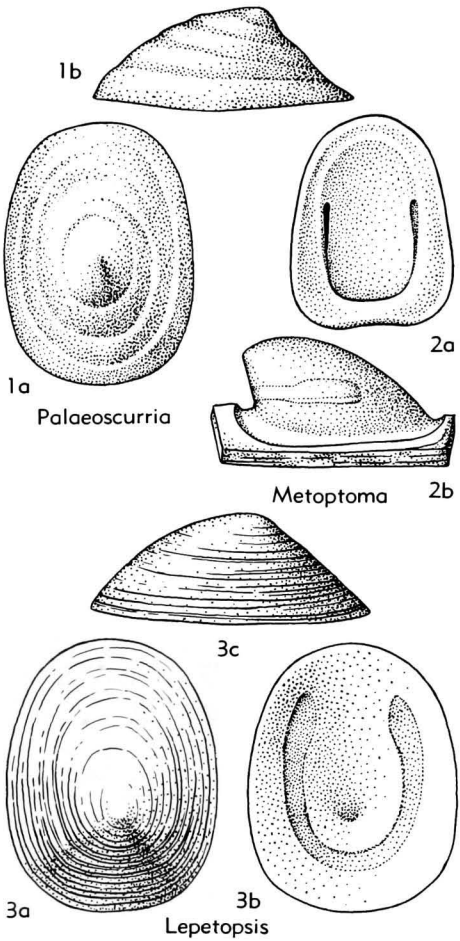


FIG. 143. Patellacea (Metoptomatidae) (p. I231-I232).

by PERNER cannot be verified; possibly congeneric with *Lepetopsis*.] M.Sil., Eu.——FIG. 143,*1*. **P. calyptrata*, Czech.; *1a,b*, from above and left side, ×2.7.

Metoptoma PHILLIPS, 1836 [**M. oblonga*; SD S.A. MILLER, 1889]. Helcioniform, with open horseshoe-shaped muscle scar; apex posterior; anterior slope convex and posterior approximately vertical. *L. Carb.(Miss.)-Perm.*, N. Am.-Eu.-SE. Asia.——FIG. 143,*2*. **M. oblonga*, L.Carb., Eng.; *2a*, interior, showing muscle scars; *2b*, steinkern, right side; ×2.

Lepetopsis WHITFIELD, 1882 [**Patella levettei* WHITE, 1882]. Thin patelliform, with open horseshoe-shaped muscle scar; apex slightly in front of center, posterior slope convex, anterior straight or concave. *Miss.-M.Perm.*, N.Am.-Eu.-SE.Asia.——FIG. 143,*3*. **L. levettei* (WHITE), M.Miss., Ind.; *3a*, from above; *3b*, interior showing scar (upper part anterior); *3c*, left side; all ×1.3.

?Family SYMMETROCAPULIDAE Wenz, 1938

[*nom. transl. et correct.* COX, herein (*ex* Symetrocapulinae WENZ, 1938)]

Cap-shaped, longitudinal profile downcurved from submedian summit to more or less anteriorly placed and directed beak; protoconch coiled, of 1.5 to 2 whorls, retained (unless eroded) by adult shell; muscle scar unknown. *Trias.-Jur., ?Cret.*

For lack of definite evidence to the contrary, this group is provisionally retained in the Patellina, following WENZ, although it may eventually prove to be related to the caenogastropod family Capulidae.

Symmetrocapulus DACQUÉ, 1933 [**Patella rugosa* J.SOWERBY, 1816 (*non* RÖDING, 1798) = **P. tessoni* J.A.EUDES-DESLONGCHAMPS, 1843] [=*Symetrocapulus* HABER, 1932 *(nom. nud.)*]. Rather large; beak at anterior third to quarter of length; ornament radial riblets and concentric folds. *Jur., ?Cret.*, Eu.——FIG. 144,*1*. **S. rugosus* (J.SOWERBY), M.Jur.(Bath.), Fr.; *1a,b*, from above and left side, ×2 (147).

?Phryx BLASCHKE, 1905 [**Capulus (Phryx) bilateralis*]. Rather small, domelike, with submedian summit and terminal beak; no ornament except growth striae; protoconch unknown. *M.Trias.-U. Trias.*, Eu.-Asia.——FIG. 144,*2*. **P. bilateralis*, M.Trias.(Ladin.), S.Tyrol; right side, ×1 (147).

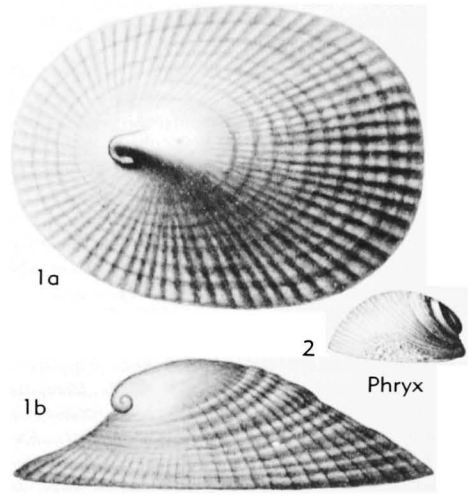


FIG. 144. Patellacea (Symmetrocapulidae) (p. I232).

Family ACMAEIDAE Carpenter, 1857

Shell conical, porcelaneous; respiratory organ a single ctenidium, no branchial cordon. *M.Trias.-Rec.*

Scurriopsis Gemmellaro, 1879 [**S. neumayri;* SD Haber, 1932]. Shell variably elevated, apex slightly or well anterior to median; ornament collabral threads with radial elements variable. *M.Trias.-U.Jur., ?L.Cret.,* Eu.-Afr.

S. (Scurriopsis). Well-elevated, broadly elliptical, apex only slightly anterior to median; cancellating collabral and radial threads on entire surface; muscle scar (observed in type species) horseshoe-shaped with broad anterior gap. *M.Trias.-U.Jur.,* Eu., N.Afr.——Fig. 145,*8*. **S. (S.) neumayri,* L.Lias., Sicily; *8a,b,* from above and left side, ×1 (130).

S. (Hennocquia) Wenz, 1938 (*ex* Haber, 1932, *nom. nud.*) [**Patella hennocquii* Terquem, 1855]. Only moderately elevated, ovate, with anterior end the narrower; apex well anterior; radial riblets almost confined to posterior end. *L.Jur.(L.Lias.),* Eu.——Fig. 145,*6*. **S. (H.) hennocquii* (Terquem), Fr.; *6a,b,* from above and right side, ×1 (224).

S. (Dietrichiella) Wenz, 1938 (*ex* Haber, 1932, *nom. nud.*) [**Patella kindopensis* Dietrich, 1914]. Small, moderately elevated, rather narrowly elliptical; apex well anterior; radial riblets very obscure. *U.Jur., ?L.Cret.,* E.Afr.-Eu.——Fig. 145,*3*. **S. (D.) kindopensis* (Dietrich), U. Jur.(Kimm.), E.Afr.; *3a,b,* from above and left side, ×2 (130).

Marbodeia Chelot, 1887 [*pro Guerangeria* Cossmann, 1885 (*non* Oehlert, 1881)] [**Patella clypeola* J.A.Eudes-Deslongchamps, 1842]. Small, narrowly elliptical, depressed, convex in profile except for apex, which forms projecting stud limited by a depression; ornament depressed, rounded radial riblets. *M.Jur.(Bathon.),* Eu.——Fig. 145,*1*. **M. clypeola* (J.A.Eudes-Deslongchamps), Fr.; *1a,b,* from above and right side, ×1.5 (17).

Conorhytis Cossmann, 1907 [**Patella squamula* J.A. Eudes-Deslongchamps, 1863]. Moderately large, well-elevated, broadly elliptical, apex just anterior to median; ornament fine squamae or wrinkles with irregular quincuncial arrangement, and obscure radial threads. *M.Jur.(Baj.-Bathon.),* Eu.——Fig. 145,*7*. **C. raduloides* (Cossmann), M.Jur.(Bathon.); *7a,b,* from above and right side, ×1 (170).

Deslongchampsia Morris & Lycett (*ex* M'Coy, MS), 1851 [**Patella appendiculata* J.A.Eudes-Deslongchamps, 1842; SD Laube, 1868 (Tate, 1868, Appendix to S.P.Woodward, *Manual of Mollusca,* p. 39, designated *D. eugenei* Morris & Lycett as type species in the same year, but Laube's designation is here accepted)]. Of small-medium size, cap-shaped, rather depressed, suborbicular, with apex anterior to median and pointing anteriorly; broad, smooth sulcus runs from apex to rounded lobelike projection of anterior margin; remainder of surface radially costate. *M. Jur.(Bathon.)-U.Jur.(Oxford.),* Eu.——Fig. 145,*2*. **D. appendiculata* (J.A.Eudes-Deslongchamps), M.Jur.(Bathon.), Fr.; *2a-c,* from above, anterior, and left side, ×1 (147).

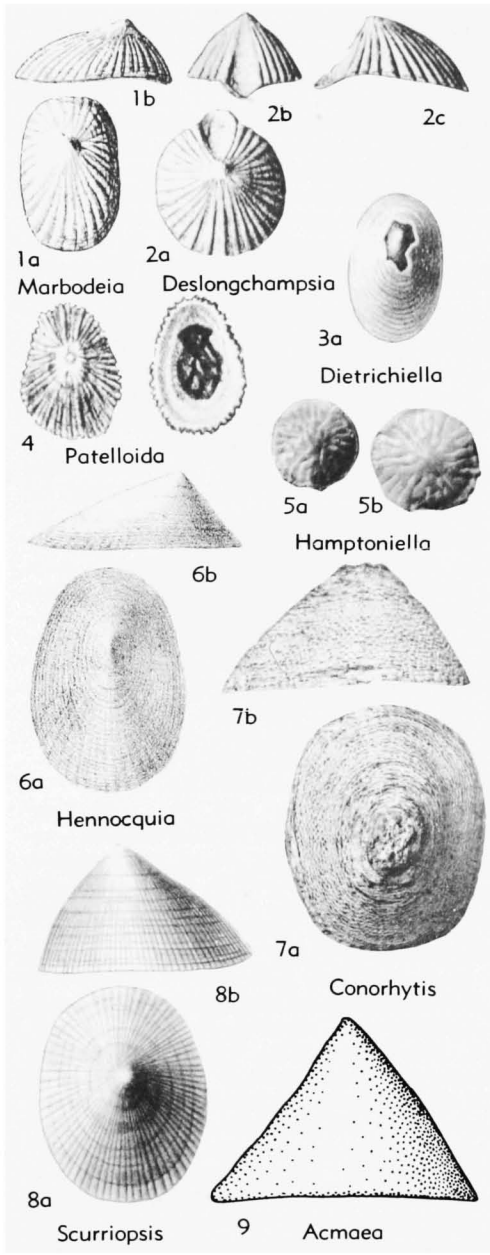


Fig. 145. Patellacea (Acmaeidae——Acmaeinae) (p. *I233-I234*).

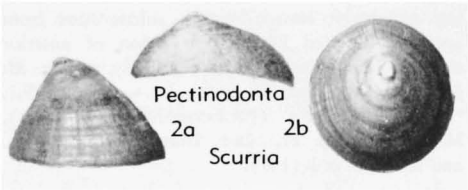


FIG. 146. Patellacea (Acmaeidae——Acmaeinae) (p. I234).

Hamptoniella WENZ, 1938 [*pro Hamptonia* HABER, 1932 *(nom. nud.) non* WALCOTT, 1920] [**Umbrella? hamptonensis* MORRIS & LYCETT, 1851]. Small, circular, flat or almost so; apex submedian; surface with straight or undulating low, rounded, subradial ribs, increasing outward by intercalation and forking. *M.Jur.(Bathon.)*, Eu.——FIG. 145,*5*. *H. hamptonensis* (MORRIS & LYCETT), Eng.; *5a,b*, specimens from above, ×1.8 (COX, n).

Acmaea ESCHSCHOLTZ, 1833 (ICZN Op. 344, 1955) [**A. mitra;* SD DALL, 1871] [=*Niveotectura* HABE, 1944]. Smooth to radially ribbed, oval, apex mostly subcentral; muscle impressions joined by a thin line anteriorly. *Oligo.-Rec.*, Pac.

A. (Acmaea). Apex central, shell white, nearly smooth. *Pleist.-Rec.*, W.N.Am.——FIG. 145,*9*. **A. (A.) mitra*, Rec., Washington; left side, ×2 (147).

A. (Actinoleuca) OLIVER, 1926 [**Patella campbelli* FILHOL, 1880]. High, finely ribbed. *Oligo.-Rec.*, Australasia.

A. (Asteracmea) OLIVER, 1926 [**Helcioniscus illibratus* VERCO, 1906]. *Rec.*, Australasia.

A. (Atalacmea) IREDALE, 1915 [**Patella fragilis* SOWERBY, 1823]. Small, thin, apex in front of center. *Mio.-Rec.*, N.Z.

A. (Chiazacmea) OLIVER, 1926 [**Patelloida flammea* QUOY & GAIMARD, 1834]. *Rec.*, S.Pac.

A. (Collisella) DALL, 1871 [**A. pelta* ESCHSCHOLTZ, 1833]. Larger than *A. (Acmaea)*, exteriorly dark colored, a colored margin within; sculpture various. *Pleist.-Rec.*, NW.N.Am.-C.Am.

A. (Collisellina) DALL, 1871 [**Patella saccharina* LINNÉ, 1758]. *Rec.*, IndoPac.

A. (Conacmea) OLIVER, 1926 [**A. parviconoidea* SUTER, 1907]. *Rec.*, Australasia.

A. (Conoidacmaea) HABE, 1944 [**Patella heroldi* DUNKER, 1861]. *Pleist.-Rec.*, Japan.

A. (Kikukozara) HABE, 1944 [**Collisella (K.) langfordi*]. *Rec.*, Japan.

A. (Naccula) IREDALE, 1924 [**Nacella parva* ANGAS, 1878 = *Patelloida punctata* QUOY & GAIMARD, 1834]. *Rec.*, Australasia.

A. (Notoacmea) IREDALE, 1915 [**Patelloida pileopsis* QUOY & GAIMARD, 1834]. *Plio.-Rec.*, Japan-Australasia.

A. (Parvacmea) IREDALE, 1915 [**A. daedala* SUTER, 1907]. Small, thin, beaks well forward, hooked. *Oligo.-Rec.*, N.Z.

A. (Patelloida) QUOY & GAIMARD, 1834 [**P. rugosa;* SD GRAY, 1847]. Radially ribbed; with strong color markings as in *A. (Collisella)*. *Rec.*, IndoPac.——FIG. 145,*4*. **A. (P.) rugosa* (QUOY & GAIMARD), Rec., E.Indies; *4a,b*, exterior and interior, anterior toward top, ×1 (147).

A. (Radiacmea) IREDALE, 1915 [**A. cingulata* HUTTON, 1883]. *Rec.*, S.Pac.

A. (Subacmea) OLIVER, 1926 [**Notoacmea scopulina*]. *Rec.*, Australasia.

A. (Tectura) GRAY, 1847 [**Patella parva* DACOSTA, 1778 = *P. virginea* MÜLLER, 1776] [=*Erginus* JEFFREYS, 1877]. Apex high, in front of center, ribbing weak, radial and concentric. *Plio.-Rec.*, Eu.

A. (Thalassacmea) OLIVER, 1926 [**Notoacmea badia*]. *Rec.*, N.Z.

Lottia GRAY, 1833 [**L. gigantea* G.B.SOWERBY, 1834; SD DALL, 1871] [=*Tecturella* CARPENTER, 1860 (*non* STIMPSON, 1854); *Tecturina* CARPENTER, 1861, *Lecania* CARPENTER, 1866 (*non* MACQUART, 1839), *pro Tecturella*]. Large, low, apex nearly marginal; muscle impressions joined by a curved line. *Rec.*, W.N.Am.

Pectinodonta DALL, 1882 [**P. arcuata*]. Low, somewhat arched, apex blunt, subcentral; animal blind; in deep water. *Rec.*, Atl.-Japan.——FIG. 146,*1*. **P. arcuata*, Rec., W.Indies; ×2 (147).

Potamacmaea PEILE, 1922 [**Tectura fluviatilis* BLANFORD, 1868]. Rounded, finely radially ribbed; in brackish to fresh water. *Rec.*, India.

Scurria GRAY, 1847 [**Patella scurra* LESSON, 1841]. High, apex subcentral; sculpture more concentric than radial. *Rec.*, W.S.Am.——FIG. 146,*2*. **S. scurra* (LESSON), Rec., W.S.Am.; ×1 (147).

Family PATELLIDAE Rafinesque, 1815

[*nom. correct.* GRAY, 1834 (*pro* Patellaria RAFINESQUE, 1815)]

Iridescent to porcelaneous within; with a branchial cordon (pallial gill lamellae) but no true ctenidium. *?Jur., Eoc.-Rec.*

Subfamily PATELLINAE Rafinesque, 1815

[*nom. transl.* THIELE, 1929 (*ex* Patellidae, *nom. correct.* GRAY, 1834, *pro* Patellaria RAFINESQUE, 1815)]

Shell strong and solid, interior iridescent; embryonal shell not evident. *?Jur., Rec.*

Patella LINNÉ, 1758 [**P. vulgata;* SD FLEMING, 1818] [=*Patellaria* GMELIN, 1793; *Patellus* MONTFORT, 1810 (obj.); *Patellopsis* THIELE in TROSCHEL, 1891 (*non* NOBRE, 1896); *Costatopatella* PALLARY, 1912; *Granopatella, Laevipatella* PALLARY, 1920]. Round to elliptical, apex subcentral; rarely smooth. *?U.Cret., Eoc.-Rec.*, Eu.-Afr.-C.Am.-Pac.-IndoPac.-Austral.-E.Asia.

P. (Patella). Oval, with strong radial ribs, apex nearly central. *?U.Cret., Eoc.-Rec.*, Eu.-Afr.——FIG. 147,*2*. **P. (P.) vulgata*, Rec., Fr.; from above, anterior toward top, ×1 (147).

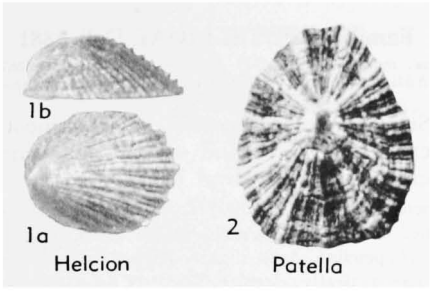


FIG. 147. Patellacea (Patellidae——Patellinae) (p. *I*234-*I*235).

P. (Ancistromesus) DALL, 1871 [**P. mexicana* BRODERIP & SOWERBY, 1829]. Adult very large and solid. *Pleist.-Rec.*, W.C.Am.

P. (Cymbula) ADAMS & ADAMS, 1854 [**P. compressa* LINNÉ, 1758]. Large, elongate-ovate, finely ribbed. *Rec.*, IndoPac.

P. (Olana) ADAMS & ADAMS, 1854 [**P. cochlear* BORN, 1778]. Anterior margin prolonged, shell spoon-shaped. *Rec.*, S.Afr.

P. (Patellastra) MONTEROSATO, 1884 [**P. lusitanica* GMELIN, 1791]. Rounded; radial ribs weakly nodose. *Mio.-Rec.*, Eu.

P. (Patellidea) THIELE in TROSCHEL, 1891 [**P. granularis* LINNÉ, 1758]. *Rec.*, S.Afr.

P. (Patellona) THIELE in TROSCHEL, 1891 [**P. granatina* LINNÉ, 1758; SD TOMLIN, 1931]. *Rec.*, S.Afr.-W.Afr.

P. (Penepatella) IREDALE, 1929 [**Penepatella inquisitor*]. *Rec.*, Austral.-Japan.

P. (Scutellastra) ADAMS & ADAMS, 1854 [**P. plicata* BORN, 1778 = *P. barbara* LINNÉ, 1758] [=*Patellanax* IREDALE, 1924]. *?Eoc., Rec.*, Pac.

Helcion DEMONTFORT, 1810 [**Patella pectinata* BORN, 1778]. Rather thin-shelled, cap-shaped, apex submarginal. *?Jur., Plio.-Rec.*, Eu.-Afr.-Pac.

H. (Helcion). Radially ribbed. *?Jur., Rec.*, Eu.-Afr.-Pac.——FIG. 147,*1*. **H. (H.) pectinatus* (BORN), Rec., S.Afr.; *1a,b*, from above and left side, ×1 (147).

H. (Ansates) SOWERBY, 1839 [**Patella pellucida* LINNÉ, 1758] [=*Patina* GRAY, 1847 (obj.)]. Apex higher than in *H. (Helcion)*. *Plio.-Rec.*, N. Atl.

H. (Patinastra) THIELE in TROSCHEL, 1891 [**Patella pruinosus* KRAUSS, 1848]. With weak radial ribs. *Rec.*, S.Afr.

H. (Rhodopetala) DALL, 1921 [**Nacella? rosea* DALL, 1872]. Small, smooth, apex overhanging margin. *Rec.*, N.Pac.

Subfamily NACELLINAE Thiele, 1929

Shell solid in some species, in others thin-shelled to transparent; interior with metallic glaze. *Eoc.-Rec.*

Nacella SCHUMACHER, 1817 [**N. mytiloides* (=**Patella mytilina* HELBLING, 1779)]. Cap-shaped, apex hooked. *Eoc.-Rec.*, Eu.-S.Am.-Antarct.

N. (Nacella). Apex submarginal; shell nearly transparent. *Eoc.-Rec.*, Eu.-S.Am.-Antarct.——FIG. 148,*2*. **N. (N.) mytilina* (HELBLING), Rec., Strait of Magellan; right side, ×1 (147).

N. (Patinigera) DALL, 1905 [**Patella magellanica* GMELIN, 1791] [*pro Patinella* DALL, 1871 (*non* GRAY, 1848)]. Apex nearly central, shell sturdier than in *N. (Nacella)*. *Rec.*, Antarct.

Cellana H.ADAMS, 1869 [**Nacella cernica*] [=*Helcioniscus* DALL, 1871]. Shell fairly solid, apex subcentral; radial ribs strong; interior brilliantly glazed. *Mio.-Rec.*, S.Pac.-IndoPac.——FIG. 148, *1*. **C. cernica* (ADAMS), Rec., Mauritius; from above, anterior toward right, ×1 (147).

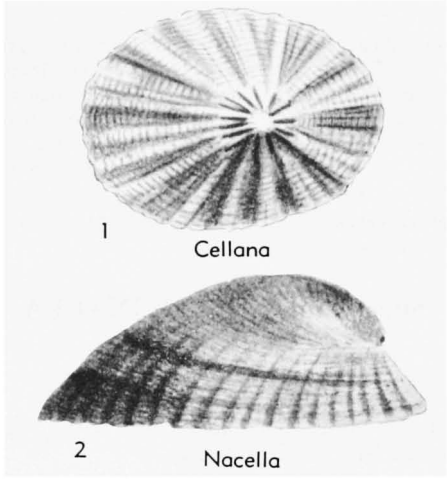


FIG. 148. Patellacea (Patellidae——Nacellinae) (p. *I*235)

Family LEPETIDAE Dall, 1869

Small, colorless shells, conical or cap-shaped, apex in front of center; smooth or with inconspicuous sculpture; muscle scar as in Acmaeidae. Animal without ctenidia or branchial cordon. *Mio.-Rec.*

Lepeta GRAY, 1847 [**Patella caeca* MÜLLER, 1776]. With fine radial ribs. *Plio.-Rec.*, Eu.-Arct.-N.Atl.-N.Pac.

L. (Lepeta). Rather small, exterior beaded; tip of muscle scar in front of apex. *Plio.-Rec.*, Eu.-N. Atl.——FIG. 149,*1*. **L. (L.) caeca* (MÜLLER), Rec., North Sea; *1a,b*, from above and right side, ×1 (147).

L. (Cryptobranchia) MIDDENDORFF, 1851 [**Patella caeca concentrica*; SD DALL, 1869] [=*Cryptoctenidia* DALL, 1918 (obj.)]. Larger, nearly smooth, tip of muscle scars not in front of apex. *Plio.-Rec.*, N.Pac.-Arct.

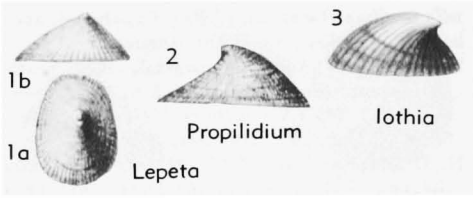


FIG. 149. Patellacea (Lepetidae) (p. *I235-I236*)

Iothia GRAY, 1850 [*non Iothia* FORBES, 1849 *(errore pro Lottia,* ICZN pend.)] [**Patella fulva* MÜLLER, 1776] [=*Pilidium* FORBES & HANLEY, 1849 (*non* MÜLLER, 1846) (obj.)]. Small, apex submarginal; with fine radial ribs. *Plio.-Rec.,* Eu.——FIG. 149, *3.* **I. fulva* (MÜLLER), Rec., Scot.; right side, ×2 (147).

Propilidium FORBES, 1849 [**Patella ancyloides* FORBES, 1840] [=*Rostrisepta* SEGUENZA, 1866]. Minute, spiral apex normally present; a small triangular septum inside the beak, as in *Puncturella;* surface finely cancellate. *Mio.-Rec.,* Eu.-Arct.——FIG. 149,*2.* **P. ancyloides* (FORBES), Rec., North Sea; left side, ×5 (147).

Punctolepeta HABE, 1958 [**P. minuta*]. Minute, with reticulate ornament. *Rec.,* Japan.

Superfamily COCCULINACEA Thiele, 1909

[*nom. correct.* THIELE, 1925 (*pro* Cocculinoidea THIELE, 1909)]

Resembling Patellacea but with apex turned backward. *Mio.-Rec.*

Family COCCULINIDAE Dall, 1882

Shell small, conical to cap-shaped. [Deep water.] *Mio.-Rec.*

Cocculina DALL, 1882 [**C. rathbuni;* SD DALL, 1908]. Shell colorless, with radiating and concentric sculpture; muscle scar as in *Phenacolepas. Mio.-Rec.,* Eu.-Atl.-N.Am.-N.Z.-E.Indies.

C. (Cocculina). Apex nearly central. *Mio.-Rec.,* Eu.-E.N.Am.-W.N.Am.——FIG. 150,*1.* **C. (C.) rathbuni,* Rec., Carib.; *1a,b,* from above and right side, ×2 (147).

C. (Maoricrater) DELL, 1956 [**Notoacmaea explorata* DELL, 1953]. *Rec.,* N.Z.

C. (Notocrater) FINLAY, 1927 [**C. craticulata* SUTER, 1908] [=*Coccopygia* DALL, 1889 (*non* REICHENBACH, 1862); *Dallia* JEFFREYS, 1883 (*non* BEAN, 1878)]. Apex hooked, near posterior margin; surface smooth or radially spinose. *Rec.,* Atl.-N.Z.

C. (Pseudococculina) SCHEPMAN, 1908 [**P. rugosoplicata;* SD WENZ, 1938]. With spiral embryonal whorls persisting. *Rec.,* E.Indies-Atl.

Family LEPETELLIDAE Dall, 1881

[*nom. transl.* THIELE, 1925 (*ex* Lepetellinae DALL, 1881)] [=Addisoniidae DALL, 1882; Bathysciadidae DAUTZENBERG & FISCHER, 1900]

Small, low to steeply conical, smooth; apex central or behind middle, not spiral; aperture rounded to oval. *Rec.*

Lepetella VERRILL, 1880 [**L. tubicola*]. Apex elevated, nearly central. *Rec.,* N.Atl.-Carib.-N.Z.

L. (Lepetella). Apex slightly hooked behind; shell margin nearly circular. *Rec.,* N.Atl.-Carib.——FIG. 150,*2.* **L. (L.) tubicola* Rec., Mass.; right side, ×5 (147).

L. (?Tecticrater) DELL, 1956 [**Cocculina compressa* SUTER, 1908]. *Rec.,* N.Z.

L. (Tectisumen) FINLAY, 1927 [**Cocculina clypidellaeformis* SUTER, 1908]. Saddle-shaped, anterior and posterior margins arched upward. *Rec.,* N.Z.

Addisonia DALL, 1882 [**A. paradoxa*]. Apex back of middle, blunt. *Rec.,* Atl.-Medit.——FIG. 150,*4.* **A. paradoxa,* Rec., NW.Atl.; right side, ×2 (147).

Bathysciadium DAUTZENBERG & FISCHER, 1900 [**B. conicum* (=**Lepeta costellata* LOCARD, 1898)]. Steeply conical, with radial striae. *Rec.,* Atl.-Pac.——FIG. 150,*3.* **B. costellatum* (LOCARD), Rec., Azores; right side, ×10 (147).

Cocculinella THIELE, 1909 [**Acmaea minutissima* SMITH, 1904]. Low, narrow-oval. *Mio.-Rec.,* Indian O.-Austral.——FIG. 150,*5.* **C. minutissima* (SMITH), Rec., Andaman I.; *5a,b,* from above and left side, ×7.5 (147).

?PATELLINA, Superfamily and Family UNCERTAIN

The following genera of Mesozoic patelliform gastropods seem closely related. *Brunonia* has been referred to the Siphonariidae and *Rhytidopilus* to the Acroriidae

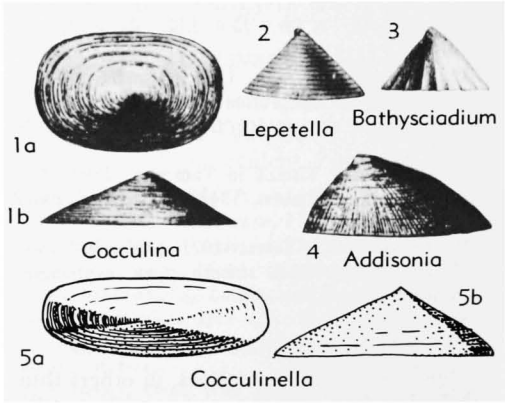


FIG. 150. Cocculinacea (Cocculinidae, Lepetellidae) (p. *I236*)

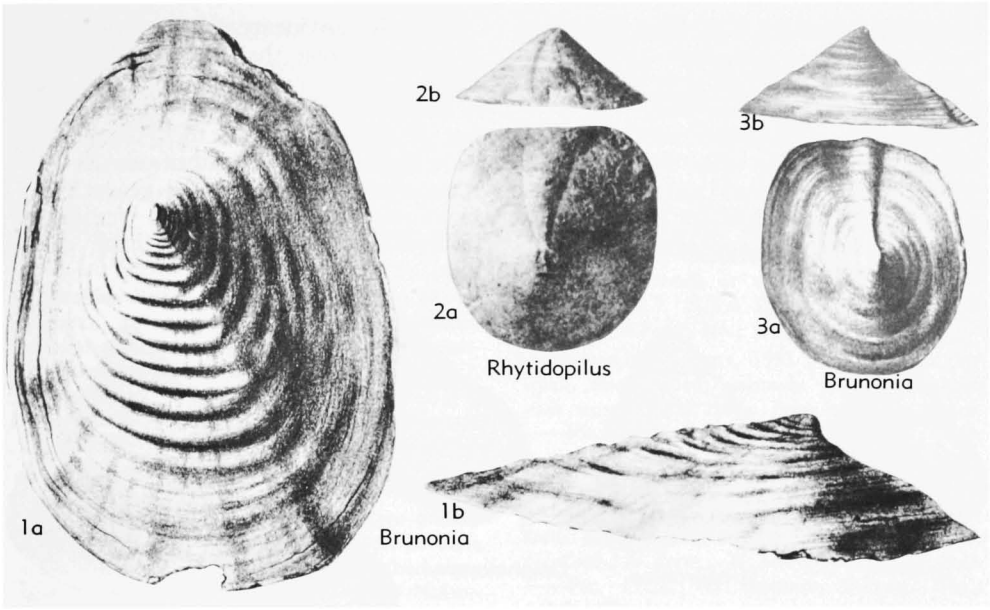


FIG. 151. ?Patellina (Superfamily and Family Uncertain) (p. *1237*).

COSSMANN, assumed also to belong to the Pulmonata. In no specimen, however, has the muscle scar been observed, and affinities with the pulmonates have yet to be proved. In the following descriptions it is assumed, without proof, that the apex, if not median, is anterior to median.

Berlieria DELORIOL, 1903 [**B. ledonica*]. Founded on broadly elliptical, patelliform internal molds of medium size; surface with concentric undulations and curved oblique furrow running from apex to anterior margin. *U.Jur.(Argov.)*, Jura.Mts.(Fr.-Switz.).

Rhytidopilus COSSMANN, 1895 [**Patella humbertina* BUVIGNIER, 1852]. Thin, patelliform, broadly elliptical, with subcentral apex; surface with concentric undulations; two furrows bordering a slightly elevated sector run from apex to anterior margin. *M.Jur.(Bathon.)-L.Cret.(Alb.)*, Eu.——FIG. 151,*2*. **R. humbertinus* (BUVIGNIER), U.Jur. (Kimm.), Fr.; *2a,b*, from above and anterior side, ×2.5 (18).

Pseudorhytidopilus COX, n.gen., herein (*pro* HABER, 1932, *nom. nud.*) [**P. lennieri* COX, n.sp., herein (*pro* HABER, 1932, *nom. nud.*) (=*Helcion castellana* LENNIER, 1868[1], *non Patella castellana* THURMANN & ÉTALLON, 1861]. Like *Rhytidopilus*, but lacking anterior elevated sector. *L.Jur.-U.Jur.*, Eu.

Brunonia MÜLLER, 1898 [**B. grandis*]. Large, patelliform, variably elevated, commonly asymmetrical; apex at or anterior to mid-length; surface with irregular concentric folds and (in some specimens) a narrow anterior elevated sector, as in *Rhytidopilus*. *U.Cret.(L.Senon.)*, Ger.——FIG. 151,*1*. **B. grandis; 1a,b*, from above and right side, ×1 (206).——FIG. 151,*3*. *B. irregularis* MÜLLER; *3a,b*, from above and right side, ×1 (206).

Suborder TROCHINA Cox & Knight, 1960

[=azygobranches chiastoneures BOUVIER, 1887; Trochomorpha NAEF, 1911]

Shell mostly conispiral, with spire not greatly elevated, more rarely discoidal; outer lip simple; inner shell layers and in some forms complete shell aragonitic and nacreous; operculum calcareous or corneous and spiral in Trochacea, calcareous and multispiral in Oriostomatacea, otherwise unknown; with single bipectinate ctenidium (left); pallial genital organs wanting; heart with 2 auricles, ventricle traversed by rectum; radula rhipidoglossate. *L.Ord.-Rec.*

[1] *Études géol. et pal. sur l'embouchure de la Seine*, p. 80, pl. 8B, figs. 8,8*a*. *Diagnosis:* Large *Pseudorhytidopilus* orbicular in outline. The species and genus (as subgenus of *Scurria*) were proposed by HABER with bibliographic references but without diagnoses, thus requiring validation before they can be recognized under the Rules.

Superfamily PLATYCERATACEA Hall, 1859

[*nom. transl.* Knight, Batten & Yochelson, herein (*ex* Platyceridae Hall, 1859)]

Primitively turbiniform with prosocline labrum and nacreous inner shell lining except in more advanced platyceratids; one group adapted to stationary habit on calyx of crinoids and to coprophagous feeding. *L. Ord.-M.Perm.*

There is no evidence of any exhalant sinus or channel other than the channel at the juncture of the parietal and outer lips, and it is assumed that the right ctenidium was lost. It is thought that the Platyceratacea were derived independently from the Pleurotomariacea, but the earliest genera recognized seem to have lost all vestiges of features suggesting a dibranchiate condition.

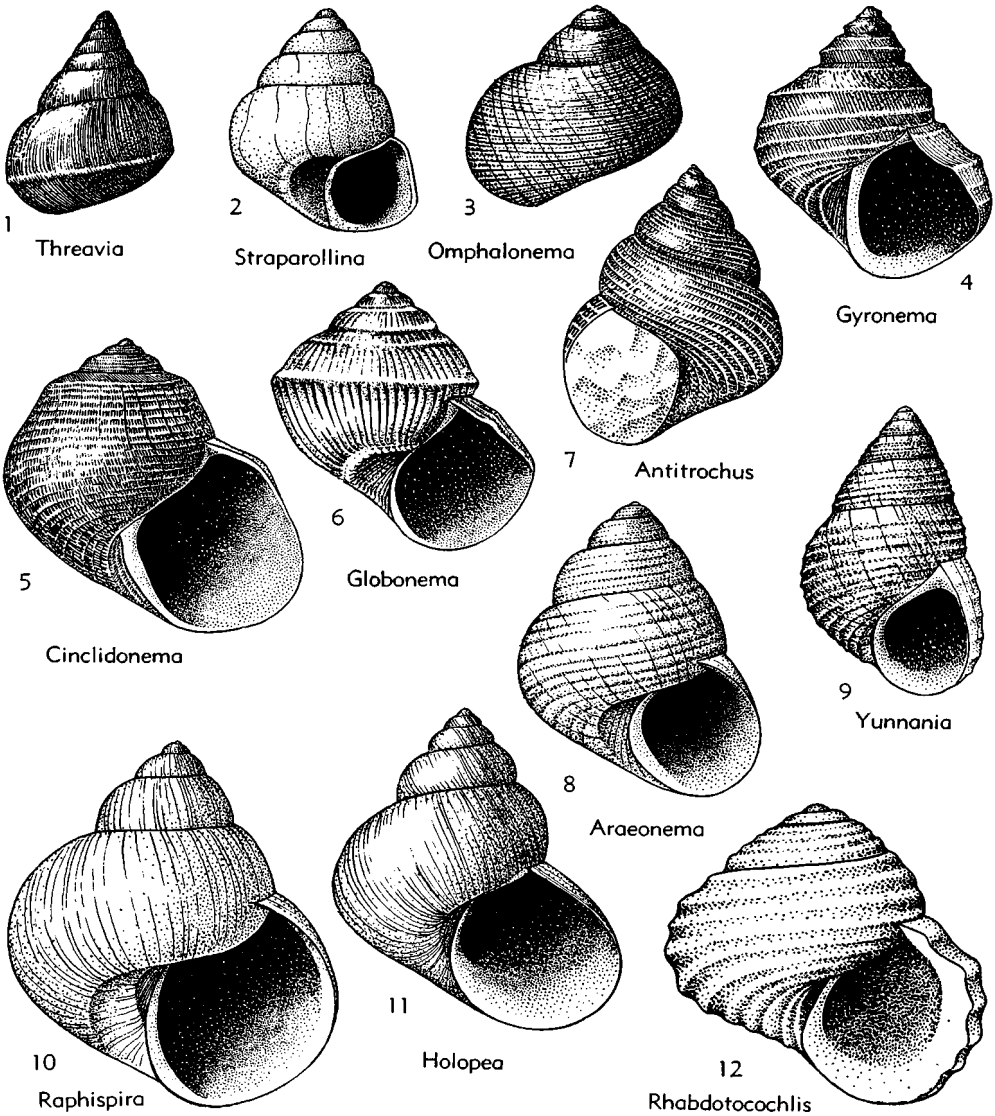


Fig. 152. Platyceratacea (Holopeidae——Holopeinae, Gyronematinae) (p. *1239*).

Family HOLOPEIDAE Wenz, 1938

Turbiniform, with or without spiral ornament; usually with narrow umbilicus. *L. Ord.-M.Perm.*

Subfamily HOLOPEINAE Wenz, 1938

[*nom. transl.* KNIGHT, BATTEN & YOCHELSON, herein (*ex* Holopeidae WENZ, 1938)]

Without or almost without spiral ornament. *L.Ord.-U.Dev.*

Straparollina BILLINGS, 1865 [**S. pelagica;* SD DE KONINCK, 1881]. Columellar lip with thickened triangular area below, generating a circumumbilical ridge. *L.Ord.*, N.Am.-Eu.——FIG. 152,*2*. **S. pelagica, L.Ord.*, Can.(Newf.); ×1.3.

Holopea HALL, 1847 [**H. symmetrica;* SD BASSLER, 1915] [=*Litiopsis* SALTER, 1866 (obj.); *Haplospira* KOKEN, 1897; *Cirropsis, Tortilla* PERNER, 1903; *Staurospira* PERNER, 1907 (*non* HAECKEL, 1887); *Anastrophina* KNIGHT, 1937 (*pro Staurospira* PERNER, 1907)]. Whorls rounded, in some species disjunct; sutures deep; final whorl may bear coarse rounded ribs. *M.Ord.-Dev.*, N.Am.-Eu.——FIG. 152,*11*. **H. symmetrica*, M.Ord., N.Y.; ×2.7.

Globonema WENZ, 1938 [**Nematotrochus bicarinatus* (WAHLENBERG) KOKEN, 1925 (*non* WAHLENBERG, 1821) = *Trochonema (Globonema) kokeni* WENZ, 1938]. Sutures moderately deep; with low carina at periphery above suture and another encircling the umbilicus; numerous collabral threads (147, p. 228). *U.Ord.*, Eu.——FIG. 152,*6*. *G. kokeni* (WENZ), Norway; ×3.3 (80).

?Threavia LAMONT, 1946 [**T. gulosa*]. With carina low on whorl (85, p. 642). *U.Ord.*, Eu.——FIG. 152,*1*. **T. gulosa*, Scot.; ×2.7 (85).

Raphispira PERNER, 1903 [**R. plena*]. Resembling *Holopea* but with a circumumbilical cord. *U.Sil.*, N.Am.-Eu.——FIG. 152,*10*. **R. plena*, Czech.; ×1.3.

?Protospirialis CLARKE, 1904 [**Platyostoma* (?) *minutissima* CLARKE, 1885]. Minute, naticiform, seemingly anomphalous. [Although very small, probably mature.] *U.Dev.*, N.Am.

Subfamily GYRONEMATINAE Knight, 1956

Spiral ornament dominant. *M.Ord.-M. Perm.*

Gyronema ULRICH in ULRICH & SCOFIELD, 1897 [**Trochonema (Gyronema) pulchellum* ULRICH & SCOFIELD, 1897]. Narrowly phaneromphalous with relatively few, strong spiral cords; outer lip prosocline; reflexed columellar lip. *M.Ord.-Sil.*, N.Am.-Eu.-N.Afr.——FIG. 152,*4*. **G. pulchellum* (ULRICH & SCOFIELD), M.Ord., Minn.; ×4.

Antitrochus WHIDBORNE, 1891 [**A. arietinus*; SD KNIGHT, 1937]. Sinistral, with numerous spiral and prosocline collabral threads. *M.Dev.*, Eu.——FIG. 152,*7*. **A. arietinus*, Eng.; ×2.

Yunnania MANSUY, 1912 [**Y. termieri;* SD COSSMANN, 1918]. Shell thick, anomphalous; ornament of spiral cords; growth lines prosocline. *Dev.-M.Perm.*, SE.Asia.-N.Am.-Eu.——FIG. 152,*9*. **Y. termieri*, L.Perm., China; ×3.3.

Araeonema KNIGHT, 1933 [**A. virgatum*] [=*Turbina* DEKONINCK, 1881 (*non* BROWN in HERRMANNSEN, 1847); *Palaeoturbina* WENZ, 1938 (147, p. 234) (*pro Turbina* DEKONINCK, 1881)]. Very small; narrowly phaneromphalous; ornament of faint spiral threads or wanting. *Miss.(L.Carb.)-Penn.(U.Carb.)*, N.Am.-Eu.——FIG. 152,*8*. **A. virgatum*, M.Penn., Mo.; ×13.3.

Rhabdotocochlis KNIGHT, 1933 [**R. rugata*]. Very small, thick-shelled; narrowly phaneromphalous; with strong spiral cords. *Penn.-M.Perm.*, N.Am.——FIG. 152,*12*. **R. rugata*, M.Penn., Mo.; ×40.

Cinclidonema KNIGHT, 1945 [**C. texanum*]. With shoulder below suture; anomphalous; columellar lip slightly reflexed; ornament of numerous spiral cords and collabral threads (72, p. 584). *Penn. (U. Carb.)-M. Perm.*, N. Am.-S. Am.-Eu.-SE. Asia.——FIG. 152,*5*. **C. texanum*, U.Penn., Tex.; ×1.7.

?Omphalonema GRABAU, 1936 [**O. multispiralis*]. Seemingly without shoulder but with ornament much like *Cinclidonema;* apertural characters unknown. *L.Perm.*, NE.Asia.——FIG. 152,*3*. **O. multispirale*, China; ×1 (48).

Family PLATYCERATIDAE Hall, 1859

[*nom. correct.* KNIGHT, 1934 (=Platyceridae HALL, 1859)] [=Platystomidae, Cyclonemidae, S.A.MILLER, 1889]

Coprophagous on crinoids and cystoids (BOWSHER, 1955), the shells showing through their range from mid-Ordovician to late Paleozoic progressively more complete adaptation to a stationary life, principally on crinoid calices; earlier members turbiniform or naticiform, with flat columellar lip but with irregular prosocline growth lines; lip becoming more uneven, conforming to irregularities of the crinoid or cystoid calyx, and the primitively coiled shell uncoiling or developing other peculiarities of growth as crinoids became more elaborate in the course of time; ornament present in more primitive stocks but gradually lost. *M.Ord.-M.Perm.*

So great is the variability induced by the stationary habit that systematics of the group are unusually difficult. One has trouble in deciding if two markedly unlike variations represent different genera or subgenera, or are actually conspecific. In the Platyceratidae the outer shell layers are relatively thick and calcitic, so that specimens

resist solution noticeably better than many gastropods that are more largely aragonitic. The inner shell layers of the primitive genus *Cyclonema* are seemingly nacreous and aragonitic, but this layer appears to be lost in the more advanced *Platyceras*.

Naticonema PERNER, 1903 [**N. similare*] [=*Otospira* PERNER, 1903; *Naticellina* PERNER, 1911]. Naticiform to globular, with flat excavated columellar lip; ornament wanting or consisting of spiral growth lines and collabral irregularly sinuous threads. Specimens known on crinoid calices. *M.Ord.-U.Sil.*, Eu.-N.Am.——FIG. 153,*1*. **N. similare*, U.Sil., Czech.; ×2.7.

Cyclonema HALL, 1852 [**Pleurotomaria bilix* CONRAD, 1842]. Basically turbiniform or trochiform but variously modified by stationary coprophagous habit; always with characteristically sharp spiral and finer collabral threads. *M.Ord.-L.Dev.*, N.Am.-Eu.

C. (Cyclonema) HALL, 1852 [=*Cyclonemina* PERNER, 1907]. Turbiniform to trochiform, with wavy surfaces and slightly irregular growth lines; columellar lip slightly excavated or irregular. Specimens known on crinoid calices. [The supposed genus *Cyclonemina* is composed of dwarfed, monstrous, or irregular individuals of several species, normal individuals of which are referred to *Cyclonema*. The irregular growth may have been due to inability to find a suitable station on a crinoid calyx.] *M.Ord.-U.Sil.*, N.Am.-Eu. ——FIG. 153,*11*. **C. (C.) bilix* (CONRAD), U. Ord., Ind.; ×2.

C. (Dyeria) ULRICH in ULRICH & SCOFIELD, 1897 [**Cyrtolites costatus* JAMES, 1872]. Earlier 3 or 4 whorls rotelliform; final whorl irregularly disjunct; with or without ornament. *M.Ord.-U.Ord.*, N.Am.——FIG. 153,*3*. **C. (D.) costatum* (JAMES), U.Ord., Ohio; ×1.

C. (Ploconema) PERNER, 1903 [**P. protendens*; SD PERNER, 1907]. Very like *Cyclonema* but with final whorl disjunct. *L.Dev.*, Eu.——FIG. 153,*5*. **C. (P.) protendens* (PERNER), L.Dev., Czech.; ×1.3.

Platyceras CONRAD, 1840 [**Pileopsis vetusta* J.DEC. SOWERBY, 1829; SD TATE, 1869]. Subgenera varying from naticiform to completely disjunct, some earlier species with spiral and collabral threads or with collabral lines, some with hollow spines arising as marginal tubes, apertural margin of many shells deeply sinuate, conforming to irregularities of crinoid calyx to which it was attached during life. [Apertural irregularities primarily record characters of the host crinoid, not of the gastropod, the reentrants of some shells resembling pleurotomarian sinuses or slits, but having no homologous function.] *Sil.-M.Perm.*, cosmop.

P. (Tubomphalus) PERNER, 1903 [**T. crenistria*]. Earliest 3 or 4 whorls rotelliform, final whorl disjunct; ornament wanting, growth lines irregular. *U.Sil.-L.Dev.*, N.Am.-Eu.——FIG. 153,*2*. **P. (T.) crenistrium* (PERNER), L.Dev., Czech.; ×1.3.

P. (Platyostoma) CONRAD, 1842 [**Platyostoma ventricosum*; SD HALL, 1859] [=*Platystoma* LINDSTRÖM, 1884 (*non* MEIGEN, 1803) (obj.); *Diaphorostoma* FISCHER, 1885 (obj.); *Platycerina* S.A.MILLER, 1889 (obj.); *Osterlina* TALLANT & PHILLIP, 1956 (136, p. 59)]. Naticiform with several whorls, of which last may or may not be disjunct; anomphalous to minutely phaneromphalous; irregularities of aperture relatively slight. *Sil.-Dev.*, cosmop.——FIG. 153,*13*. **P. (P.) ventricosum* (CONRAD), L.Dev., N.Y.; ×1.

P. (Platyceras) [=**Acroculia* PHILLIPS, 1841 (obj.); *Actita* FAHRENKOHL, 1844; *Acrocylia* AGASSIZ, 1846 (obj.); *Acrocyllis* HERRMANNSEN, 1846 (obj.); *Exogyroceras* MEEK & WORTHEN, 1868]. Irregularly capuliform, with 1 or 2 early whorls (or rarely more) coiled; protoconch vermiform; ornament commonly wanting or consisting of spiral and collabral threads. [This and *P. (Orthonychia)* are the most abundant, ubiquitous, and long-ranging members of the family. They are not infrequently preserved on the calices of fossil crinoids if the conditions of burial were suitable.] *Sil.-Miss.*, cosmop.——FIG. 153,*4*. **P. (P.) vetustum* (J.DEC.SOWERBY), Miss., Ire.; *4a*, oblique apertural view; *4b*, apical view; both ×0.7.

P. (Visitator) PERNER, 1911 [**V. extraneus*] [=*Aulopea, Distemnostoma, Saffordella* DUNBAR, 1920; *Cowwarrella* TALENT & PHILLIP, 1956, (136, p. 61)]. Coiling irregularly subtrochiform, with 4 to 6 whorls; sinuses, one high on side near upper suture and another near columellar lip, point to usual station over a pair of salients on crinoid; in some specimens a single sinus; ornament lacking. *U.Sil.-L.Dev.*, N.Am.-Eu.-N. Afr.——FIG. 153,*6*. *P. (V.) tennesseense* (DUNBAR), L.Dev., Tenn.; ×0.7.

P. (Orthonychia) HALL, 1843 [**Platyceras (Orthonychia) subrectum* HALL, 1859] [=*Igoceras* HALL, 1860; *Palaeocapulus* GRABAU & SHIMER, 1909; *Geronticeras* GRABAU, 1936]. Very similar to *Platyceras (s.s.)* but without coiling except that the vermiform protoconch in some specimens becomes fused to shell; ornament like that of *Platyceras (s.s.)*, or, more commonly, of strong longitudinal folds produced by sinus over strong salient on crinoid calyx. [Specimens are common on crinoid calices.] *?Sil., L.Dev.-M. Perm.*, cosmop.——FIG. 153,*10*. **P. (O.) subrectum* HALL, M.Dev., N.Y.; steinkern, ×0.7.

P. (Praenatica) PERNER, 1903 [**Strophostylus gregarius proeva*; SD KNIGHT, 1941 (69, p. 270)] [=*Prosigaretus* PERNER, 1907]. Naticiform to auriform; ornament of fine lamellar growth lines and crowded, oblique, irregular cords; columellar lip slightly thickened, strongly arcuate. *U. Sil.-L.Dev.*, Eu.-N.Am.——FIG. 153,*8*. **P. (P.)*

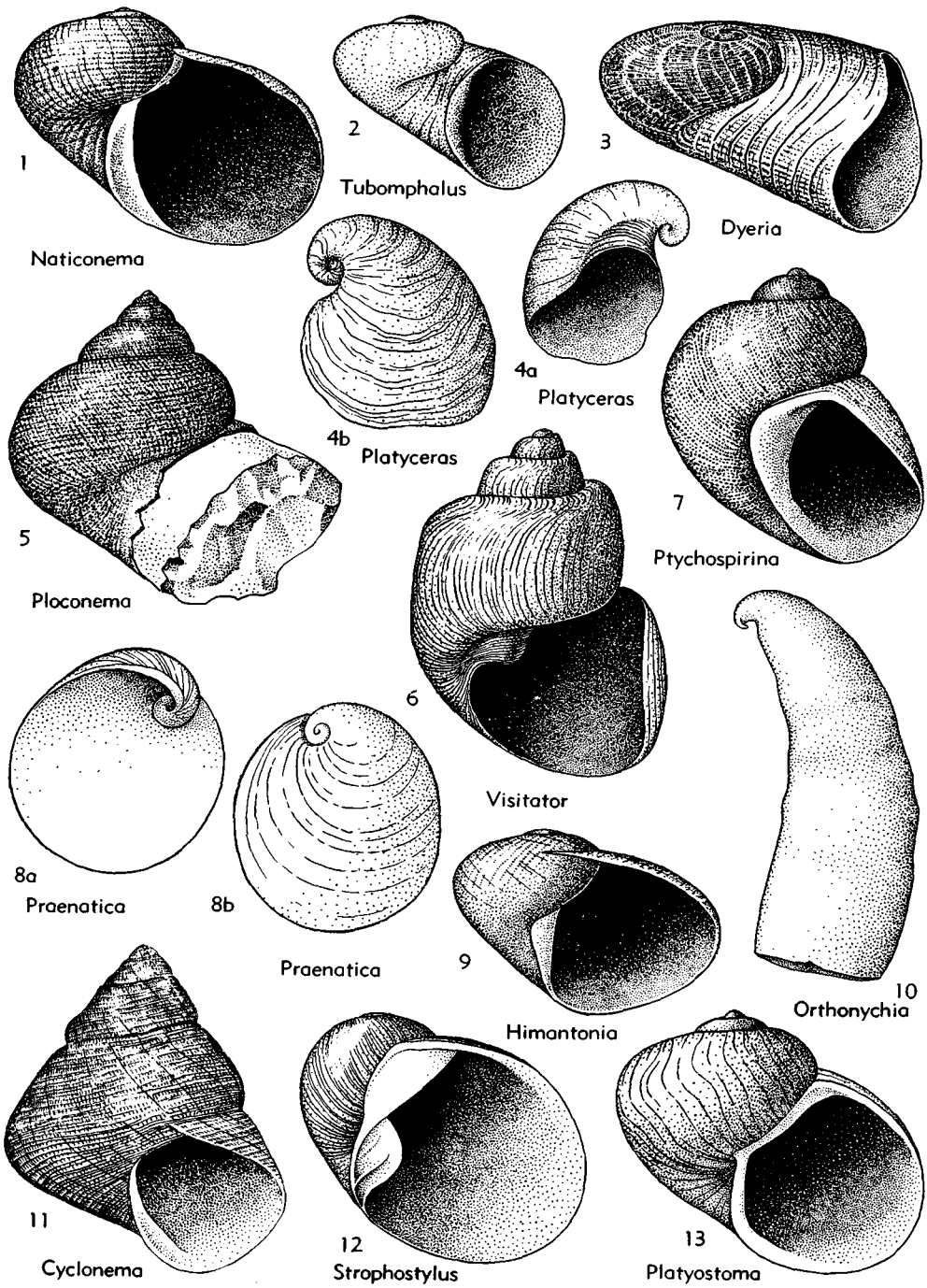


FIG. 153. Platyceratacea (Platyceratidae) (p. *1240-1242*).

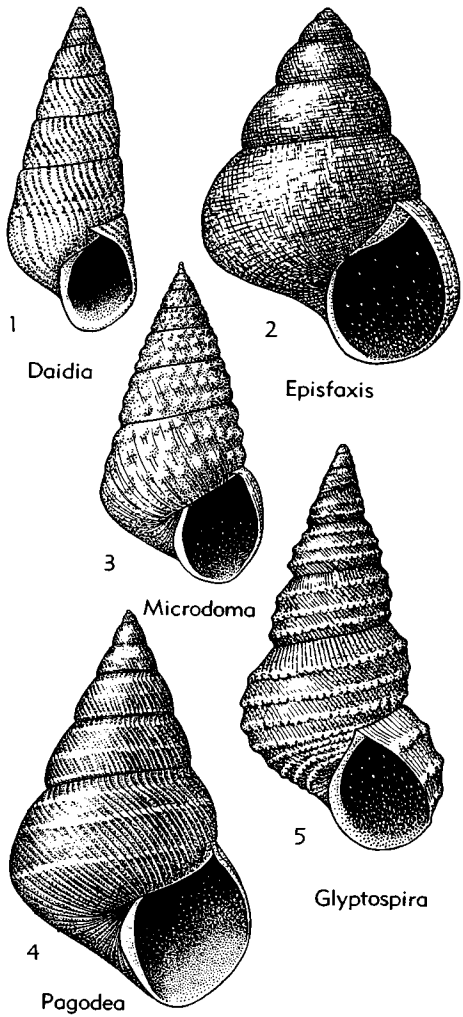


FIG. 154. Microdomatacea (Microdomatidae) (p. *1242-1243*).

proevum (PERNER), U.Sil., Czech.; *8a*, view into aperture; *8b*, apical; both ×0.7.

Ptychospirina PERNER, 1907 [*pro Ptychospira* PERNER, 1907 (*non* HALL & CLARKE, 1895)] [**Holopea mima* PERNER, 1903; SD COSSMANN, 1918]. Naticiform, with obliquely oblong aperture and no true columellar lip; ornament wanting or comprising sharp, somewhat irregular collabral threads. *U.Sil.-L.Dev.*, Eu.-N.Am.——FIG. 153,*7*. **P. mima* (PERNER), L.Dev., Czech.; ×2.7.

Strophostylus HALL, 1859 [**S. andrewsi* HALL, 1860; SD KEYES, 1890] [=*Helicostylus* KNIGHT, 1934 (obj.)]. Naticiform, with wide aperture; with spiral columellar plate. *?Sil., L.Dev., ?Penn.*, N.Am.——FIG. 153,*12*. **S. andrewsi*, L.Dev., Md.; ×1.3.

?Himantonia PERNER, 1911 [**Nerita amoena* PERNER, 1907]. Naticiform, outer lip strongly prosocline; ornament of strong oblique rounded cords with narrow interspaces normal to outer lip; growth lines seemingly without irregularities. *L. Dev.*, Eu.——FIG. 153,*9*. **H. amoena* (PERNER), Czech.; ×4.

Superfamily MICRODOMATACEA Wenz, 1938

[*nom. transl.* KNIGHT, BATTEN & YOCHELSON, herein (*ex* Microdominae WENZ, 1938)]

Subulate to turbiniform, with simple rounded aperture, reflexed columellar lip and nacreous inner shell layer. [Probably derived from the Pleurotomariacea.] *M. Ord.-M.Perm.*

Family MICRODOMATIDAE Wenz, 1938

[*nom. transl. et correct.* KNIGHT, BATTEN & YOCHELSON, herein (*ex* Microdominae WENZ, 1938)]

Umbilicus minute; usually ornamented; spire relatively high. *M.Ord.-M.Perm.*

Daidia WILSON, 1951 [**Eunema cerithioides* SALTER, 1859]. Turriculate, with slight shoulder at suture and very slight angulation about midway between sutures; collabral threads orthocline above and slightly prosocline below (150, p. 73). *M.Ord.*, N.Am.——FIG. 154,*1*. **D. cerithioides* (SALTER), Can.(Que.); ×1 (150).

Episfaxis KNIGHT, 1937 [*pro Cosmina* PERNER, 1903 (*non* ROBINEAU-DESVOIDY, 1830)] [**Cosmina complacens* PERNER, 1903]. Turbiniform, with rounded whorls and moderately high spire; ornament a network of fine spiral and orthocline collabral threads. *L.Dev.*, Eu.——FIG. 154,*2*. **E. complacens* (PERNER), Czech.; ×2.7.

Pagodea PERNER, 1903 [**P. concomitans*]. Turbiniform, with rounded whorls, shallow sutures, and moderately high spire; labrum orthocline, close to upper suture, but turning shortly to strongly prosocline; ornament of 3 low spiral cords and sharp lamellar collabral threads. *L.Dev.*, N.Am.-Eu.——FIG. 154,*4*. **P. concomitans*, Czech.; ×2.7.

Microdoma MEEK & WORTHEN, 1867 [**M. conicum*] [=*Tuberculopleura* JAKOWLEW, 1899; *Pleurotrochus* SHERZER & GRABAU, 1909; *Microdomus* COSSMANN, 1915 [1916] (obj.)]. Much like *Pagodea* but with higher spire and shallower sutures; ornament of protoconch much like that of *Pagodea*, broad collabral ribs with fine threads between them appearing on 4th whorl and 2 spiral grooves developing gradually on later whorls, breaking the ribs into 3 rows of pustules. *L.Dev.-L.Perm.*, N.Am.-Eu.-N.Asia.——FIG. 154,*3*. **M. conicum*, M.Penn., Ill.; ×6.7.

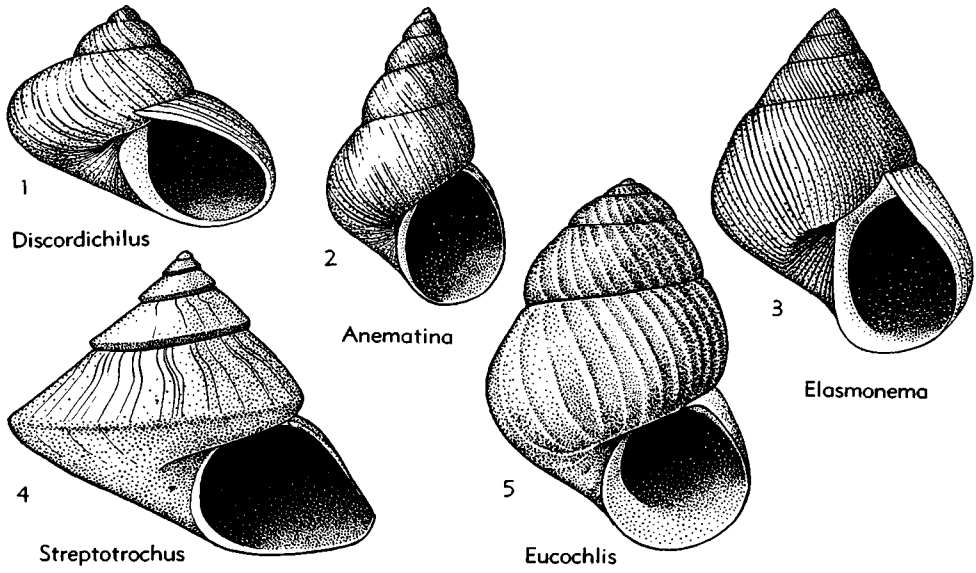


FIG. 155. Microdomatacea (Elasmonematidae) (p. *I*243).

Glyptospira H.CHRONIC, 1952 [**G. cristulata*]. Much like *Microdoma* but with ornament of 2 or 3 strong revolving cords on sides of whorls and 3 to 5 or more weaker cords on base, all crossed by strong lamellar rasplike, prosocline collabral threads (14, p. 127). *L.Perm.-M.Perm.*, N.Am.-Eu.-SE.Asia.——FIG. 154,*5*. **G. cristulata*, M. Perm., Ariz.; ×5.3.

Family ELASMONEMATIDAE Knight, 1956

Umbilicus commonly narrow, rarely minute; ornament wanting or consisting of collabral threads. *U.Sil.-U.Carb.(Penn.)*.

Streptotrochus PERNER, 1907 [**S. rugulosus*]. Trochiform, with angular periphery; labrum with shallow sinus, growth lines orthocline above, then slightly prosocline, next curving gently forward to an opisthocline direction; umbilicus seemingly narrow but not minute. *U.Sil.*, Eu.——FIG. 155,*4*. **S. rugulosus*, Czech.; ×1.3.

Discordichilus COSSMANN, 1918 [**Trochus mollis* LINDSTRÖM, 1884]. Depressed turbiniform, with strongly rounded periphery; labrum strongly prosocline; columellar lip thickened; umbilicus narrow. *M.Sil.*, Eu.——FIG. 155,*1*. **D. mollis* (LINDSTRÖM), Gotl.; ×1.3.

Elasmonema FISCHER, 1885 [*pro Callonema* HALL, 1879 (*non* CONRAD, 1875)] [**Loxonema bellatulum* HALL, 1861; SD S.A.MILLER, 1889]. Conoidal, with shallow sutures; narrow funnel-like umbilicus; ornament slightly prosocline cords. *L.Dev.*, N.Am.——FIG. 155,*3*. **E. bellatulum* (HALL), Ohio; ×2.2.

Anematina KNIGHT, 1933 [**Holopea proutana* HALL, 1858]. Somewhat like *Elasmonema* but with higher spire; umbilicus minute; ornament lacking. *Miss.(L.Carb.)-Penn.(U.Carb.)*, N.Am.-Eu.——FIG. 155,*2*. **A. proutana* (HALL), M. Miss., Ind.; ×4.

?**Eucochlis** KNIGHT, 1933 [**E. perminuta*]. Very small, cyrtoconoid, with narrow umbilicus; ornament of rather widely spaced, prosocline collabral cords. *Penn.*, N.Am.——FIG. 155,*5*. **E. perminuta*, M.Penn., Mo.; ×30.

Superfamily ANOMPHALACEA Wenz, 1938

[*nom. transl.* KNIGHT, BATTEN & YOCHELSON, herein (*ex* Anomphalidae WENZ, 1938)]

Rotelliform to naticiform, with prosocline nonsinuate outer lip; narrowly phaneromphalous, cryptomphalous, or hemiomphalous; columellar lip commonly thickened or callused in various ways; inner shell layers seemingly nacreous. *Sil.-M.Perm.*

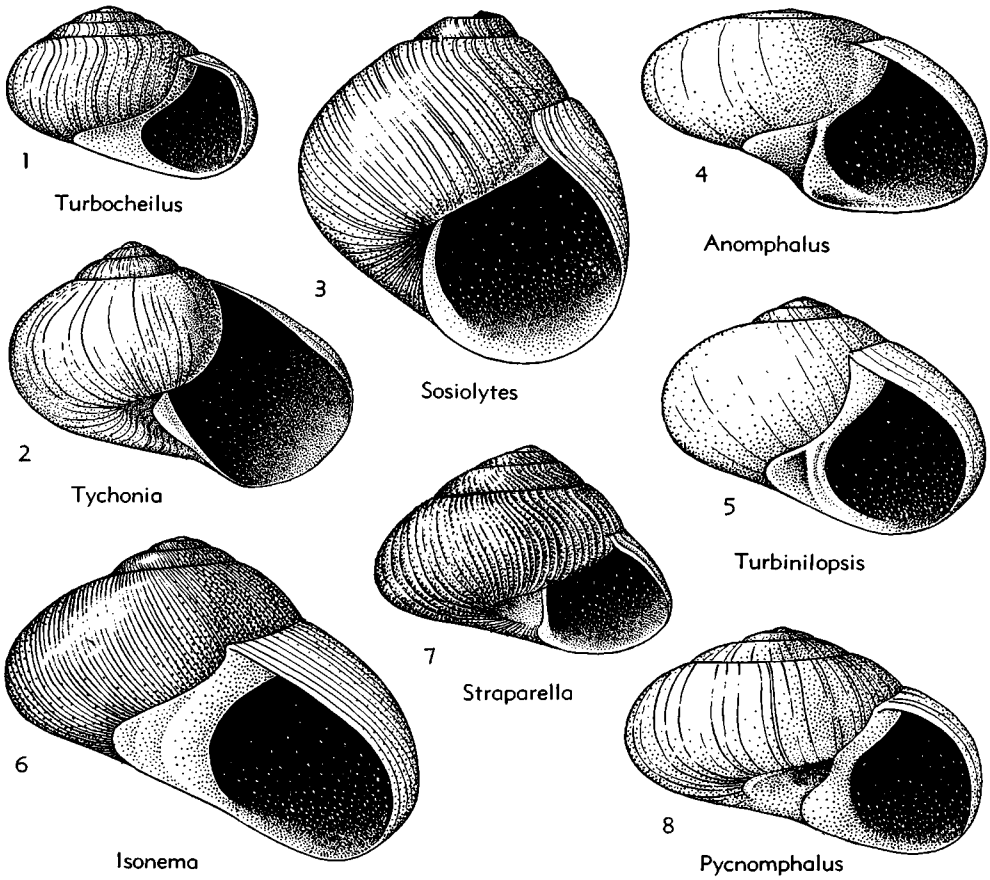


FIG. 156. Anomphalacea (Anomphalidae) (p. *I*244-*I*245).

Family ANOMPHALIDAE Wenz, 1938

With characters of superfamily. *Sil.-M. Perm.*

?Turbocheilus PERNER, 1907 [**Turbo immaturus* PERNER, 1903]. Globular, naticiform; outer lip prosocline above, turning to opisthocline at mid-whorl and gently prosocline below; callus-filled umbilicus gently concave externally. *M.Sil.*, Eu. ——FIG. 156,*1*. **T. immaturus* (PERNER), Czech.; ×1.3.

Pycnomphalus LINDSTRÖM, 1884 [**P. obesus;* SD PERNER, 1907]. Rotelliform, with numerous whorls and very thick shell; bearing within the umbilicus shelf-like funicle generated by massive thickening at base of columella. *Sil.*, N.Am.-Eu. ——FIG. 156,*8*. **P. obesus,* M.Sil., Gotl.; ×2.

Isonema MEEK & WORTHEN, 1866 [**I. depressum* MEEK & WORTHEN, =*Naticopsis linearis* KEYES, 1889, *pro N. depressa* (MEEK & WORTHEN) KEYES, 1889 (*non* WINCHELL, 1864), =*I. humile* MEEK, 1872. Naticiform, labrum strongly prosocline; columellar lip thickened with heavy callus extending over umbilical region; ornament of collabral threads or cords. *L.Dev.*, N.Am.——FIG. 156,*6*. *I. humile* MEEK, Ohio; ×2.

Anomphalus MEEK & WORTHEN, 1867 [**A. rotulus*] [=*Antirotella* COSSMANN, 1918]. Rotelliform, whorls deeply embracing above; outer lip prosocline; adult columellar lip thickened, highly variable from species to species, producing a variety of umbilical characters, so that shell ranges from heavily cryptomphalous to phaneromphalous; exterior polished. *M.Dev.-Penn.(U.Carb.)*, N.Am.-Eu.-NE.Asia-SE.Asia.——FIG. 156,*4*. **A. rotulus,* M.Penn., Ill.; ×10.

?Tychonia DEKONINCK, 1881 [**Natica omaliana* DE KONINCK, 1843]. Depressed naticiform, with outer lip curving forward from upper suture to about mid-whorl, strongly prosocline below; columellar lip thickened and developing a funicle; surface without ornament. *L.Carb.*, Eu.——FIG. 156,*2*. **T. omaliana* (DEKONINCK), Belg.; ×1.3.

Straparella FISCHER, 1885 [**Straparollus fallax* DE

KONINCK, 1843]. Rotelliform, with broad, gentle labral sinus in outer lip; columellar lip thickened at its base, generating a funicle; ornament of collabral threads. *L.Carb.*, Eu.——FIG. 156,*7*. **S. fallax* (DEKONINCK), Belg.; ×2.

Turbinilopsis DEKONINCK, 1881 [**T. inconspicua;* SD COSSMANN, 1915 [1916]]. Naticiform, with prosocline outer lip and thickened inner lip with longitudinal groove; narrow umbilicus with callus wash; without ornament. *L.Carb.*, Eu.——FIG. 156,*5*. **T. inconspicua*, Belg.; ×4.

?**Sosiolytes** GEMMELLARO, 1889 [**S. schlotheimi*]. Small, naticiform; labrum opisthocline close to suture, turning to roundly and strongly prosocline a short distance below; narrowly phaneromphalous; ornament growth lines alone. *M. Perm.*, Eu.——FIG. 156,*3*. **S. schlotheimi*, Sicily; ×2.

?**Eiselia** DIETZ, 1911 [**E. dyadica*]. Small, rotelliform, phaneromphalous, with wide, low collabral cords; labrum seemingly arched forward at about mid-whorl; not well known. *M.Perm.*, Eu.

Superfamily ORIOSTOMATACEA Wenz, 1938

[*nom. transl.* KNIGHT, BATTEN & YOCHELSON, herein (*ex* Oriostomatidae WENZ, 1938)]

Trochiform to discoidal, closely coiled or disjunct; strongly ornamented with spiral cords or spines. *U.Sil.-L.Dev., ?Trias.*

Family ORIOSTOMATIDAE Wenz, 1938

[=Horiostomidae KOKEN, 1897 (ICZN pend.)]

Closely coiled; with heavy multispiral calcareous operculum; shell with nacreous inner layer. *U.Sil.-L.Dev.*

Morphotropis PERNER, 1903 [**M. aliena;* SD PERNER, 1907]. Depressed turbiniform with moderately wide umbilicus; whorls round, sutures deep; ornament of collabral orthocline, fine threads with more widely spaced undulating lamellae. *U.Sil.*, Eu.——FIG. 157,*1*. **M. aliena*, Czech.; ×1.3.

Beraunia KNIGHT, 1937 [*pro Eucyclotropis* COSSMANN, 1909 (*non* JORDAN, 1904), *Eucyclotropis* COSSMANN, 1909, *pro Cyclotropis* PERNER, 1903 (*non* TAPPARONE-CANEFRI, 1883)] [**Cyclotropis docens* PERNER, 1903; SD PERNER, 1907] [=*Rhabdospira* PERNER, 1903 (*non* DONALD, 1898)]. Discoidal to depressed turbiniform; whorls rounded, with deep sutures, rarely disjunct; ornament dominantly spiral. *U.Sil.-L.Dev.*, Eu.——FIG. 157,*3*. **B. docens* (PERNER), U.Sil., Czech.; oblique apertural view with operculum, ×1.3.

Oriostoma MUNIER-CHALMAS, 1876 [**O. barrandei*] [=*Horiostoma* FISCHER, 1885 (obj.)]. Turbiniform; umbilicus moderately wide to narrow; ornament of dominantly spiral carinae, cords or threads with finer collabral elements, in some species producing elaborate crenulations. *U.Sil.-L.Dev.*, N.Am.-Eu.——FIG. 157,*2*. *O. coronatum* LINDSTRÖM, U.Sil., Gotl.; apertural view showing operculum, ×2 (90).

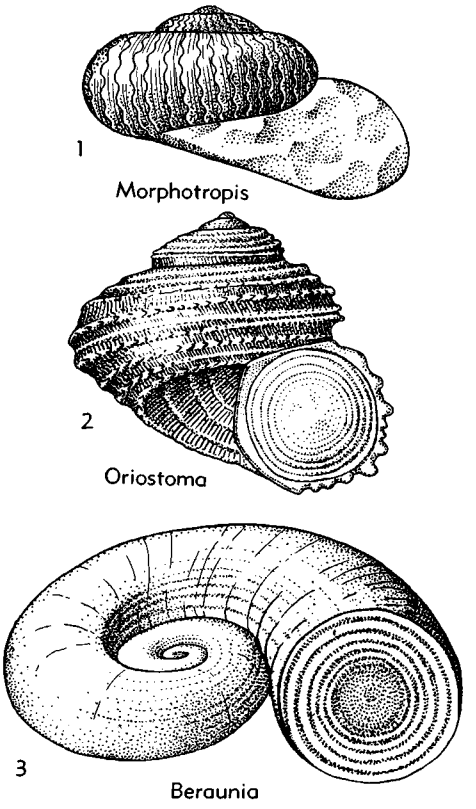


FIG. 157. Oriostomatacea (Oriostomatidae) (p. *1245*).

Family TUBINIDAE Knight, 1956

Mostly disjunct whorls, with more or less expanded aperture; ornament dominantly spiral with pustules or tubular spines aligned on some of spiral cords; operculum unknown, probably wanting in adult; shell structure unknown. [The shape of the shell suggests sedentary habits. The hollow spines or pustules may have been functional when they first appeared on the margins of the aperture.] *L.Dev., ?Trias.*

Semitubina COSSMANN, 1918 [**Tuba spinosa* QUENSTEDT, 1852]. Whorls subturbiniform, disjunct except for earlier ones; aperture slightly expanded; ornament of spiral cords bearing hollow spines at aperture. *L.Dev.*, Eu.——FIG. 158,*2*. **S. spinosa* (QUENSTEDT), Czech.; apertural view, ×2.

Tubina OWEN, 1859 [**T. armata*]. Coiling nearly discoidal; aperture slightly expanded at final stage;

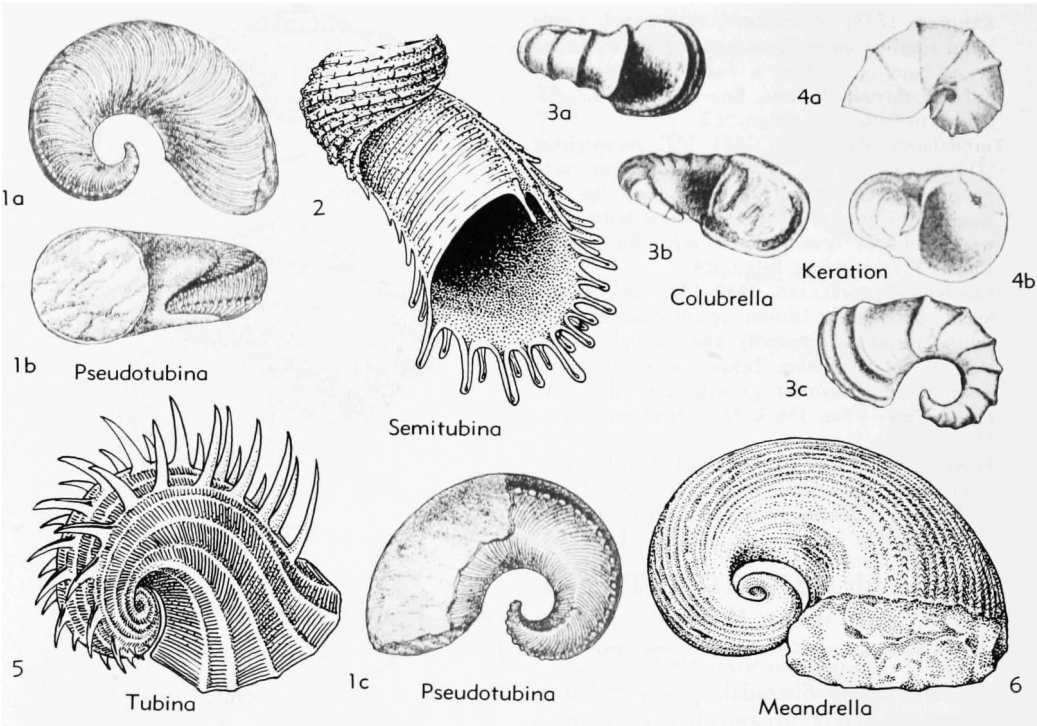


FIG. 158. Oriostomatacea (Tubinidae) (p. *I245-I246*).

ornament of spiral cords, a few with long hollow spines opening adaperturally, and finer collabral threads. *L.Dev.*, Eu.——FIG. 158,*5*. **T. armata*, Czech.; oblique, ×1.5.

Meandrella PERNER, 1903 [**M. sculpta*]. Coiling nearly discoidal; aperture slightly expanded; spiral ornament numerous cords, a few of which at early growth stages carried hollow pustules; collabral ornament of fine, sharp, zigzag threads pointing abaperturally on cords and adaperturally between. *L.Dev.*, Eu.——FIG. 158,*6*. **M. sculpta*, Czech.; oblique, from above, ×1.3.

?**Pseudotubina** KOKEN, 1896 [**P. biserialis;* SD DIENER, 1926]. Hornlike, not quite planispiral, consisting of rather more than a single disjunct whorl; outer face limited above and below, or below only, by carina bearing tubercles or short prickles that disappear near aperture; growth lines parasigmoid on upper face, prosocyrt on lower. *U.Trias.(Carn.)*, Eu.——FIG. 158,*1*. **P. biserialis*, Aus.; *1a-c*, ×2 (79).

?**Colubrella** KOKEN, 1896 [**C. squamata*]. Mostly hornlike, almost planispiral, consisting of up to two whorls circular or quadrate in cross section and partly or wholly disjunct in most forms; growth lines accentuated at intervals to form collabral rings or lamellae, except on inner face of whorls. *M.Trias.(Ladin.)-U.Trias.(Nor.)*, Eu.

C. (Colubrella). Whorls partly or wholly disjunct, last expanded at aperture. *M.Trias.(Ladin.)-U.Trias.(Nor.)*, Eu.——FIG. 158,*3*. *C. (C.) kokeni* BROILI, U.Trias.(Nor.), S.Tyrol; *3a,b*, ×1.5 (10).

C. (Keration) BROILI, 1907 [**K. nautiliforme*]. Small, nautiliform, whorls in contact, the last only slightly expanded at aperture. *U.Trias.(Carn.)*, Eu.——FIG. 158,*4*. **C. (K.) nautiliformis*, S.Tyrol; *4a-c*, ×1.5 (10).

Superfamily TROCHACEA Rafinesque, 1815

[*nom. transl.* THIELE, 1925 (*ex* Trochidae GRAY, 1834, *nom. correct., pro* Trochinia RAFINESQUE, 1815)]

[Some help in preliminary organization of data for Tertiary genera was given by Miss GRACE JOHNSON and is here acknowledged.]

Conical, turbiniform or subglobose shells with entire aperture; inner shell layer, and outermost layer in some genera, nacreous; operculum corneous or calcareous, spiral (18, 139, 147). *Trias.-Rec.*

Family TROCHIDAE Rafinesque, 1815

[*nom. correct.* Gray, 1834 (*pro* Trochinia Rafinesque, 1815)]

Peristome discontinuous in most genera, with columellar and outer lips not in same plane. Operculum circular, multispiral, thin, corneous, with central nucleus. *Trias.-Rec.*

Subfamily PROCONULINAE Cox, n. subfam.

Conical, mostly elevated shells with acute apex; nearly all of small or small-medium size; anomphalous or phaneromphalous; base more or less flattened; aperture quadrangular; columellar lip simple or with single plication. *Trias.-U.Cret.*

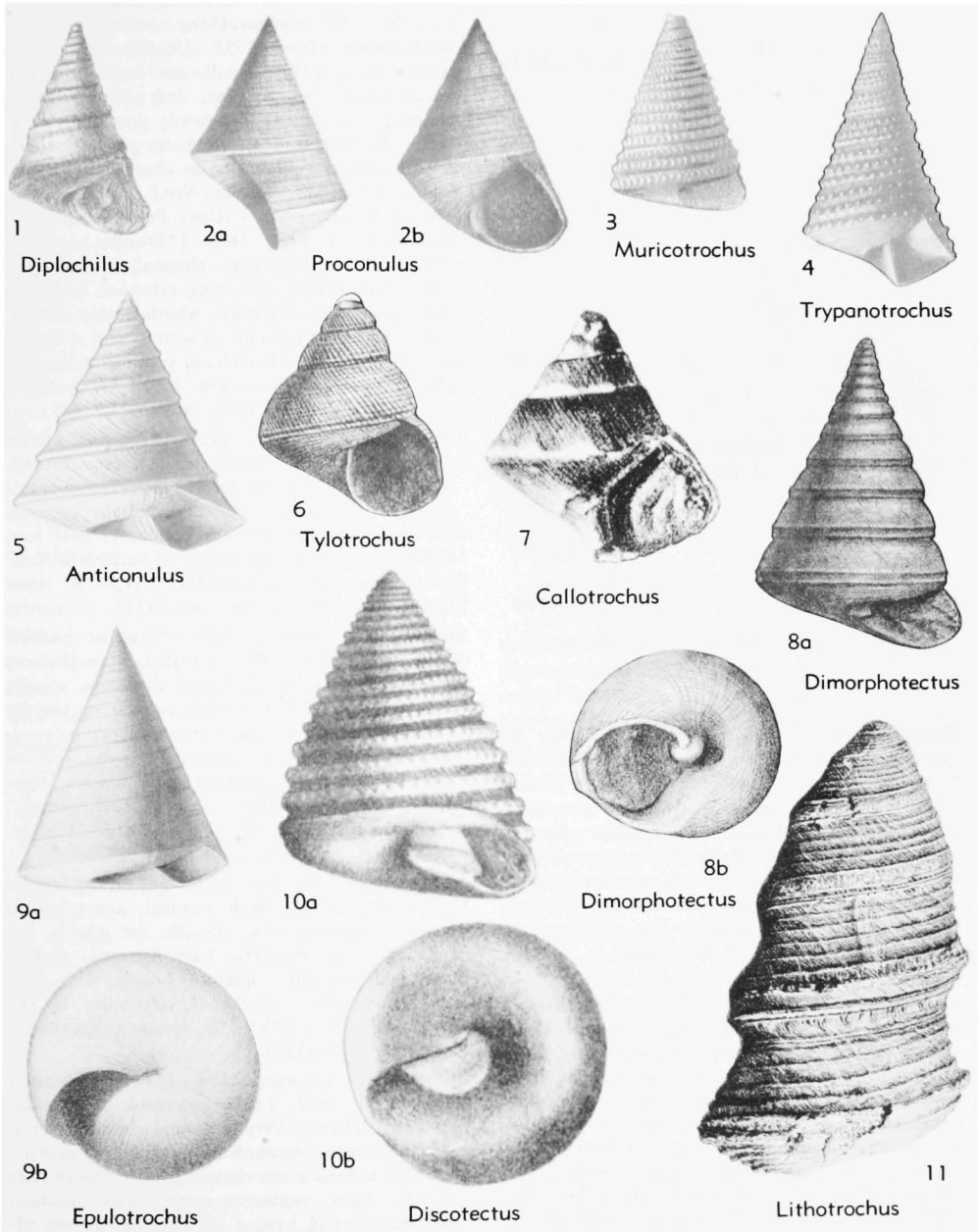


Fig. 159. Trochacea (Trochidae——Proconulinae (p. *I*248-*I*249).

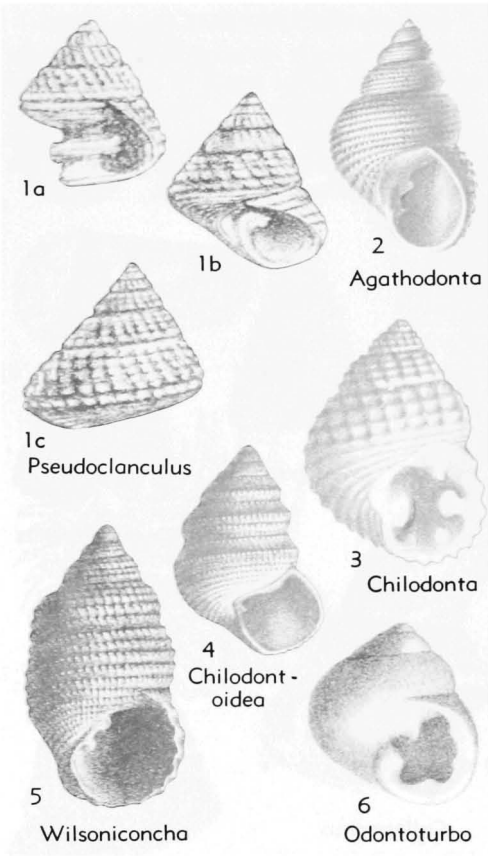


FIG. 160. Trochacea (Trochidae——Chilodontinae) (p. I249).

Diplochilus WÖHRMANN, 1894 [**D. gracilis;* SD COSSMANN, 1916] [=*Wöhrmannia* COSSMANN, 1916 (erroneously cited as 1895) (*non* J.BÖHM, 1895); *Raiblia* COSSMANN, 1916 (both *pro Diplochilus* WÖHRMANN, *non Diplochila* BRULLÉ, 1835)]. Well-elevated, narrowly phaneromphalous; base flattened; whorls bicarinate near lower suture; sutures deep; apertural characters imperfectly known. *Trias.*, Eu.-Asia.——FIG. 159,*1*. *D. bistriatus* (MÜNSTER), M.Trias.(Ladin.), S.Tyrol; ×3.5 (89).

Dimorphotectus COSSMANN, 1918 [**Tectus hoernesi* KOKEN, 1896 = **Scoliostoma fasciatum* HOERNES, 1856]. Coeloconoid, elevated, with very acute apex, anomphalous; whorls numerous, flat or almost so, last carinate or bicarinate at periphery, carinae just exposed on spire whorls; ornament spiral striae commonly obsolete on later whorls; base flattened; columellar lip short, with prominent median fold. *M.Trias.(Carn.)-L.Jur., Eu.-N.Z.*——FIG. 159,*8*. **D. fasciatus* (HOERNES), U. Trias.(Nor.), Aus.; *8a,b*, ×2.5 (79).

?Callotrochus KUTASSY in WENZ, 1938 [*pro Mesotrochus* KUTASSY, 1927 (*non* WASMANN, 1890)] [**Mesotrochus triadicus*]. Almost biconical, anomphalous, with spire less elevated and of fewer whorls and with base more extended than in typical genera of subfamily; whorls flat, smooth, except for obscure nodes at abapical suture and on peripheral carina of last; columellar lip straight, simple, thickened. *U.Trias.(Nor.)*, Eu.-S.Am.——FIG. 159,*7*. **C. triadicus*, Hung.; ×1 (200).

Eocalliostoma HAAS, 1953 [**Calliostoma interruptum* COX, 1947]. Small, moderately elevated, anomphalous; whorls flat, last subangular at periphery; ornament depressed, irregular transverse ribs that tend to break up on last whorl; base flattened; columellar lip short, with strong fold at lower end. *U.Trias.(Nor.)*, S.Am.——FIG. 180A,*3*. **E. interruptum* (COX), Peru; ×6 (21).

?Tylotrochus KOKEN, 1896 [**Trochus konincki* HÖRNES, 1856]. Moderately elevated, anomphalous, with fewer whorls and more extended base than most genera of subfamily; whorls feebly convex, with delicate ornament of spiral and collabral threads; aperture subquadrate, columellar lip simple. *Trias.*, Eu.-Asia.——FIG. 159,*6*. **T. konincki* (HÖRNES), U.Trias.(Carn.), Aus.; ×1.7 (79).

Anticonulus COSSMANN, 1918 [**Trochus mariae* D'ORBIGNY, 1853]. Well elevated, phaneromphalous; whorls flat to feebly convex, subimbricate in some species, smooth or spirally grooved, last angular or rounded at periphery; base low, convex; columellar lip simple, of variable inclination. *Trias.-L.Jur.*, Eu.——FIG. 159,*5*. *A. nisus* (D'ORBIGNY), M.Lias., Fr.; ×3 (111).

Proconulus COSSMANN, 1918 [**Trochus guillieri* COSSMANN, 1885]. Well elevated, anomphalous; whorls fairly numerous, flat or almost so, spirally striated or smooth, last with angular or sharply rounded periphery; base feebly convex; columellar lip simple, with moderately broad, callous outer surface having distinct outer margin, commonly an angulation. *L.Jur.-U.Cret.(Senon.)*, cosmop.——FIG. 159,*2*. *P. raulineus* (BUVIGNIER), Lias, Fr.; 2a,b, ×1.5 (165).

Epulotrochus COSSMANN, 1918 [**Trochus epulus* D'ORBIGNY, 1850]. Well elevated, anomphalous, of very numerous low, smooth, flat whorls, last subangular at periphery; base flattened, slightly excavated mesially; aperture broad, with very oblique, simple, unthickened columellar lip. *L. Jur.*, Eu.——FIG. 159,*9*. **E. epulus* (D'ORBIGNY), Fr.; *9a,b*, ×2.5 (111).

Lithotrochus CONRAD, 1855 [**Turritella andii* D'ORBIGNY, 1842 (=*Pleurotomaria humboldtii* VONBUCH, 1839)]. Very large and elevated, slightly cyrtoconoid, anomphalous, with peripherally carinate, imbricate whorls that overlap less in later growth stages; ornament spiral cords, strongest on outer part of base, a very prominent one adjoining peripheral carina; aperture imperfectly

known. *L.Jur.*, S.Am.——Fig. 159,*11*. **L. humboldtii* (vonBuch), Chile; ×0.7 (162).

Trypanotrochus Cossmann, 1918 [**Trochus normanianus* d'Orbigny, 1850]. Well elevated, phaneromphalous; whorls fairly numerous, flat, last carinate at periphery; ornament nodose spiral cords; base flattened, umbilical margin carinate; columellar lip simple, straight or almost so, of variable inclination. *L.Jur.*, Eu.——Fig. 159,*4*. **T. normanianus* (d'Orbigny), Fr.; ×2 (111).

Muricotrochus Cossmann, 1918 [**M. hudlestoni*]. Well elevated, anomphalous, of numerous low whorls bearing 2 or more tuberculate spiral cords, lowest forming periphery; base smooth, flattened; columellar lip short, simple. *M.Jur.(Baj.)-U.Jur.(Kimm.)*, Eu.——Fig. 159,*3*. *M. subluciensis* (Hudleston), *M.Jur.(Baj.)*, Eng.; ×2.5 (59).

Discotectus Favre, 1913 [**Trochus massalongoi* Gemmellaro; SD Cossmann, 1918]. Cyrtoconoid, moderately elevated, anomphalous; whorls numerous, last subangular at periphery; base flattened; ornament spiral cords; columellar lip short, with prominent, median fold produced beyond aperture as semicircular pad in some species. *M.Jur.(Bathon.)-L.Cret.(Senon.)*, Eu.——Fig. 159,*10*. *D. crassiplicatus* (Etallon), U.Jur.(Kimm.), Fr.Jura; *10a,b*, ×3.3 (95).

Subfamily CHILODONTINAE Wenz, 1938
[=Polyodontinae Cossmann, 1916]

Turbiniform, conical or pupiform shells of small or small-medium size; most forms with margined parietal callus producing continuous peristome and columellar and outer lips lying almost in same plane; tooth or fold present high on columellar lip; other teeth on one or more lips in some genera. *M.Trias.-U.Cret.*

Pseudoclanculus Cossmann, 1918 [**Monodonta cassiana* Wissmann in Münster, 1841]. Small, broadly conical, anomphalous; whorls feebly convex, with ornament of granose spiral cords; base rather flattened, bearing in middle arched coating of callus spreading from columellar lip; strong fold high on columellar lip extending short distance into aperture; labrum thickened and may be weakly dentate internally. *M.Trias.(Ladin.)-U.Trias.(Carn.)*, Eu.——Fig. 160,*1*. **P. cassianus* (Wissmann), M.Trias.(Ladin.), S.Tyrol; *1a,b*, ×4; *1c*, ×3 (64).

Chilodontoidea Hudleston, 1896 [**C. oolitica*]. Crytoconoid, anomphalous, with high spire of mesially carinate whorls bearing spiral cords rendered granose by collabral threads; base strongly convex; small tooth high on columellar lip; parietal callus in some shells with obtuse swelling or pair of small denticles; outer lip slightly thickened internally, almost orthocline. *M.Jur.(Baj.)*, Eu.——Fig. 160,*4*. **C. oolitica*, Eng.; ×2.5 (59).

Wilsoniconcha Wenz, 1939 [*pro Wilsonia* Hudleston, 1896 (*non* Bonaparte, 1838) [**Wilsonia liassica*]. Pupoidal but with acute apex, anomphalous; ornament spiral cords rendered granose by collabral threads; aperture obliquely ovate, extending to left of axis; inner lip with 2 strong denticles near middle; outer lip slightly thickened, almost orthocline. *L.Jur.-U.Jur.(Raurac.)*, Eu.——Fig. 160,*5*. **W. liassica*, Lias., Eng.; ×2.75 (59).

Chilodonta Étallon, 1862 [**C. clathrata;* SD de Loriol, 1887]. With low conical spire and globose last whorl; anomphalous; aperture orbicular, with thickened outer lip and five strong teeth distributed around peristome. *U.Jur.(Oxford.)-U.Cret.(Maastricht.)*, Eu.

C. (Chilodonta). Spire with cancellating spiral and collabral threads, base with spiral threads only; parietal callus thick. *U.Jur.(Oxford.)-U.Cret.(Maastricht.)*, Eu.——Fig. 160,*3*. **C. (C.) clathrata*, U.Jur.(Kimm.), Fr.Jura; ×3 (95).

C. (Odontoturbo) deLoriol, 1887 [**O. delicatulus*]. Small, globose, smooth; no parietal callus. *U.Jur.(Kimm.)*, Eu.——Fig. 160,*6*. **C. (O.) delicatula*, Fr.Jura; ×6 (95).

Agathodonta Cossmann, 1918 [**Trochus dentigerus (sic)* d'Orbigny, 1843] [=*Agnathodonta* Wenz, 1938 (obj.)]. High turbiniform, anomphalous, with strongly convex whorls and base; ornament granose spiral cords; columellar lip with two strong, obtuse teeth. *L.Cret.*, Eu.——Fig. 160,*2*. **A. dentigera* (d'Orbigny), L.Cret.(Neocom.), Fr.; ×2 (110).

Subfamily MARGARITINAE Stoliczka, 1868

Small, thin shells, iridescent within; conical, turbiniform, or sublenticular; mostly phaneromphalous, a few anomphalous; peristome interrupted and columellar and outer lips unthickened in most but not all genera; columellar lip only rarely toothed; outer lip not strongly prosocline. *Trias.-Rec.*

Eosolariella Haas, 1953 [**Margarita turbinea* von Ammon, 1893]. Depressed turbiniform, rather broadly phaneromphalous, with whorls and base strongly convex and smooth; aperture suborbicular; peristome thin, continuous; columellar lip strongly concave, not reflected, without teeth. *U.Trias.*, Eu.-S.Am.——Fig. 161,*15*. **E. turbinea* (vonAmmon), Rhaetic, N.Italy; *15a*, ×1.5; *15b*, ×1.75 (160).

Solariooconulus Cossmann, 1918 [**Trochus nudus* Münster, 1841] [=*Solariconulus* Wenz, 1938 (obj.)]. Turbiniform, with slightly coeloconoid spire and sharp apex; narrowly phaneromphalous; whorls and base convex, smooth or with faint spiral striae; aperture quadrangular; columellar lip reflected, without teeth. *M.Trias.(Ladin.)-U.Trias.(Nor.)*, Eu.-S.Am.——Fig. 161,*16*. **S. nudus* (Münster), S.Tyrol; ×4 (89).

Atira Stewart, 1926 [**Angaria ornatissima* Gabb,

1864]. Turbiniform, rather broadly phaneromphalous, with last whorl convex or somewhat flattened laterally and angulation forming umbilical margin; ornament faint spiral striae; peristome thin, continuous; columellar lip strongly concave, not reflected, without teeth. *U.Cret.*, N.Am.——Fig. 161,*18*. **A. ornatissima* (Gabb), Chico Gr., Calif.; ×3 (221).

Garramites Stephenson, 1941 [**G. nitidus*]. Turbiniform, rather broadly phaneromphalous, with strongly convex whorls and base; smooth except for about 4 faint spiral grooves; umbilical margin a crenulated angulation; aperture not known intact. *U.Cret.*, N.Am.——Fig. 161,*13*. **G. nitidus*, Navarro Gr., Tex.; ×5 (220).

Margarites Gray, 1847 (*ex* Leach MS.) [**Trochus helicinus* Fabricius, 1780 (?=*Turbo helicinus* Phipps, 1774)] [=*Margarita* Leach, 1819 (*non* Leach, 1814); *Eumargarita* Fischer, 1885 (obj.); *Valvatella* "Gray" Melvill, 1897 (*non* Gray, 1857)]. Smooth or spirally ribbed, nacre conspicuous. *U.Cret.-Rec.*

M. (Margarites). Spire low, whorls nearly smooth, last whorl large. *U.Cret.(Dan.)-Rec.*, Eu.-N.Am.-Arct.——Fig. 161,*4*. **M. (M.) helicinus* (Fabricius), Rec., N.Atl.; ×2 (147).

M. (Bathymophila) Dall, 1881 [**Margarita? euspira*]. *Rec.*, Carib.

M. (Cantharidoscops) Galkin, 1955 [**M. frigidus* Dall, 1919]. Small, higher than wide, periphery rounded; umbilicus obsolete. *Rec.*, Arct.——Fig. 161,*3*. **M. (C.) frigidus* Dall, Okhotsk Sea; ×3 (185).

M. (Margaritopsis) Thiele, 1906 [**Margarita frielei* Krause, 1885]. Spire low, apex blunt. *Rec.*, Arct.

M. (Periaulax) Cossmann, 1888 [**Solarium spiratum* Lamarck, 1804]. Umbilicus with a beaded margin, spirally ribbed within. *U.Cret.-Plio.*, Eu.-Afr.-N.Am.-E.Indies.——Fig. 161,*5*. **M. (P.) spiratus* (Lamarck), Eoc., Fr.; *5a,b*, ×3 (147).

M. (Pupillaria) Dall, 1909 [**Trochus pupillus* Gould, 1849]. Larger than *M. (Margarites)*, with higher spire; with spiral ribs and some axial riblets. *Mio.-Rec.*, N.Atl.-N.Pac.-Arct.

Antimargarita Powell, 1951 [**Valvatella dulcis* Smith, 1907]. Thin, elaborately sculptured, low-spired; umbilicus wide, deep. *Rec.*, Antarct.

Basilissa Watson, 1879 [**B. superba;* SD Cossmann, 1888]. Thin, carinate, low to high-spired. *U.Cret.-Rec.*

B. (Basilissa). Spire low-conical, periphery channeled, base spirally ribbed. *U.Cret.-Rec.*, Eu.-Afr.-Austral.-Pac.——Fig. 161,*1*. **B. (B.) superba*, Rec., Austral.; ×1 (227).

B. (Ancistrobasis) Dall, 1889 [**B. costulata* Watson, 1879]. Spire with interrupted axial ribs. *Rec.*, Carib.

Euchelus Philippi, 1847 [**Trochus quadricarinatus* Holten, 1802 (?=*Trochus asper* Gmelin, 1791); SD Herrmannsen, 1847] [=*Aradasia* Gray, 1850; *Tallorbis* G. & H. Nevill, 1869; *Huttonia* Kirk, 1882 (*non* Pickard-Cambridge, 1880)]. Ovate-conical aperture rounded, outer lip thickened, lirate within; inner lip usually with tooth below. *Plio.-Rec.*

E. (Euchelus). Rather small, sturdy; whorls convex; juvenile shells with umbilicus, adult without; operculum few-whorled. *Plio.-Rec.*, IndoPac.——Fig. 161,*14*. **E. (E.) quadricarinatus* (Holten), Rec., India; ×1 (147).

E. (Antillachelus) Woodring, 1928 [**Calliostoma asperrimum* var. *dentiferum* Dall, 1889]. Small, whorls flat-sided, nodosely sculptured; umbilicus wide. *Mio.-Rec.*, W.Indies.——Fig. 161,*6*. **E. (A.) dentiferus* (Dall), Rec., W.Indies; ×3 (147).

E. (Herpetopoma) Pilsbry, 1889 [**E. scabriusculus* A.Adams & Angas, 1867]. Cancellately sculptured; operculum multispiral. *Plio.-Rec.*, Austral.

E. (Mirachelus) Woodring, 1928 [**Calliostoma corbis* Dall, 1889]. Small, without umbilicus; with coarse cancellate sculpture. *Mio.-Rec.*, Carib.

E. (?Nevillia) H.Adams, 1868 [**N. picta;* SD Tomlin, 1938]. Small, without umbilicus, otherwise like *E. (Herpetopoma)*. *Rec.*, IndianO.——Fig. 161,*8*. **E. (N.) pictus;* ×5 (159).

E. (Vaceuchelus) Iredale, 1929 [**E. angulatus* Pease, 1867]. Without basal tooth, otherwise like *E. (Euchelus)*. *Rec.*, S.Pac.

Granata Cotton, 1957. [**Stomatella imbricata* Lamarck, 1816] [=*Stomatella* auctt., *non* Lamarck]. Ear-shaped, with few whorls; sculpture of numerous spiral ridges. *Rec.*, Austral.

Guttula Schepman, 1908 [**G. sibogae*]. Like *Margarites* but with angular aperture. *Rec.*, Pac.

Hybochelus Pilsbry, 1889 [**Stomatella cancellata* Krauss, 1848] [=*Stomatella* auctt., *non* Lamarck]. Depressed, short-spired, last whorl large; sculpture spiral or cancellate; with or without an umbilicus; no tooth on inner lip. *Rec.*, S. Afr.-Austral.——Fig. 161,*11*. **H. cancellatus* (Krauss), S.Afr.; *11a,b*, ×1 (147).

Lischkeia Fischer in Kiener, 1879 [**Trochus moniliferus* Lamarck, 1816]. Relatively large, thick-shelled; spire conical, base flattened; sculpture of nodose spiral ribs. *Cret.-Rec.*

L. (Lischkeia). Umbilicus partially concealed; columella with weak fold. *U.Cret.(Maastricht.)-Rec.*, Eu.-S.Afr.-Japan.——Fig. 161,*17*. **L. (L.) monilifera* (Lamarck), Rec., Japan; ×1 (147).

L. (Calliotropis) Seguenza, 1903 [**Trochus ottoi* Philippi, 1844] [=*Solariellopsis* Schepman, 1908 (*non* deGregorio, 1886)]. Umbilicus wide. *Plio.-Rec.*, W.Atl.-Eu.-S.Pac.——Fig. 161,*9*. **L. (C.) ottoi* (Philippi), Plio.-Pleist., Italy; ×2 (211).

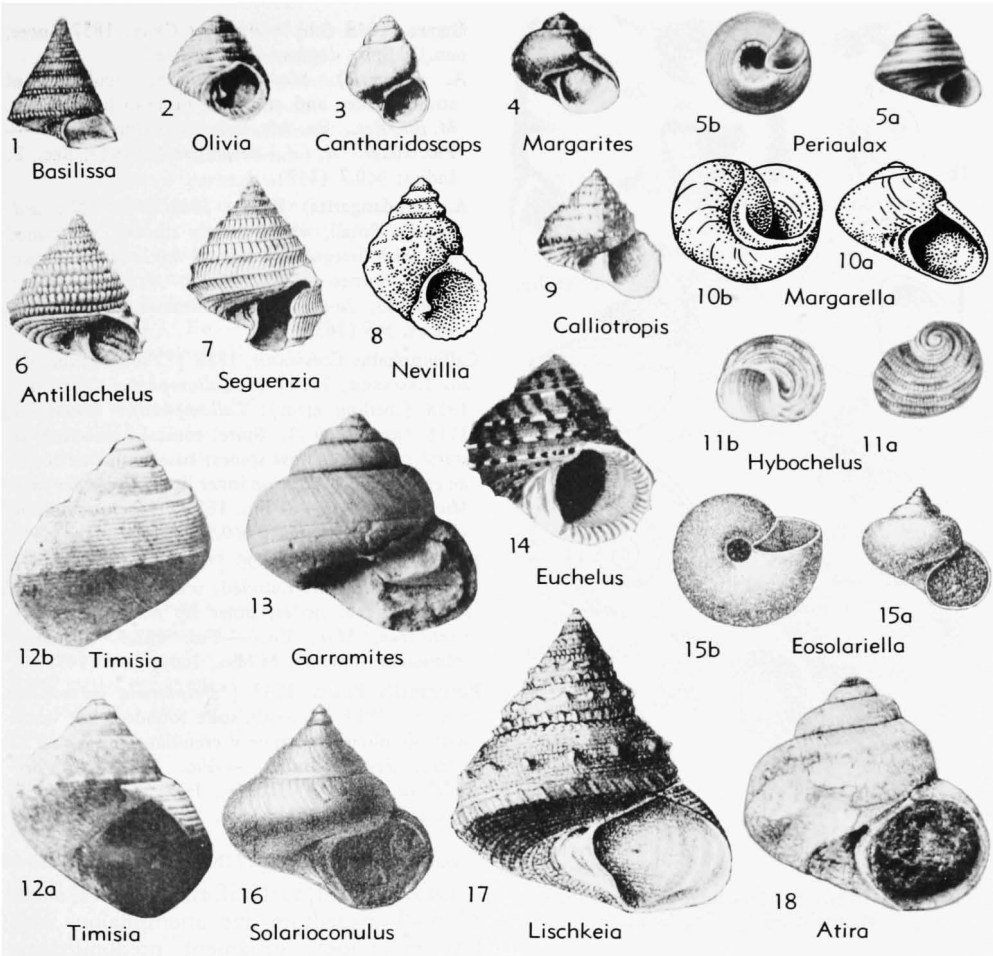


FIG. 161. Trochacea (Trochidae——Margaritinae) (p. *I*249-*I*251).

Margarella THIELE in TROSCHEL, 1893 [**Trochus expansus* SOWERBY, 1838; SD THIELE, 1924] [*pro Margaritella* THIELE in TROSCHEL, 1891 (*non* MEEK & HAYDEN, 1860)]. Small, thin-shelled, globose, nearly smooth. *Mio.-Rec.*

M. (Margarella). With rounded periphery, surface smooth. *Mio.-Rec.*, N.Z.-Antarct.——FIG. 161,*10*. **M. (M.) expansa* (SOWERBY), Rec., S.Georgia; *10a,b*, ×1.5 (147).

M. (Promargarita) STREBEL, 1908 [**Margarites tropidophoroides*]. With 2 blunt spiral carinae. *Rec.*, Antarct.

M. (Submargarita) STREBEL, 1908 [**Margarites impervia*]. Minute, with fine spiral riblets; nuclear whorls large. *Rec.*, Antarct.

Olivia CANTRAINE, 1835 [**O. otaviana*] [=*Craspedotus* PHILIPPI, 1847 (*non* SCHOENHERR, 1844); *Heliciella* COSTA, 1861; *Danilia* BRUSINA, 1865]. Small, with cancellate sculpture; columella with strong fold, ending in a notch, like *Euchelus*. *U. Cret.(Dan.)-Rec.*, Eu.-IndoPac.-N.Z.——FIG. 161, *2*. **O. otaviana*, Pleist., Italy; ×1 (166).

Seguenzia JEFFREYS, 1876 [**S. formosa*; SD HARRIS, 1897]. With several carinae; aperture with an anal notch above and columellar notch below. *Eoc.-Rec.*, Eu.-W.Atl.-S.Pac.——FIG. 161,*7*. **S. formosa*, Rec., off New England; ×5 (147).

Tibatrochus NOMURA, 1940 [**T. husaensis*]. Like *Euchelus* but with smooth aperture. *Rec.*, Japan.

Timisia JEKELIUS, 1944 [**T. pseudopicta*]. *Mio.*, SE.Eu.——FIG. 161,*12*. **T. pseudopicta*, Rumania; *12a,b*, ×2 (194).

Tropidomarga POWELL, 1951 [**T. biangulata*]. Shape of *Margarella (Promargarita)* but more strongly sculptured. *Rec.*, Antarct.

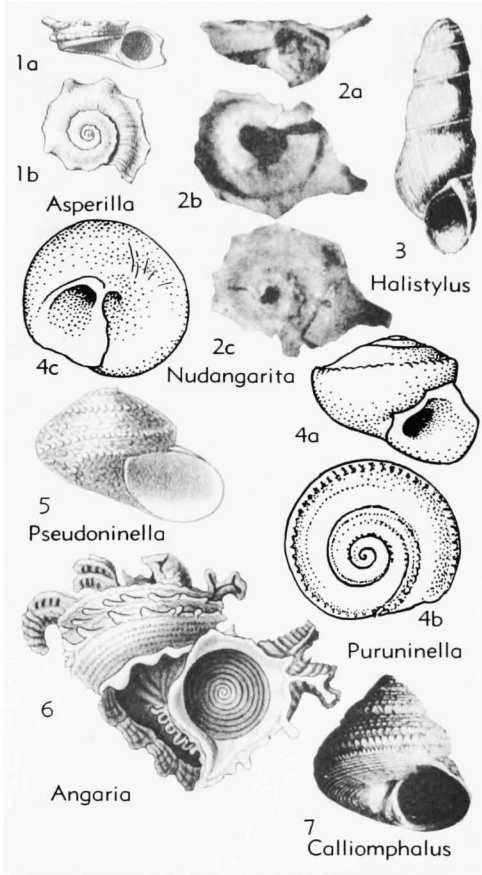


FIG. 162. Trochacea (Trochidae——Angariinae, Halistylinae) (p. *1252-1262*).

Subfamily ANGARIINAE Thiele, 1924
[=Delphinulinae STOLICZKA, 1868]

Small to moderately large, low-spired or conical; surface with rows of nodes or branching spines; umbilicus wide; aperture nacreous within; operculum horny, thin. *Trias.-Rec.*

Asperilla KOKEN, 1896 [**Delphinula conoserra* QUENSTEDT, 1884; SD KOKEN, 1897 (=**D. longispina* ROLLE, 1860)]. Discoidal or with slightly protruding spire, broadly phaneromphalous, with smooth upper surface spinose at periphery; outer whorl face and base with or without spiral ornament; aperture orbicular or quadrangular, with continuous peristome. *U.Trias.(Nor.) - U.Jur.(Kimm.),* Eu.——FIG. 162,*1*. **A. longispina* (ROLLE), U.Jur., Ger.; *1a,b,* ×1 (11).

Angaria RÖDING, 1798 [**Turbo delphinus* LINNÉ, 1758; SD FISCHER, 1875] [=*Delphinula* LAMARCK, 1804 (obj.); *Delphinulus* MONTFORT, 1810 (obj.); *Praxidice* RAFINESQUE, 1815 *(nom. nud.); Scalator* GISTEL, 1848 (obj.); *Angarus* GRAY, 1857 *(nom. van.)*]. Spire depressed or flattened.

A. (Angaria). Moderately large, sculpture of strong nodes and recurved to branching spines. *M.Jur.-Rec.,* Eu.-Afr.-IndoPac.-Australasia. —— FIG. 162,*6*. **A. (A.) delphinus* (LINNÉ), Rec., E. Indies; ×0.7 (147).

A. (Nudangarita) BEETS, 1942 [**A. (N.) ardjunoi*]. Small, whorls nearly smooth, not noded but with irregular flange or keel below suture. *Neog.,* Borneo.——FIG. 162,*2*. **A. (N.) ardjunoi,* E.Borneo; *2a-c,* apertural, umbilical, and apical views, ×5 (163).

Calliomphalus COSSMANN, 1888 [**Turbo squamulosus* LAMARCK, 1804] [=*Callomphalus* COSSMANN, 1918 (spelling error); *Callomphalifer* COSSMANN, 1918 *(nom. van.)*]. Spire conical, sculpture of spiral rows of hollow spines; base with fine cords; an ear-shaped process on inner lip. *U.Cret.(Senon.)-Mio.,* Eu.-N.Am.——FIG. 162,*7*. **C. squamulosus* (LAMARCK), Eoc., Fr.; ×0.5 (147).

Pseudoninella SACCO, 1896 [**Delphinula miosolarioides*]. Spire low, rounded; sculpture of irregular spiral rows of nodes; inner lip not recurved. *U.Cret.(Dan.)-Mio.,* Eu.——FIG. 162,*5*. **P. miosolarioides* (SACCO), M.Mio., Italy; ×1 (147).

Puruninella BEETS, 1943 [**Delphinula permodesta* MARTIN, 1914]. Smooth, spire rounded; last whorl with shouldered periphery crenulated by a row of nodes. *Eoc.,* E.Indies.——FIG. 162,*4*. **P. permodesta* (MARTIN), U.Eoc., Java; *4a-c,* apertural, apical, and umbilical views, ×3 (163).

Subfamily MONODONTINAE Cossmann, 1916

Littoriniform, turbiniform or conical shells of small or medium size, anomphalous with few exceptions; ornament predominantly spiral or smooth; outer lip strongly prosocline in most genera and columellar lip with one or more teeth in many genera. *?Trias., M.Jur.-Rec.*

?Praelittorina KUTASSY, 1937 [**P. triadica;* SD KUTASSY, 1940]. Littoriniform, anomphalous, with subglobose last whorl and low acute spire; ornament spiral threads; aperture imperfectly known. *U.Trias.(Carn.),* Eu.——FIG. 163,*9*. **P. triadica,* Hung.; ×1.5 (84).

Ozodochilus COSSMANN, 1918 [**Trochus subfilosus* BUVIGNIER, 1852]. Small, subglobose to littoriniform, with cyrtoconoid spire, anomphalous; whorls flat or feebly convex, base strongly convex; ornament spiral threads, obscurely nodose in some species; peristome lying almost in a single plane and in some shells uninterrupted; columellar lip concave, joining basal lip in even curve and bearing obtuse denticle, scarcely perceptible in some species. *M.Jur.(Baj.)-U.Jur.(Kimm.),* Eu.——FIG. 163,*17*. **O. subfilosus* (BUVIGNIER), U.Jur. (Raurac.), Fr.; ×4 (165).

Cochleochilus COSSMANN, 1918 [**Trochus cottaldinus* D'ORBIGNY, 1853]. Biconical, anomphalous, with flat or feebly concave whorls, last one subcarinate at periphery; ornament spiral grooves; base flattened-convex in outline; columellar lip narrowly reflected above, where its outer margin continues that of parietal callosity, abruptly expanded and hollowed out below, where it is bordered on left by a carina that continues the apertural basal margin, describing sharp curve to meet margin of reflected part of lip; tubercle at upper end of hollowed-out part. *M.Jur.(Bathon.)-U.Jur.(Portland.)*, Eu.——FIG. 163,*16*. **C. cottaldinus* (D'ORBIGNY), U.Jur.(Raurac.), Fr.; ×8 (Cox, n).

Islipia COX & ARKELL, 1950 [**Monodonta lycetti* LYCETT, 1863]. Depressed turbiniform, anomphalous whorls and base convex; ornament prominent spiral cords; columellar lip straight, unthickened; to its left, and originating at its lower end, spiral bulge occupies middle of base, limited on outer side by deep groove indenting basal lip. *M.Jur.(Bathon.)*, Eu.——FIG. 163,*20*. *I. lycetti* (LYCETT), Eng.; ×2.7 (Cox, n).

Michaletia COSSMANN, 1904 [**M. semigranulata*]. Turbiniform, anomphalous but with base excavated mesially; last whorl evenly convex at periphery; ornament granose spiral cords; aperture orbicular, with interrupted peristome; outer lip strongly prosocline; columellar lip very oblique, with callous thickening at top. *Cret.(Barrem.-Maastricht.)*, Eu.——FIG. 163,*15*. **M. semigranulata*, U.Cret.(L.Coniac.), Fr.; ×2.7 (Cox, n).

Monodonta LAMARCK, 1799 [**Trochus labio* LINNÉ, 1758] [=*Monodontes* MONTFORT, 1810 (obj.); *Labio* OKEN, 1815 (obj.); *Odontis* SOWERBY, 1825 (obj.); *Trochidon* SWAINSON, 1840; *Pimpellies* GISTEL, 1847 (obj.)]. Thick-shelled, spirally sculptured. *U.Cret.(Dan.)-Rec.*

M. (Monodonta). Medium-sized, somewhat globose, columellar teeth wide. *Oligo.-Rec.*, Eu.-IndoPac.-Australasia.——FIG. 163,*14*. **M. (M.) labio* (LINNÉ), Rec., E.Indies, ×1 (147).

M. (Austrocochlea) FISCHER, 1885 [**M. constricta* LAMARCK, 1822] [=*Austrochlea* PILSBRY, 1889 (obj.)]. Spiral ribs widely spaced, columellar tooth weak. *Rec.*, Austral.

M. (Incisilabium) COSSMANN, 1918 [**M. parisiensis* DESHAYES, 1832]. Spiral ribs noded. *Eoc.*, Eu.

M. (Monodontella) SACCO, 1896 [**Turbo quadrulus* MICHELOTTI, 1840]. Small, sculpture clathrate, fine. *Mio.*, Eu.

M. (Osilinus) PHILIPPI, 1847 [**M. punctulata* LAMARCK, 1822; SD BUCQUOY, DAUTZENBERG & DOLLFUS, 1885] [=*Gibbium* GRAY, 1847 (*non* SCOPOLI, 1777); *Trochius* GRAY, 1847; *Neptheusa* GRAY, 1852 (=*Nephteusa* MONTEROSATO, 1888); *Trochocochlea* MÖRCH, 1852; *Caragolus* MONTEROSATO, 1884]. Smooth or with weak spiral ribs; columellar tooth weak, broad. *U.Cret.(Dan.)-Rec.*, Eu.-Afr.Atl.

Bankivia KRAUSS, 1848 [**B. varians* (=**Phasianella fasciata* MENKE, 1830); SD FISCHER, 1875]. Slender, high-spired, nearly smooth; columella with a weak fold. *Mio.-Rec.*, Austral.-S.Pac.

B. (Bankivia). Brilliantly nacreous. *Pleist.-Rec.*, Australasia.——FIG. 163,*4*. **B. fasciata* (MENKE), Rec., Austral.; ×1 (147).

B. (Leiopyrga) ADAMS & ADAMS, 1863 [**L. picturata* = *Cantharidus lineolaris* GOULD, 1861]. Whorls obtusely carinate, spiral riblets beaded; umbilicus small. *Mio.-Rec.*, S.Pac.

Bathybembix CROSSE, 1893 [**Bembix aeola* WATSON, 1879] [*pro Bembix* WATSON, 1879 (*non* FABRICIUS, 1775)]. Thin-shelled, somewhat inflated, spirally nodose to smooth, suture adpressed to channeled; in deep water. *Oligo.-Rec.*

B. (Bathybembix). Smooth or with subdued sculpture on periphery. *Oligo.-Rec.*, Japan-W.N.Am.-E.Atl.——FIG. 163,*7*. **B. (B.) aeola* (WATSON), Rec., Japan; ×0.5 (227).

B. (Ginebis) OTUKA, 1942 [**Trochus argenteonitens* LISCHKE, 1872]. With one row of nodes per whorl. *Oligo.-Rec.*, Japan.

Cantharidus MONTFORT, 1810 [**Trochus iris* GMELIN, 1791 = *Limax opalus* MARTYN, 1784 (ICZN op. 479)] [=*Cantharis* FÉRUSSAC, 1821 (obj.); *Elenchus* SWAINSON, 1840 (*non* CURTIS, 1831) (obj.); *Cantharidium* SCHAUFUSS, 1869 *(pro Cantharis)*]. Spire tapering, surface nearly smooth; columellar fold and tooth weak or wanting. *Mio.-Rec.*

C. (Cantharidus). Medium-sized; columella with fold but tooth obscure. *Mio.-Rec.*, Austral.——FIG. 163,*19*. **C. (C.) iris* (GMELIN), Rec., N.Z.; ×1 (147).

C. (Iwakawatrochus) KURODA & HABE, 1954 [**Gibbula vittata* PILSBRY, 1903]. Shell as in *Cantharidus*, but radula with cuspate rachidian tooth. *Rec.*, Japan.

C. (Levella) MARWICK, 1943 [**L. tersa*]. Minute, smooth, columella without fold. *L.Mio.*, N.Z.——FIG. 163,*22*. **C. (L.) tersa* (MARWICK); ×5 (204).

C. (Micrelenchus) FINLAY, 1927 [**Trochus sanguineus* GRAY, 1843]. Small, spire relatively low, columellar fold not apparent. *Mio.-Rec.*, N.Z.

C. (Phasianotrochus) FISCHER, 1885 [**Trochus badius* WOOD, 1828 = *Bulimus eximius* PERRY, 1811]. Columellar fold well developed. *Plio.-Rec.*, Austral.

C. (Plumbelenchus) FINLAY, 1927 [**Trochus capillaceus* PHILIPPI, 1848 = *T. pruninus* GOULD, 1844]. Columellar fold evanescent. *Rec.*, N.Z.

Chrysostoma SWAINSON, 1840 [**Turbo nicobaricus* "CHEMNITZ, 1781" (not binominal) = *Helix paradoxa* BORN, 1780]. Low-spired, globose, smooth; inner lip with a callus partially concealing false umbilicus. *Cret.-Rec.*, IndoPac.-N.Z.——FIG. 163,

*8. *C. paradoxum* (Born), Rec., E.Indies; ×1 (147).

Diloma Philippi, 1845 [**Turbo nigerrimus* Gmelin, 1791; SD Herrmannsen, 1847] Spire of moderate height to low; aperture oblique; columella weakly dentate. *Mio.-Rec.*

D. (Diloma). Nearly smooth; columella with a central area of nacre. *Rec.*, W.S.Am.-Pac.——Fig. 163,*11*. **D. (D.) nigerrima* (Gmelin), Rec., Chile; ×1 (147).

D. (Anisodiloma) Finlay, 1927 [**Trochus lugubris* Gmelin, 1791]. With nodose spiral ribs. *Rec.*, N.Z.

D. (Cavodiloma) Finlay, 1927 [**Trochocochlea excavata* A.Adams & Angas, 1864]. Small, smooth, with blunt peripheral keel. *Rec.*, N.Z.

D. (Chlorodiloma) Pilsbry, 1889 [**Trochus crinitus* Philippi, 1849] [=*Latona* Hutton, 1884 (*non* Schumacher, 1817)]. Spire higher than in *D. (Diloma)*; shell less nacreous; with an umbilical chink. *Rec.*, Austral.

D. (Fractarmilla) Finlay, 1927 [**Labio corrosa* A.Adams, 1853]. Peristome interrupted by last whorl. *Rec.*, N.Z.

D. (Melagraphia) Gray, 1847 [**Turbo aethiops* Gmelin, 1791] [=*Neodiloma* Fischer, 1885 (obj.); *Zediloma* Finlay, 1927]. Spirally sculptured, with a strong columellar tooth. *Mio.-Rec.*, Eu.-Austral.——Fig. 163,*10*. **D. (M.) aethiops* (Gmelin), Rec., N.Z.; ×1 (147).

D. (Miofractarmilla) Laws, 1948 [**M. bartrumi*]. Like *D. (Fractarmilla)* but with one small elevated tooth in front of columella. *L.Plio.*, N.Z.

D. (Oxystele) Philippi, 1847 [**Trochus merula* "Chemnitz" (not binominal) = *Trochus sinensis* Gmelin, 1791; SD Herrmannsen, 1847] [=*Oxytele* auctt. (obj.)]. Relatively large; inner lip broad, with a central furrow. *Mio.-Rec.*, Eu.-Afr.-Japan.——Fig. 163,*18*. **D. (O.) sinensis* (Gmelin), Rec., S.Afr.; ×1 (147).

D. (Pictodiloma) Habe, 1946 [**Trochus suavis* Philippi, 1850]. *Rec.*, Japan.

Jujubinus Monterosato, 1884 [**Trochus matoni* Payraudeau, 1827 = *T. exasperatus* Pennant, 1777; SD Pilsbry, 1889] [=*Manotrochus* Fischer, 1885; *Mirulinus* Monterosato, 1917; *Clelandella* Winckworth, 1932]. Like *Calliostoma* in form but more slender and with radula more like that of *Monodonta*. *U.Cret.(Turon.)-Rec.*

J. (Jujubinus). With small columellar tooth; peripheral spiral cord nodose. *U.Cret.(Turon.)-Rec.*, Eu.-Atl.-IndoPac.——Fig. 163,*2*. **J. exasperatus* (Pennant), Rec., Medit.; ×2 (147).

J. (Strigosella) Sacco, 1896 [**Trochus strigosus* Gmelin, 1791]. No columellar tooth; narrow umbilicus present. *Paleoc.-Rec.*, Eu.

Lesperonia Tournouër, 1874 [**L. princeps*]. Like *Jujubinus*, but smaller and with a strong carina. *Oligo.*, Eu.——Fig. 163,*3*. **L. princeps*, Oligo., Fr.; ×2 (147).

Pachydontella Marwick, 1948 [**P. etiampicta*]. Small, turbinate, stout, spirally ribbed; columella with large tooth. *Plio.*, N.Z.——Fig. 163,*1*. **P. etiampicta*; ×2 (204).

Pictiformes Kolesnikov, 1939 [**Monodonta mamilla* Andrzejowski, 1830]. With deep suture and faint keel. *Mio.(Sarmat.)*, SW.Asia.

Tegula Lesson, 1835 [**T. elegans* (=*Trochus pellisserpentis* Wood, 1828)]. Of moderate size to large, solid, whorls flat-sided; with or without umbilicus. *Mio.-Rec.*

T. (Tegula). With nodose spiral ribs; base flattened. *Mio.-Rec.*, N.Am.-S.Am.-Pac.——Fig. 163, *21*. **T. (T.) pellisserpentis* (Wood), Rec., W.S. Am.; *21a,b*, ×1 (147).

T. (Agathistoma) Olsson & Harbison, 1953 [**Trochus viridulus* Gmelin, 1791]. Smooth or finely beaded spirally, with a narrow umbilicus. *Plio.-Rec.*, E.C.Am.-W.C.Am.

T. (Chlorostoma) Swainson, 1840 [**Trochus argyrostomus* Gmelin, 1791; SD Herrmannsen, 1846]. Smooth or axially ribbed above, base smooth or spirally ribbed. *Mio.-Rec.*, Japan-N. Am.-S.Am.

T. (Omphalius) Philippi, 1847 [**Trochus rusticus* Gmelin, 1791; SD Herrmannsen, 1847] [=*Neomphalius* Fischer, 1885 (obj.)]. Like *T. (Chlorostoma)* but smooth; most species with umbilicus. *Mio.-Rec.*, Japan-W.N.Am.-?W.Indies.

T. (Promartynia) Dall, 1909 [**Trochus pulligo* Gmelin, 1791]. Smooth, with wide umbilicus. *Pleist.-Rec.*, W.N.Am.

Thalotia Gray, 1847 [**Trochus pictus* Wood, 1828 (=*Monodonta conica* Gray, 1827)]. Elevated-conical solid, granular or spirally ribbed. *Mio.-Rec.*

T. (Thalotia). Periphery rounded, aperture small. *U.Tert.-Rec.*, E.Indies.——Fig. 163,*5*. **T. conica* (Gray), Rec., Austral., ×1 (147).

T. (Alcyna) A.Adams, 1860 [**A. ocellata*; SD Pilsbry, 1888]. Aperture relatively large, columella truncate below. *Rec.*, Pac.

T. (Beraua) Beets, 1941 [**Cantharidus (B.) erinaceus*]. More conical than in *T. (Thalotia)* and with sutural nodes stronger. *Mio.*, E.Indies. ——Fig. 163,*6*. **T. (B.) erinacea* (Beets), Mio., Borneo; ×1 (163).

T. (Calthalotia) Iredale, 1929 [**Trochus arruensis* Watson, 1880]. *Plio.-Rec.*, Austral.

T. (Odontotrochus) Fischer in Kiener, 1879 [**Trochus chlorostomus* Menke, 1843]. Periphery angulate, spire high. *Rec.*, Austral.

T. (Prothalotia) Thiele, 1930 [**Trochus flindersi* Fischer, 1878]. Periphery rounded; umbilicus narrow; columella smooth. *Rec.*, Austral.

Turcica A.Adams, 1854 [**T. monilifera*] [=*Ptychostylis* Gabb, 1866]. Spire high, sides flattened; sutures impressed; sculpture nodose. *Mio.-Rec.*

T. (Turcica). Columella with 1 or 2 large teeth on strong fold. *Mio.-Rec.*, N.Am.-Japan-Austr.

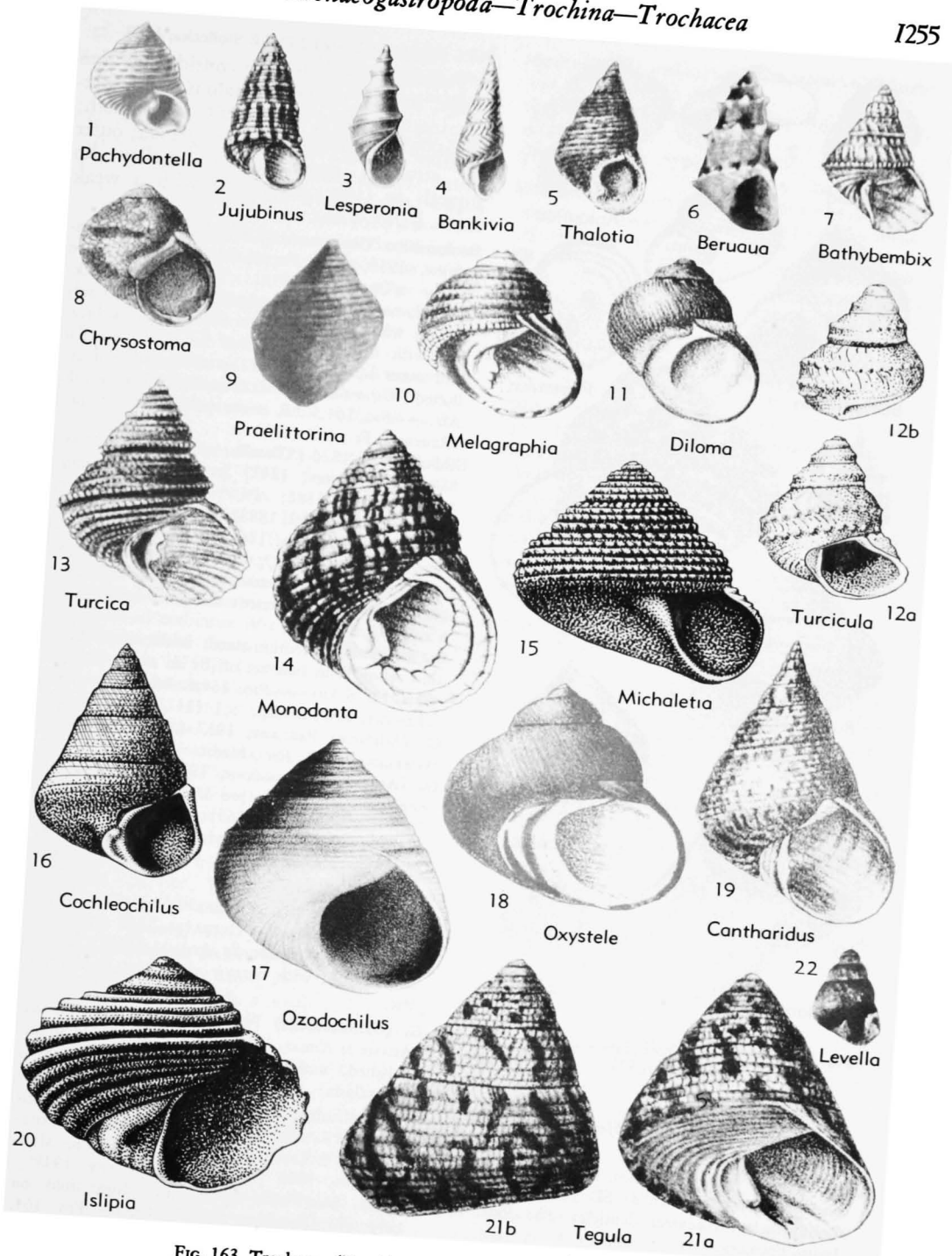


FIG. 163. Trochacea (Trochidae——Monodontinae) (p. *1252-1256*).

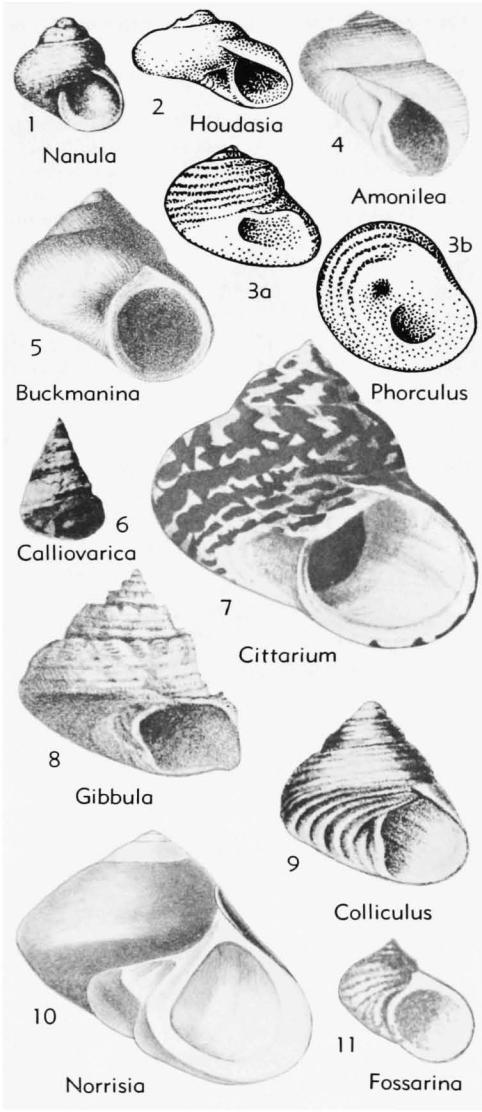


FIG. 164. Trochacea (Trochidae——Gibbulinae) (p. *I*256-*I*257).

——FIG. 163,*13*. **T. monilifera*, Rec., Austral.; ×1 (147).

T. (Perrinia) ADAMS & ADAMS, 1854 [**Monodonta angulifera* A.ADAMS, 1853; SD PILSBRY, 1889]. Columella with several denticles. *Plio.-Rec.*, E. Indies-Formosa.

Turcicula DALL, 1881 [**Margarita imperialis*]. Resembling *Lischkeia*, but with reflected lip and vermiculate sculpture. *Rec.*, Carib.——FIG. 163, *12*. **T. imperialis* (DALL), Cuba; *12a,b*, ×1 (217).

Subfamily GIBBULINAE Stoliczka, 1868

Turbiniform shells with considerable size range, mostly phaneromphalous; with predominantly spiral ornament or smooth; peristome interrupted in most genera; outer lip strongly prosocline; columellar lip smooth or (less commonly) with a weak tooth. *U.Jur.-Rec.*

Buckmanina COSSMANN, 1920 [*pro Brasilia* COSSMANN, 1918 (*non* BUCKMAN, 1908)] [**Turbo erinus* D'ORBIGNY, 1853]. Turbiniform, thick-shelled, narrowly phaneromphalous, with strongly convex whorls and base, smooth; aperture orbicular, with thin parietal callus linking columellar and outer lips; columellar lip thickened, not reflected. *U.Jur.(Raurac.)-L.Cret.(Neocom.)*, Eu.-S. Afr.——FIG. 164,*5*. **B. erinus* (D'ORBIGNY), U.Jur. (Raurac.), Fr.; ×2 (111).

Gibbula RISSO, 1826 [**Trochus magus* LINNÉ, 1758; SD HERRMANNSEN, 1847] [=*Magulus, Puteolus* MONTEROSATO, 1888; *Phorculus* MONTEROSATO, 1888 (*non* COSSMANN, 1888); *Conotrochus* PILSBRY, 1889 (*non* SEGUENZA, 1864); *Phorculellus* SACCO, 1896 *(pro Phorculus); Phorculorbis* COSSMANN, 1918; *Forskaliopsis* COEN, 1931 (*non* HAECKEL, 1888)]. Sutures impressed; umbilicus bounded by a ridge. *U.Cret.-Rec.*

G. (Gibbula). Medium-sized, wider than high; last whorl with base set off by an angle. *U.Cret.-Rec.*, Eu.-S.Am.——FIG. 164,*8*. **G. (G.) magus* (LINNÉ), Rec., Medit.; ×1 (147).

G. (Adriaria) PALLARY, 1917 [**Trochus albidus* GMELIN, 1791]. *Rec.*, Medit.

G. (Amonilea) COSSMANN, 1920 [**Gibbula parnensis* BAYAN, 1870] [*pro Moniliopsis* COSSMANN, 1918 (*non* CONRAD, 1865); *Moniliopsidea* TOMLIN, 1930]. Whorls inflated, sculpture fine, spiral. *Eoc.*, Eu.——FIG. 164,*4*. **G. (A.) parnensis*, Eoc., Fr.; ×2 (147).

G. (Calliotrochus) FISCHER in KIENER, 1879 [**Turbo phasianellus* DESHAYES, 1863 (not homonym of *T. phasianella* ADAMS, 1850)]. Small, turbiniform, with narrow umbilicus. *Rec.*, Indo-Pac.

G. (Cantharidella) PILSBRY, 1889 [**G. picturata* ADAMS & ANGAS, 1864; SD SUTER, 1913]. Small, polished, umbilicus narrow or wanting. *Rec.*, Australasia.

G. (Colliculus) MONTEROSATO, 1888 [**Trochus adansoni* PAYRAUDEAU, 1827; SD BUCQUOY, DAUTZENBERG & DOLLFUS, 1898] [=*Glomulus* MONTEROSATO, 1888 (=*Glossulus* PALLARY, 1938)]. Small, base with spiral ribs; slight fold on columella. *Eoc.-Rec.*, Eu.-Afr.-Pac.——FIG. 164, *9*. **G. (C.) adansoni* (PAYRAUDEAU), Rec., Medit.; ×2 (147).

G. (Enida) A.ADAMS, 1860 [**E. japonica;* SD KOBELT, 1879]. Small, depressed, with wide umbilicus. *Pleist.-Rec.*, Japan-IndoPac.

G. (Eurytrochus) FISCHER in KIENER, 1879 [**Clanculus danieli* CROSSE, 1862; SD PILSBRY, 1889]. Low-spired, spirally ribbed; periphery bluntly angulate. *Rec.*, S.Pac.

G. (Forskaelena) IREDALE, 1918 [**Trochus fanulum* GMELIN, 1791] [*pro Forskälia* ADAMS & ADAMS, 1854 (*non* KÖLLIKER, 1853)]. Axially ribbed above periphery, spirally below, with a double keel at periphery. *Mio.-Rec.*, Eu.

G. (Hisseyagibbula) KERSHAW, 1955 [**Littorina hisseyana* TENISON-WOODS, 1876]. *Rec.*, Tasmania.

G. (Notogibbula) IREDALE, 1924 [**G. coxi* ANGAS, 1867 (=*Stomatia bicarinata* ADAMS, 1854)]. With 2 rounded keels. *Rec.*, Austral.

G. (Phorcus) RISSO, 1826 [**P. margaritaceus*; SD BUCQUOY, DAUTZENBERG & DOLLFUS, 1885]. Apex blunt; spiral sculpture weak. *Oligo.-Rec.*, Eu.-S.Am.-C.Am.

G. (Pseudodiloma) COSSMANN, 1888 [**Trochus mirabilis* DESHAYES, 1863]. Globose, with thickened lip. *Eoc.*, Eu.-N.Am.

G. (Robur) KOLESNIKOV, 1939 [**Trochus robur* DAVIDACHVILI, 1932]. Turbinate, with 2 low carinae. *Mio.(L.Sarmat.)*, SW.Asia.

G. (Rollandiana) KOLESNIKOV, 1939 [**Trochus rollandianus* D'ORBIGNY, 1845]. Low-whorled, with broad umbilicus. *Mio.*, SW.Asia.

G. (Steromphala) GRAY, 1847 [**Trochus cinerarius* LINNÉ, 1758] [=*Korenia* FRIELE, 1877 (obj.); *Gibbulastra* MONTEROSATO, 1884; *Gibbuloidella* SACCO, 1896]. Apex and periphery rounded; spirally striate. *Mio.-Rec.*, Eu.

G. (Tumulus) MONTEROSATO, 1888 [**Trochus umbilicaris* LINNÉ, 1758; SD BUCQUOY, DAUTZENBERG & DOLLFUS, 1898]. Like *G. (Steromphala)* but with higher spire. *Mio.-Rec.*, Eu.

Calliovarica VOKES, 1939 [**C. eocensis*]. Outer lip strongly reflected; with numerous varices crossed by spiral ribs. *Eoc.*, W.N.Am.——FIG. 164,*6*. **C. eocensis*, Eoc., Calif.; ×1 (225).

Cittarium PHILIPPI, 1847 [**Turbo pica* LINNÉ, 1758] [=*Meleagris* MONTFORT, 1810 (*non* LINNÉ, 1758) (obj.); *Livona* GRAY, 1847 (obj.)]. Large, turbinate, inner lip with a small callus. *Pleist.-Rec.*, Carib.——FIG. 164,*7*. **C. pica* (LINNÉ), Rec., W.Indies; ×0.5 (147).

Fossarina A.ADAMS & ANGAS, 1864 [**F. patula*] [(=*Minos* HUTTON, 1884)]. Small to minute, spiral sculpture very fine. *Rec.*

F. (Fossarina). Aperture entire. *Rec.*, Austral.——FIG. 164,*11*. **F. (F.) patula*, S.Austral.; ×3 (147).

F. (Clydonochilus) FISCHER, 1890 [**C. mariei*]. Minute, outer lip with a notch below suture. *Rec.*, E.Afr.

F. (Minopa) IREDALE, 1924 [**F. legrandi* PETTERD, 1879]. Minute, smooth, inner lip interrupted by last whorl. *Rec.*, Austral.

Gaza WATSON, 1879 [**G. daedala*]. Turbinate, finely spirally striate; umbilicus partly or entirely concealed by callus. *Rec.*

G. (Gaza). Umbilicus entirely concealed. *Rec.*, Pac.-Carib.

G. (Callogaza) DALL, 1881 [**G. (C.) watsoni*]. Umbilicus partly concealed. *Rec.*, Carib.

Houdasia COSSMANN, 1902 [**H. splendens*]. Small, depressed, few-whorled. *Eoc.*, Eu.——FIG. 164,*2*. **H. splendens*, Eoc., Fr.; ×5 (147).

Nanula THIELE, 1924 [**Gibbula tasmanica* PETTERD, 1879]. Small, globose, nearly smooth. *Rec.*, Austral.——FIG. 164,*1*. **N. tasmanica* (PETTERD); ×3 (147).

Norrisia BAYLE, 1880 [**Trochiscus norrisi* SOWERBY, 1838] [*pro Trochiscus* SOWERBY, 1838 (*non* HEYDEN, 1826)]. Large, solid, rounded-conical. *Pleist.-Rec.*, W.N.Am.——FIG. 164,*10*. **N. norrisi* (SOWERBY), Rec., Calif.; ×0.7 (147).

Phorculus COSSMANN, 1888 [**Turbo fraterculus* DESHAYES, 1863]. Small, depressed, with strong spiral ribs. *Eoc.-Mio.*, Eu.-N.Am.-S.Am.——FIG. 164,*3*. **P. fraterculus* (DESHAYES), Eoc., Fr.; *3a,b*, ×1.5 (147).

Trochinella IREDALE, 1937 [**T. perconfusa*]. Thin, pellucid. *Rec.*, Pac.

Subfamily CALLIOSTOMATINAE Thiele, 1924

[=Conulinae COSSMANN, 1916 *(partim)*]

Conical or turbiniform shells mostly of medium to large-medium size, anomphalous or narrowly phaneromphalous, many with flattened base; aperture quadrangular; peristome discontinuous, parietal region without callus in most genera; outer lip strongly prosocline; columellar lip straight, vertical or inclined, meeting parietal lip in abrupt angle, and smooth or with denticle at lower end. *L.Cret.-Rec.*

Calliostoma SWAINSON, 1840 [**Trochus conulus* LINNÉ, 1758; SD HERRMANNSEN, 1846] [=*Conulus* NARDO, 1840 (*non* LESKE, 1778); *Ziziphinus* GRAY, 1847 (*non* GRAY, 1843); *Montagua* GRAY, 1852 (*non* FLEMING, 1828); *Stylotrochus* SEGUENZA, 1876 (*non* HAECKEL, 1862); *Jacinthinus* MONTEROSATO, 1889 (obj.); *Callistoma, Callistomus, Callisoma* AUCTT. (obj.)]. Without umbilicus. *L.Cret.(Calliostoma s.lat.)-Rec.* (61).

C. (Calliostoma). Shell thick, with granular spirals on early whorls, later whorls nearly smooth; columellar tubercle distinct. *Mio.-Rec.*, Medit.——FIG. 165,*5*. **C. (C.) conulus* (LINNÉ), Rec., Medit.; *5a,b*, ×1 (147).

C. (Alertalex) DELL, 1956 [**A. blacki*]. Thin, iridescent, with smooth, prominent spiral ribs. *Rec.*, N.Z.

C. (Ampullotrochus) MONTEROSATO, 1890 [**Trochus granulatus* BORN, 1778]. Entirely granulate. *Rec.*, Medit.-?W.N.Am.

C. (Anceps) KOLESNIKOV, 1939 [**Trochus anceps*

EICHWALD, 1850]. Thin-walled, with flat base and whorls. *Mio.(Sarmat.)*, SW.Asia.

C. (Benthastelene) IREDALE, 1936 [**B. katherina*]. Small, aperture semilunar. *Rec.*, Austral.

C. (Carinator) IKEBE, 1942 [**C. (C.) makiyamai*]. Whorls with 2 strong carinae; suture canaliculate. *U.Plio.*, Japan.

C. (Eucasta) DALL, 1889 [**C. (E.) indianum*]. With a sulcus near periphery. *Rec.*, Carib.

C. (Fautor) IREDALE, 1924 [**Ziziphinus comptus* A.ADAMS, 1855] [=*Salsipotens* IREDALE, 1924]. Relatively high-spired. *Rec.*, Austral.

C. (Feneoniana) KOLESNIKOV, 1939 [**Trochus feneonianus* D'ORBIGNY, 1845]. With sharp basal keel and spiral ribs. *Mio.(Sarmat.)*, SW.Asia.

C. (Laetifautor) IREDALE, 1929 [**C. trepidum* HEDLEY, 1907 = *C. deceptum* SMITH, 1899]. Spiral ribs nodose. *Plio.-Rec.*, Australasia.

C. (Maurea) OLIVER, 1926 [**Trochus tigris* GMELIN, 1791 (ICZN, Op. 479)] [=*Mauriella* OLIVER, 1926; *Calliotropis* OLIVER, 1926 (*non* SEGUENZA, 1903); *Mucrinops*, *Venustas* FINLAY, 1927 (obj.); *Calotropis* THIELE, 1929 *(pro Calliotropis)*]. With pointed spire and rounded periphery. *Mio.-Rec.*, N.Z.

C. (Otukaia) IKEBE, 1942 [**C. kiheiziebisu* OTUKA, 1939]. Whorls simply sculptured, with 2 strong spiral keels. *Plio.-Rec.*, Japan.

C. (?Putzeysia) SULLIOTTI, 1889 [**Trochus clathratus* ARADAS, 1847] [=*Gemmula* SEGUENZA, 1876 (*non* WEINKAUFF, 1875)]. Small, somewhat inflated, with cancellate sculpture. *Mio.-Rec.*, Eu.

C. (Sarmates) KOLESNIKOV, 1939 [**Trochus sarmates* EICHWALD, 1850]. With median keel. *Mio. (Sarmat.)*, SW.Asia.

C. (Sinutor) COTTON & GODFREY, 1935 [**Ziziphinus incertus* REEVE, 1863]. Sinistral. *Rec.*, Austral.

C. (Spikator) COTTON & GODFREY, 1935 [**C. spinulosum* TATE, 1893]. Small, with cancellate sculpture. *Rec.*, Austral.

C. (Tristichotrochus) IKEBE, 1942 [**C. aculeatum* SOWERBY, 1912]. With whorls shouldered, primary and secondary spirals mostly granulate. *Oligo.-Rec.*, Japan-W.N.Am.——FIG. 165,7. **C. (T.) aculeatum*, Rec., Japan; ×1 (61).

C. (Ziziphinus) GRAY, 1843 [**Z. canaliculatus* "MARTYN" HUMPHREY, 1786; SD REHDER, 1937]. Large for genus, spiral ribs smooth. *Oligo.-Rec.*, W.N.Am.

Astele SWAINSON, 1855 [**Trochus subcarinatus* SWAINSON, 1855 (*non* PHILIPPI, 1843) = *Calliostoma adamsi* PILSBRY, 1890] [=*Eutrochus* A. ADAMS, 1864 (obj.)]. Like *Calliostoma* in form but with an umbilicus. *U.Cret.-Rec.*

A. (Astele). Spiral ribs beaded, umbilicus bounded by beaded cord. *U.Cret.-Rec.*, cosmop.——FIG. 165,8. **A. adamsi* (PILSBRY), Rec., Tasmania; ×1 (147).

A. (Astelena) IREDALE, 1924 [**Ziziphinus scitulus* A.ADAMS, 1855]. Small, aperture semilunar, columella long. *Rec.*, Australasia.

A. (Callistele) COTTON & GODFREY, 1935 [**A. calliston* VERCO, 1905]. Umbilicus narrow. *Rec.*, Austral.

A. (Coralastele) IREDALE, 1930 [**C. allanae*]. Conical, with pointed spire; umbilical pit deep. *Rec.*, Austral.-Japan.

A. (Dentistyla) DALL, 1889 [**Margarita asperrima* DALL, 1881]. Sculpture nodulous; outer lip lirate within. *Mio.-Rec.*, Carib.

A. (Eurastele) COEN, 1946 [**A. (E.) lusitanica*]. *Rec.*, Medit.

A. (Leiotrochus) CONRAD, 1862 [**L. distans*]. Spire rather low; spiral ribs smooth. *Mio.*, E.N. Am.——FIG. 165,4. **A. (L.) distans* (CONRAD), Mio., USA. (Md.); ×1 (203).

A. (Mazastele) IREDALE, 1936 [**Trochus glypta* WATSON, 1886]. Sutures sunken; umbilicus very wide. *Rec.*, Austral.

A. (Omphalotukaia) YOSHIDA, 1948 [**Calliostoma hajimeanum*]. Like *Calliostoma (Otukaia)* but umbilicate. *Rec.*, Japan.

A. (Pulchrastele) IREDALE, 1929 [**Calliostoma septenarium* MELVILL & STANDEN, 1899]. Small, ribs noded. *Plio.-Rec.*, Austral.

A. (Scrobiculinus) MONTEROSATO, 1889 [**Trochus strigosus* GMELIN, 1791]. Umbilicus a mere chink. *Rec.*, N.Afr.

Falsimargarita POWELL, 1951 [**Margarites gemma* SMITH, 1915]. Like *Calliostoma*, but shell thin, iridescent, umbilicate. *Rec.*, Antarct.

?Kishinewia KOLESNIKOV, 1935 [**Phasianella bessarabica* D'ORBIGNY, 1844]. High-spired, slightly carinate, aperture rounded. *Mio.(Sarmat.)*, SW. Asia.——FIG. 165,6. **K. bessarabica* (D'ORBIGNY), Mio., USSR; ×2 (197).

Metaconulus COSSMANN, 1918 [**Trochus princeps* DESHAYES, 1863]. Higher than wide, suture bordered above by nodose keel. *?U.Cret.; Eoc.-Oligo.*, Eu.-N.Afr.——FIG. 165,2. **M. princeps* (DESHAYES), Eoc., Fr.; ×1 (147).

Photinastoma POWELL, 1951 [**Trochus taeniatus* WOOD, 1828]. Shell resembling *Photinula* but radula nearer that of *Calliostoma*. *Rec.*, Antarct.

Photinula ADAMS & ADAMS, 1854 [**Margarita coerulescens* KING & BRODERIP, 1831; SD FISCHER, 1875] [*pro Photina* ADAMS & ADAMS, 1853 (*non* BURMEISTER, 1838); *Kingotrochus* VONIHERING, 1902 (obj.)]. Depressed, nearly smooth, umbilicus concealed by callus. *Rec.*, Antarct.-S.Am.

?Sinzowia KOLESNIKOV, 1935 [**Trochus elatior* D'ORBIGNY, 1845]. Turriculate, many-whorled, with a peripheral keel. *Mio.(Sarmat.)*, SW.Asia. ——FIG. 165,1. **S. elatior* (D'ORBIGNY), Mio., USSR.; ×3.3 (197).

Venustatrochus POWELL, 1951 [**V. georgianus*]. Shell like other deep-water members of subfamily but radula with numerous lateral teeth. *Rec.*, S.Atl.

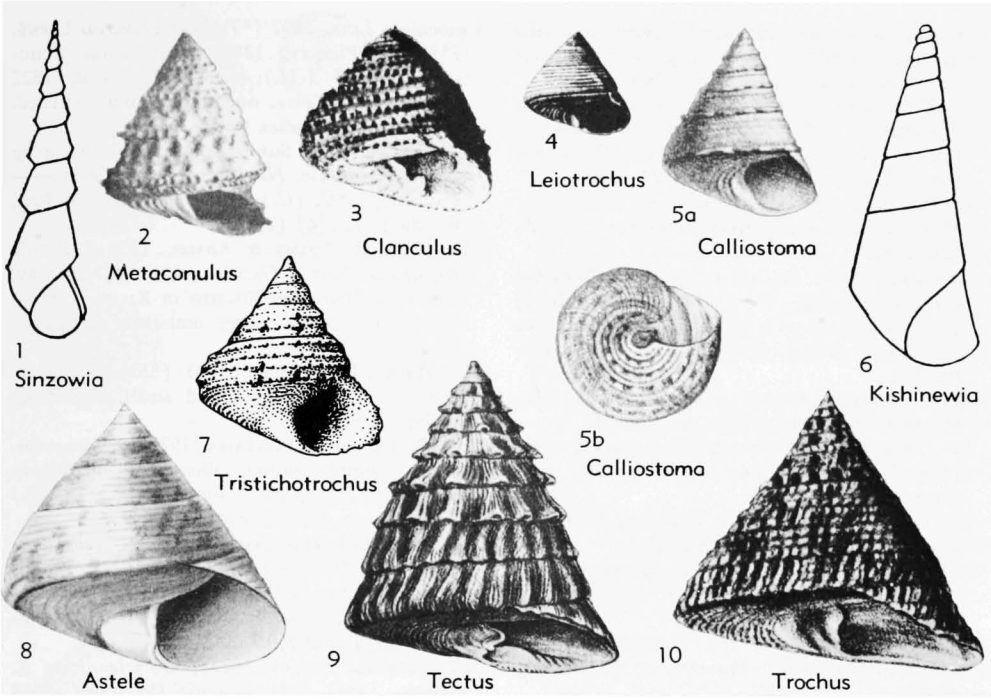


FIG. 165. Trochacea (Trochidae——Calliostomatinae, Trochinae) (p. *I257-I260*).

Subfamily TROCHINAE Rafinesque, 1815

[*nom. correct.* SWAINSON, 1840 (*pro* Trochidia RAFINESQUE, 1815)]

Conical or, less commonly, turbiniform, nodosely ornamented shells with considerable range of size, narrowly phaneromphalous, or anomphalous with base excavated in middle; aperture quadrangular with strongly discordant lips; outer lip sharp, strongly prosocline; columellar lip straight, emerging from umbilicus or basal excavation, smooth, undulating or toothed, commonly forming marked angle with basal margin. *U.Cret.-Rec.*

Trochus LINNÉ, 1758 [**T. maculatus;* SD IREDALE, 1912] [=*Polydonta* SCHUMACHER, 1817 (obj.); *Lamprostoma* SWAINSON, 1840 (obj.)]. Conical, base more or less flattened. *Mio.-Rec.*

T. (Trochus). Medium-sized to large; whorls flat-sided, periphery angular; ornament granose spiral cords; umbilicus or pseudumbilicus with callus coating; columellar lip separated by gap from parietal lip, multidentate to almost smooth, meeting basal lip in well-marked angle. *Mio.-Rec.,* Afr.-IndoPac.-Austral.——FIG. 165,*10*. **T. (T.) maculatus,* Rec., Philippines; ×1.0 (147).

T. (Belangeria) FISCHER, 1879 [**T. scabrosus* PHILIPPI, 1850]. With a spirally grooved false umbilicus. *Rec.,* IndoPac.

T. (Coelotrochus) FISCHER, 1879 [**T. tiaratus* QUOY & GAIMARD, 1834] [=*Neozelandia* COSSMANN, 1918]. Relatively small, with slightly convex whorls and a deep false umbilicus. *Plio.-Rec.,* N.Z.

T. (Infundibulops) PILSBRY, 1889 [**T. erythraeus* BROCCHI, 1821]. Like *T. (Trochus)* but columella without folds or denticulations. *Pleist.-Rec.,* IndoPac.-Red Sea.

T. (Infundibulum) MONTFORT, 1810 [**T. concavus* GMELIN, 1791] [=*Carinidea* SWAINSON, 1840 (obj.)]. Surface with axial folds, base spirally ribbed; columella with single fold. *Rec.,* IndoPac.

T. (Praecia) GRAY, 1857 [**T. elegantulus* WOOD, 1828]. Relatively small, with wavy axial folds; columella ending in a tooth. *Rec.,* India.

T. (Thorista) IREDALE, 1915 [**Polydonta tuberculata* GRAY, 1843 = *Trochus viridis* GMELIN, 1791] [=*Anthora* GRAY, 1857 (*non* DOUBLEDAY, 1844) (obj.)]. Relatively small; upper surface with spirally arranged nodes; base with smooth spiral ribs. *Pleist.-Rec.,* N.Z.

T. (Thoristella) IREDALE, 1915 [**Polydonta chathamensis* HUTTON, 1873]. Small, smooth, periphery rounded-carinate, columella smooth. *Mio.-Rec.,* N.Z.

Clanculus MONTFORT, 1810 [**Trochus pharaonius* LINNÉ, 1758] [=*Otavia* RISSO, 1826; *Fragella* SWAINSON, 1840 (obj.)]. Rather small, rounded-

conical, surface most commonly beaded; columella with tooth; umbilical pit bordered with crenulate ridge. *U.Cret.-Rec.,* Afr.-IndoPac.-W.C.Am.

C. (Clanculus). With single strong tooth at base of columella. *U.Cret.(Maastricht.)-Rec.,* Eu.-IndoPac.-Australasia.——Fig. 165,*3*. **C. (C.) pharaonius* (Linné), Rec., Red Sea; ×1 (147).

C. (Camitia) Adams & Adams, 1854 (*ex* Gray MS) [**Camitia pulcherrima*]. Depressed, smooth. *Rec.,* IndoPac.

C. (Clanculopsis) Monterosato, 1879 [**Trochus cruciatus* Linné, 1758; SD Sacco, 1896] [=*Clanculella* Sacco, 1896]. With more than one denticle at end of columella. *Mio.-Rec.,* Eu.-IndoPac.

C. (Euclanculus) Cotton & Godfrey, 1934 [**C. leucomphalus* Verco, 1905]. *Rec.,* Austral.

C. (Euriclanculus) Cotton & Godfrey, 1934 [**Trochus flagellatus* Philippi, 1849]. *Plio.-Rec.,* Austral.

C. (Isoclanculus) Cotton & Godfrey, 1934 [**C. yatesi* Crosse, 1863]. *Rec.,* Austral.

C. (Macroclanculus) Cotton & Godfrey, 1934 [**Monodonta undata* Lamarck, 1816]. *Rec.,* Austral.

C. (Mesoclanculus) Cotton & Godfrey, 1934 [**Trochus plebejus* Philippi, 1851]. *Rec.,* Austral.

C. (Microclanculus) Cotton & Godfrey, 1934 [**C. euchelioides* Tate, 1893]. *Rec.* Austral.

C. (?Panocochlea) Dall, 1908 [**C. (P.) rubidus*]. Depressed, nearly smooth, a single strong tooth at end of columella. *Rec.,* W.C.Am.

C. (Paraclanculus) Finlay, 1927 [**P. peccatus*]. *Rec.,* Australasia.

Tectus Montfort, 1810 [**Trochus mauritianus* Gmelin, 1791] [=*Pyramis* Schumacher, 1817 (*non* Röding, 1798); *Pyramidea* Swainson, 1840]. Conical, higher than wide, base nearly smooth; no umbilicus; columella with a strong spiral fold. *U.Cret.-Rec.,* IndoPac.-E.Indies.

T. (Tectus). Medium-sized to large, with axial folds on spire. *U.Cret.-Rec.,* Eu.-Afr.-IndoPac.-Japan.——Fig. 165,*9*. **T. (T.) mauritianus* (Gmelin), Rec., E.Indies; ×0.7 (147).

T. (Cardinalia) Gray, 1847 [**Trochus virgatus* Gmelin, 1791]. Upper surface with beaded spiral ribs; columellar fold weak. *Plio.-Rec.,* IndoPac.

T. (Rochia) Gray, 1857 [**Trochus acutangulus* "Chemnitz" (not binominal) = **T. conus* Gmelin, 1791]. Like *T. (Cardinalia)* but with columellar fold ending in tooth. *Plio.-Rec.,* E. Indies.

Subfamily UMBONIINAE Pilsbry, 1886

Medium-sized shells, mostly of lenticular form; umbilicus partly or entirely filled by a callus pad. *U.Cret.-Rec.*

Umbonium Link, 1807 [**Trochus vestiarius* Linné, 1758; SD Pilsbry, 1889] [=*Globulus* Schumacher, 1817 (obj.); *Rotella* Lamarck, 1822 (obj.)]. Solid, glossy, smooth or spirally striated. *Mio.-Rec.,* Pac.-E.Indies.

U. (Umbonium). Suture indistinct, callus plug circular, complete. *Plio.-Rec.,* Japan-IndoPac.——Fig. 166,*7*. **U. (U.) vestiarium* (Linné), Rec., E.Indies; *7a,b,* ×1 (147).

U. (Ethalia) Adams & Adams, 1854 [**Rotella guamensis* Quoy & Gaimard, 1834; SD Pilsbry, 1889] [=*Liotrochus* Fischer in Kiener, 1879]. Callus only partly filling umbilicus. *Mio.-Rec.,* Pac.

U. (Ethaliella) Pilsbry, 1905 [**Ethalia floccata* Sowerby, 1903]. Callus pad small, not filling umbilicus. *Rec.,* Pac.

U. (Protorotella) Makiyama, 1925 [**P. yuantaniensis*]. Suture abutting, callus broad, filling umbilicus. *Mio.,* Japan.——Fig. 166,*10*. **U. (P.) yuantaniensis,* Mio., Japan; ×2 (147).

U. (Suchium) Makiyama, 1925 [**U. suchiense* Yokoyama, 1923; SD Makiyama, 1927]. Whorls with spiral ribs; callus divided into 2 lobes. *L. Plio.-Rec.,* Japan.——Fig. 166,*9*. **U. (S.) suchiense,* Plio., Japan; ×0.7 (147).

U. (Zethalia) Finlay, 1927 [**U. zelandicum* A. Adams, 1854] [=*Ethaliopsis* Cossmann, 1918 (*non* Schepman, 1908)]. Almost without umbilicus; callus bordered by beaded ridge. *Plio.-Rec.,* N.Z.——Fig. 166,*4*. **U. (Z.) zelandicum,* Rec., N.Z.; ×1 (147).

Antisolarium Finlay, 1927 [**Solarium egenum* Gould, 1849]. Spire conical, with beaded ribs; columellar lip only slightly reflected over umbilicus. *Oligo.-Rec.,* N.Z.-Pac.——Fig. 166,*2*. **A. egenum* (Gould), Rec., N.Z.; *2a,b,* ×2 (147).

Callumbonella Thiele, 1924 [**Gibbula gorgonarum* Fischer, 1883] [=*Umbotrochus* Thiele, 1924 (*non* Perner, 1908) (obj.)]. Spire conical, periphery angulate, base convex; umbilical callus narrow. *Rec.,* E.Atl.——Fig. 166,*11*. **C. gorganarum* (Fischer), Cape Verde; ×2 (147).

Ethminolia Iredale, 1924 [**E. probabilis*]. Depressed-trochoid, widely umbilicate, small. *Rec.,* Austral.-Japan.

E. (Ethminolia). Whorls shouldered medially. *Rec.,* Austral.

E. (Sericominolia) Kuroda & Habe, 1954 [**Minolia stearnsi* Pilsbry, 1895]. Whorls rounded. *Rec.,* Japan.——Fig. 166,*8*. **E. (S.) stearnsi* (Pilsbry); ×4 (199).

Isanda Adams & Adams, 1854 [*I. coronata* A.Adams, 1854]. Solid, small, polished. *U.Cret.-Rec.,* IndoPac.-Austral.-N.Z.

I. (Isanda). Globose, umbilicus bordered by a beaded rib. *Rec.,* IndoPac.——Fig. 166,*3*. **I. (I.) coronata,* Austral.; ×1 (147).

I. (Archiminolia) Iredale, 1929 [**Monilea oleacea* Hedley & Petterd, 1905]. *Rec.,* Austral.

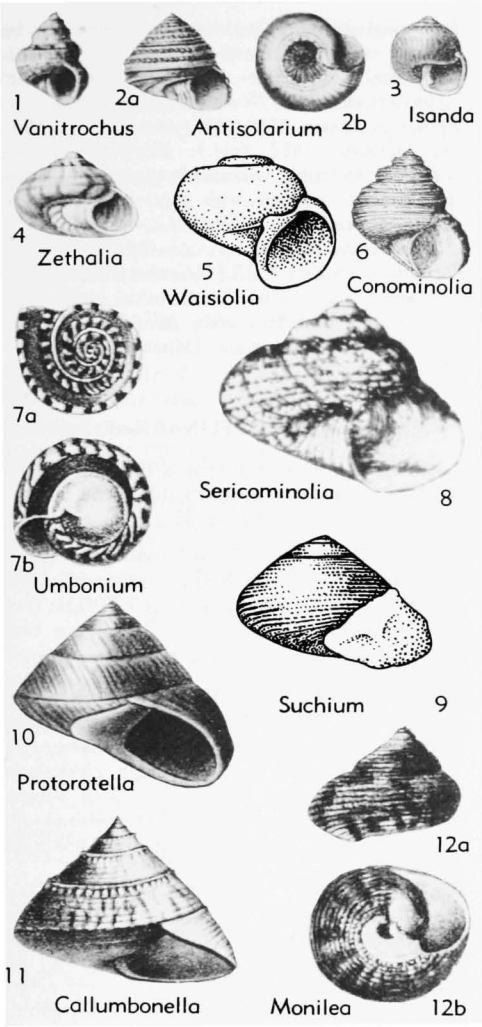


FIG. 166. Trochacea (Trochidae——Umboniinae) (p. *I*260-*I*261).

I. (Conominolia) FINLAY, 1927 [**Heliacus conicus* MARSHALL, 1917]. Spire with three noded ribs; base with numerous spirals; umbilicus wide. *U.Cret.(Wangaloan)-Mio.*, N.Z.——FIG. 166,*6*. **I. (C.) conica* (MARSHALL), U.Cret.(Wangaloan); ×2 (183).

I. (Conotalopia) IREDALE, 1929 (**Minolia henniana* MELVILL, 1891]. With 2 spiral keels. *Rec.*, S.Pac.

I. (Parminolia) IREDALE, 1929 [**Minolia agapeta* MELVILL & STANDEN, 1896 = *Monilea apicina* GOULD, 1861]. *Rec.*, S.Pac.

I. (Umbonella) A.ADAMS, 1863 [**Turbo murreus* REEVE, 1848]. Whorls smooth; small. *Rec.*, Indo-Pac.

I. (Vanitrochus) IREDALE, 1929 [**Solariella tragema* MELVILL & STANDEN, 1869] [=*Conotrochus* PILSBRY, 1889 (*non* SCHRÖTER, 1863)]. Small, spire relatively high, with spiral ribs. *Oligo.-Rec.*, E.Indies-Austral.——FIG. 166,*1*. **I. (V.) tragema* (MELVILL & STANDEN), Rec., Loyalty Is.; ×5 (147).

I. (Waisiolia) BEETS, 1942 [**I. (W.) jucanda*]. With 2 peripheral angulations; deeply umbilicate. *U.Oligo.*, E.Indies.——FIG. 166,*5*. **I. (W.) jucanda*; ×10 (163).

Monilea SWAINSON, 1840 [**Trochus calliferus* LAMARCK, 1822] [=*Talopia* GRAY, 1842 *(nom. nud.)*]. Elevated, spirally ribbed. *Plio.-Rec.*, E. Indies-Pac.-India.

M. (Monilea). Medium-sized, inner lip thickened and recurved but not concealing umbilicus. *Plio.-Rec.*, W.Pac.-S.Pac.——FIG. 166,*12*. **M. (M.) callifera* (LAMARCK), Rec., E.Indies; *12a,b*, ×1 (147).

M. (Priotrochus) FISCHER in KIENER, 1879 [**Trochus obscurus* WOOD, 1828; SD PILSBRY, 1889] [=*Aphanotrochus* MARTENS, 1880 (obj.)]. Umbilicus closed; inner lip with denticles. *Pleist.-Rec.*, E.Afr.-India.

M. (Rossiteria) BRAZIER, 1895 [**Trochus nucleus* PHILIPPI, 1849] [*pro Solanderia* FISCHER in KIENER, 1879 (*non* DUCHASSAING & MICHELIN, 1846)]. Small, umbilicus wide, not set off by angle, spirally ribbed within; inner lip widened. *Plio.-Rec.*, E.Indies.

M. (Talopena) IREDALE, 1918 [**M. incerta*]. Small, spirally ribbed above, smoother below; umbilicus wide, bounded by smooth rib. *Rec.*, S.Pac.

Subfamily SOLARIELLINAE Powell, 1951

Conical with open umbilicus; aperture more or less circular; radula with an exceptionally small number of marginal teeth (121). *U.Cret.-Rec.*

Solariella WOOD, 1842 [**S. maculata*]. Last whorl rounded or with obsolete keel. *Mio.-Rec.*, Eu.-Atl.-IndoPac.-Arct.-E.Asia-W.Indies.

S. (Solariella). Umbilicus bounded by a beaded spiral rib. *U.Cret.-Rec.*, cosmop.——FIG. 167,*8*. **S. (S.) maculata*, Plio., Eng.; *8a,b*, ×2 (231).

S. (Bowdenagaza) WOODRING, 1928 [**Microgaza cossmanni*]. Small; aperture relatively large, ovate. *Mio.*, W.Indies.

S. (Ethaliopsis) SCHEPMAN, 1908 [**S. (E.) callomphala*]. Umbilicus partly concealed by inner lip. *Rec.*, Atl.-IndoPac.

S. (Machaeroplax) FRIELE, 1877 [**Margarita affinis* FRIELE, 1877, *ex* JEFFREYS MS]. Relatively high-spired, with well-developed spiral ribs and collabral striae. *Mio.-Rec.*, N.Am.-Atl.-Arct.-N.Pac.——FIG. 167,*5*. **S. (M.) affinis* (FRIELE), Rec., N.Atl.; ×5 (213).

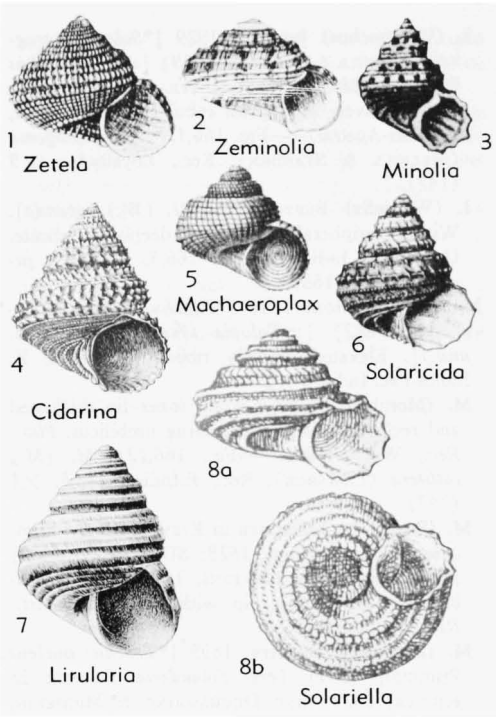


FIG. 167. Trochacea (Trochidae——Solariellinae) (p. *I*261-*I*262).

S. (Microgaza) DALL, 1881 [**M. rotella*]. Spire low, aperture subquadrate. *Rec.*, Carib.

S. (Micropiliscus) DALL, 1927 [**S. (M.) constricta*]. Initial whorls colored, not glassy. *Rec.*, SE.USA.

S. (Solaricida) DALL, 1919 [**S. (S.) hondoensis*]. Resembling *Cidarina* but with wider umbilicus. *Rec.*, Japan.——FIG. 167,*6*. **S. (S.) hondoensis*; ×1 (191).

S. (Spectamen) IREDALE, 1924 [**Trochus philippensis* WATSON, 1880]. Spire moderately high, turriculate. *Plio.-Rec.*, Austral.

S. (Suavotrochus) DALL, 1924 [**S. lubrica* DALL, 1881]. Almost or entirely smooth; in deep water. *Rec.*, W.Indies.

S. (Zetela) FINLAY, 1927 [**Minolia textilis* MURDOCH & SUTER, 1906]. Small, sculpture sharply cancellate, spiral ribs beaded on last whorl. *?Mio.-Rec.*, S.Pac.——FIG. 167,*1*. **S. (Z.) textilis* (MURDOCH & SUTER), Rec., N.Z.; ×5.

Cidarina DALL, 1909 [**Margarita cidaris* CARPENTER, 1864]. Large, resembling *Bathybembix*, with channeled suture and nodose sculpture; umbilicus nearly closed by reflected inner lip. *Pleist.-Rec.*, W.N.Am.——FIG. 167,*4*. **C. cidaris* (CARPENTER), Rec., Calif.; ×1 (230).

?Lirularia DALL, 1909 [**Margarites lirulata* CARPENTER, 1864]. Small, with strong spiral and delicate axial sculpture; peristome interrupted by last whorl; umbilicus narrower than in *Solariella*. *Pleist.-Rec.*, W.N.Am.——FIG. 167,*7*. *L. lirulata* (CARPENTER), Rec., Washington; ×3 (172).

Minolia A.ADAMS, 1860 [**M. punctata*] [=*Minosia* DUNKER, 1882 (obj.); *Minolops* IREDALE, 1929]. Resembling *Solariella* but in general larger; periostracum marked with spots and stripes of color. *U.Cret.-Rec.*, W.Pac.-N.Z.——FIG. 167,*3*. **M. punctata*, Rec., Korea; ×1 (147).

?Zeminolia FINLAY, 1927 [**Minolia plicatula* MURDOCH & SUTER, 1906]. Small, initial whorls relatively large; umbilicus wide. *Mio.-Rec.*, N.Z.——FIG. 167,*2*. **Z. plicatula* (MURDOCH & SUTER), Rec., N.Z.; ×5 (147).

Subfamily HALISTYLINAE Keen, 1958

Small, cylindrical shells, smooth or spirally striate. Radula suggesting some affinity with Umboniinae. *Pleist.-Rec.*

Halistylus DALL, 1890 [**Cantharidus (H.) columna*]. *Pleist.-Rec.*, N.Am.-S.Am.——FIG. 162,*3*. **H. columna* (DALL), Rec., Brazil; ×5 (147).

TROCHIDAE Subfamily UNCERTAIN

Kittlitrochus COSSMANN, 1909 [*pro Paratrochus* KITTL, 1899 (*non* PILSBRY, 1893)] [**Tectus? margine-nodosus* J.BÖHM, 1895] [=*Paratrochoides* TOMLIN, 1929 (obj.)]. Small, high cyrtoconoid, with high flat-sided whorls and deep sutures; narrowly phaneromphalous; faint collabral ribs on early whorls; characters of aperture unknown. *M.Trias.(Ladin.)*, S.Tyrol.

Trochodon SEELEY, 1861 [**Trochus (Trochodon) cancellatus*]. Founded on broken internal molds, showing traces of spiral ribbing, of conical gastropods with internally denticulate outer lip. *U. Cret.(Cenom.)*, Eng.

Family ATAPHRIDAE Cossmann, 1918

Small or small-medium, turbiniform or trochiform, with flat to moderately convex, smooth whorls forming usually cyrtoconoid spire with even outline; shell wall thick; base convex; anomphalous, or possibly cryptomphalous in some forms; aperture orbicular or almost so; columellar lip concave in most forms, meeting parietal lip in uninterrupted curve; callus commonly forming tubercle on columellar lip or semicircular pad partly covering base; operculum and shell structure unknown. *Trias.-U.Cret.*

Ataphrus GABB, 1869 [**A. crassus*]. Convexity of spire whorls feeble; columellar lip with broad outer face; base without median callus pad. *L.Jur.-U.Cret.(Maastricht.)*, cosmop.

A. (Ataphrus). Outer face of columellar lip smooth or with basal denticle, and not limited by a strong carina. *M. Jur. (Baj.) - U. Cret. (Maastricht.)*, cosmop.——Fig. 168,*7*. **A. (A.) acmon* (d'Orbigny), M.Jur.(Baj.), Eng.; ×1.75 (59).

A. (Endianaulax) Cossmann, 1902 [**E. planicallosum*]. Outer face of columellar lip without denticle and limited by strong carina. *L.Jur. (Lias.)-U.Jur.(Portland.)*, Eu.——Fig. 168,*5*. **A. (E.) richei* Cossmann, M.Jur.(Baj.), Eng.; ×1.75 (59).

A. (Plocostylus) Gemmellaro, 1878 [**P. typus*]. Columellar lip with conspicuous tubercle facing towards aperture. *L.Jur.(L.Lias.)*, Sicily.——Fig. 168,*4*. **A. (P.) typus*; ×2.25 (187).

Cirsostylus Cossmann, 1918 [**Trochus glandulus* Laube, 1869]. Columellar lip vertical, with distinct outer margin, and with strong fold at its lower end. *Trias.-L.Jur.(L.Lias.)*, Eu.——Fig. 168, *6*. **C. glandulus* (Laube), M.Trias.(Ladin.), S. Tyrol; ×1.5 (64).

Trochopsidea Wenz, 1938 [*pro Trochopsis* Gemmellaro, 1879 (*non* Ehrenberg, 1832)] [**Trochopsis moroi*; SD Cossmann, 1918]. Whorls more convex than in *Ataphrus;* outer face of columellar lip relatively narrow, with narrow furrow parallel to its margin but without tubercle; type species described as having 4 spiral grooves, not reaching margin, in outer wall of aperture. *L.Jur.-M.Jur. (Baj.)*, Eu.——Fig. 168,*1*. **T. paludinoides* (Hudleston), M.Jur.(Baj.), Eng.; ×2.4 (59).

Lewisiella Stoliczka, 1868 [**Pitonnellus conicus* d'Orbigny, 1853]. [=*Aulacotrochus* Cossmann, 1916]. Moderately elevated, whorls more convex than in *Ataphrus;* inner lip without denticle, but extended above as semicircular callous pad covering middle of base and circumscribed by groove. *L.Jur.*, Eu.——Fig. 168,*3*. **L. conica* (d'Orbigny), U.Lias., Fr.; ×4.5 (111).

?Parataphrus Chavan, 1954 [**Trochus viadrinus* M. Schmidt, 1905]. *Ataphrus*-like, but with spirally striated whorls and very narrow umbilicus; outer lip with outer face widening toward junction with basal lip and with furrow parallel with its margin. *U.Jur.*, Eu.——Fig. 168,*2*. **P. viadrinus* (Schmidt), Ger.; ×4 (167).

Family STOMATELLIDAE Gray, 1840

[=Stomatiidae Stoliczka, 1868]

Few-whorled, mostly low-spired shells, not umbilicate; operculum wanting in most groups; aperture large, interior of last whorl entirely visible through it from below. *Trias.-Rec.*

Mesogena (Kutassy, 1940, *nom. nud.*), Cox, n.gen.[1] [**Inoceramus arctus* Hoernes, 1855]. Rather small, auriform, with very rapidly expanding whorls and evenly convex surface, without carinae; ornament fine spiral and collabral threads, with collabral undulations in type species. *U.Trias. (Nor.)*, Eu.——Fig. 169,*7*. **M. arcta* (Hörnes), Aus.; ×3 (79).

[1] Proposed by Kutassy with citation of type species but without diagnosis and therefore a *nomen nudum*, needing validation.

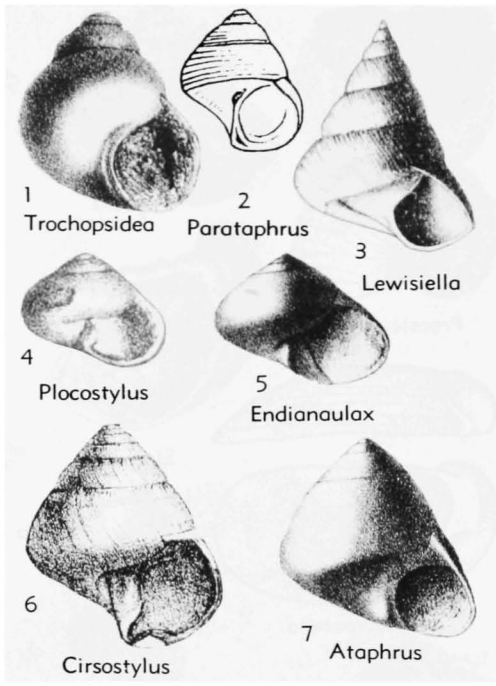


Fig. 168. Trochacea (Ataphridae) (p.*1263*).

Praestomatia (Kutassy, 1940, *nom. nud.*), Cox, n. gen.[1] [**Stomatia acutangula* Koken, 1897]. Small, with rapidly expanding whorls having flattened upper surface separated by carina from almost vertical, moderately high outer face which may carry 2 spiral angulations; ornament collabral ridges. *U.Trias.(Nor.)-U.Jur.*, Eu.——Fig. 169,*1*. **P. acutangula* (Koken), U.Trias.(Nor.), Aus.; *1a,b*, ×10 (79).

Stomatella Lamarck, 1816 [**S. auricula;* SD Anton, 1839] [=*Phymotis* Rafinesque, 1815 *(nom. nud.); Plocamotis* Fischer, 1885]. Ear-shaped, without operculum. *Rec.*, E.Indies-IndoPac.

S. (Stomatella). Surface smooth. *Plio.-Rec.*, Indo-Pac.——Fig. 169,*3*. **S. (S.) auricula*, E.Indies; *3a,b*, ×2 (213).

S. (Gena) Gray, 1850 [**Stomatella nigra* Quoy & Gaimard, 1834; SD Thiele, 1924]. Last whorl finely spirally striate. *Rec.*, IndoPac.

Broderipia Gray, 1847 [**Scutella rosea* Broderip, 1834]. Oval, limpet-shaped. *Rec.* Pac.——Fig. 169,*6*. **B. rosea* (Broderip), S.Pac.; *6a-c*, ×3 (147).

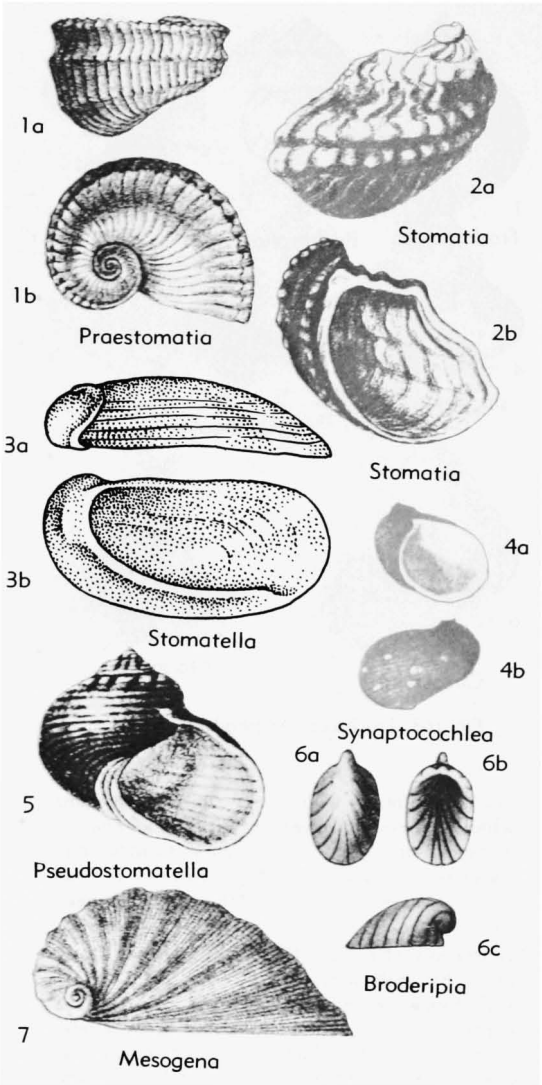


FIG. 169. Trochacea (Stomatellidae) (p. *I263-I264*).

Pseudostomatella THIELE, 1924 [**Stomatella papyracea* "CHEMNITZ," A.ADAMS (=*Turbo papyraceus* GMELIN, 1791)] [=*Stomatella (partim)* AUCTT., *non* LAMARCK, 1816]. Spire short, conical, not plicate below suture; sculpture of more or less rough spiral ribs; operculum, if present, multispiral. *Rec.*, Austral.-IndoPac.

P. (Pseudostomatella). Relatively large, spire not flattened, last whorl inflated; sculpture various. *Rec.*, IndoPac.——FIG. 169,*5*. **P. papyracea* (GMELIN), E.Indies; ×1 (147).

P. (Stomatolina) IREDALE, 1937 [**Stomatella rufescens* GRAY, 1847]. Depressed, sculpture spiral or decussate. *Rec.*, Austral.-IndoPac.

Roya IREDALE, 1912 [**R. kermadecensis*]. Resembling *Broderipia* but apex not terminal but at about 0.8 of length; muscle impression horseshoe-shaped, in 2 parts. *Oligo-Rec.*, N.Z.-IndoPac.

Stomatia HELBLING, 1779 [**S. phymotis*] [=*Stomax* MONTFORT, 1810 (obj.)]. Whorls plicate below sutures; with several spiral ribs; aperture ovate-triangular; no operculum. *Rec.*, RedSea-Pac.-E.Indies.

S. (Stomatia). Ear-shaped, oblique, spire small. *Rec.*, IndoPac.——FIG. 169,*2*. **S. (S.) phymotis*, Red Sea; *2a,b*, ×0.7 (147).

S. (Microtis) ADAMS & ADAMS, 1850 [**M. tuberculata* A.ADAMS, 1850] [*Microtina* A.ADAMS in SOWERBY, 1854 (obj.)]. Low, rather flat, with 2 tuberculate ridges; columellar margin visible within to apex of spire. *Rec.*, Pac.

S. (?Miraconcha) BERGH in SCHEPMAN, 1908 [**M. obscura*]. Shell membranous and iridescent. *Rec.*, E.Indies.

Synaptocochlea PILSBRY, 1890 [**Stomatella montrouzieri* (?=*S. stellata* SOUVERBIE, 1863)]. Spire very short, submarginal; surface spirally striate or decussate; aperture longer than wide; shell somewhat porcelaneous; operculum present. *Rec.*, S. Pac.-Carib.——FIG. 169,*4*. **S. stellata* (SOUVERBIE), N.Caledonia; *4a,b*, ×2 (147).

Family TURBINIDAE Rafinesque, 1815

[*nom. correct. et transl.* GRAY, 1824 (*ex* Turbinacea RAFINESQUE, 1815)]

Strong, solid shells, small to large, few-whorled, globose; rarely smooth but mostly with well-developed sculpture; aperture nacreous within; peristome entire in most genera, rounded, lying in one plane; columella smooth, arched; operculum calcareous, spiral, with central or eccentric nucleus (42). Mainly in warm seas. *M. Trias.-Rec.*

Subfamily ASTRAEINAE Davies, 1933

[=Astraliinae ADAMS & ADAMS, 1851]

Conical with more or less carinate periphery; base flattened; operculum most commonly oval. *M.Trias.-Rec.*

Rothpletzella J.BÖHM, 1895 [**R. richthofeni* (?=*Coelocentrus infracarinatus* KITTL, 1894)]. Depressed biconical, anomphalous, with carinate periphery; ornament opisthocline ridges crossing orthocline growth lines and ending in hollow thorns at periphery, spiral cords on base. *M.Trias., ?L.Cret.*, Eu. [Most post-Triassic species included by COSSMANN in this genus seem unrelated to the type species.]——FIG. 170,*1*. **R. richthofeni*, M. Trias.(Ladin.), S.Tyrol; ×1 (147).

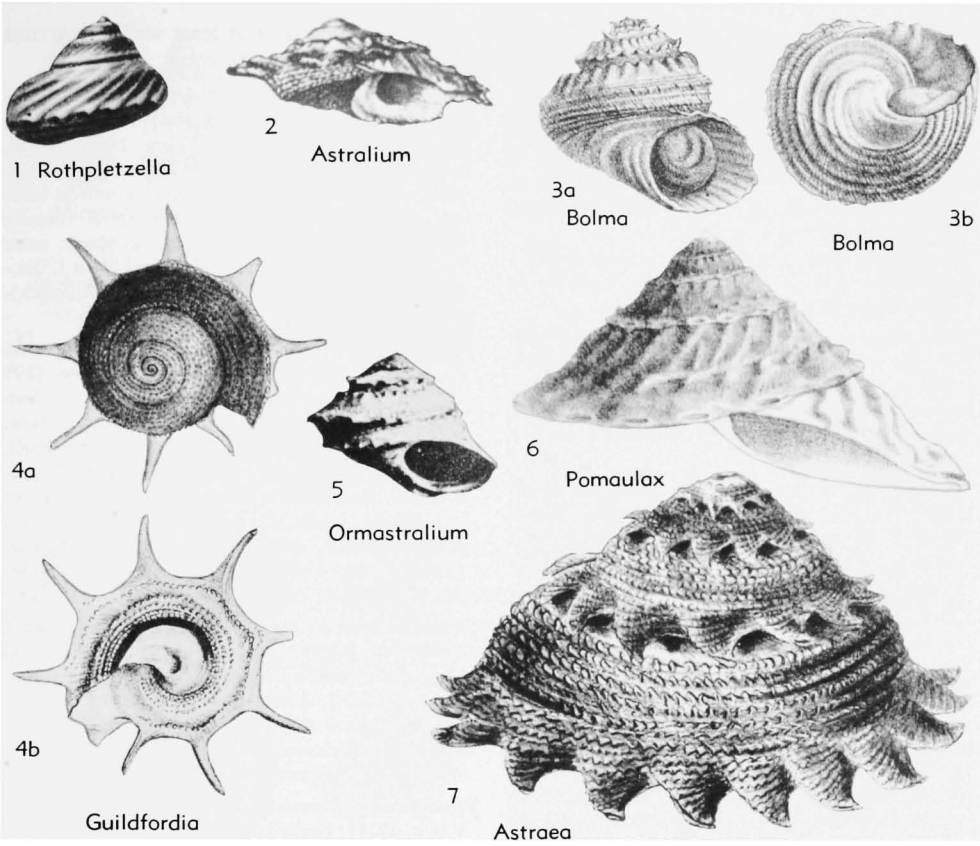


FIG. 170. Trochacea (Turbinidae——Astraeinae) (p. *I264-I266*).

Coelobolma COSSMANN, 1918 [**C. corbarica*]. Large, depressed conical, anomphalous but with median funnel-like excavation of base; ornament granose spiral cords; aperture very oblique; callosity of inner lip extending rather broadly over base. *U.Cret.(Cenom.-Senon.)*, Eu.-Asia.

Astraea RÖDING, 1798 [**Trochus imperialis* GMELIN, 1791; SD SUTER, 1913 = *T. heliotropium* MARTYN, 1784 (ICZN op. 479)] [=*Imperator* MONTFORT, 1810 (obj.); *Canthorbis* SWAINSON, 1840 (obj.); *Macropelmus* GISTEL, 1848 (obj.)]. Periphery variously ornamented with spines. *Eoc.-Rec.*, cosmop.

A. (Astraea). Widely umbilicate. *Mio.-Rec.*, Australasia.——FIG. 170,7. **A. heliotropium* (MARTYN), Rec., N.Z.; ×0.7 (147).

A. (Astralium) LINK, 1807 [**Turbo calcar* LINNÉ, 1758; SD FISCHER, 1873] [=*Calcar* MONTFORT, 1810 (obj.); *Cyclocantha* SWAINSON, 1840; *Stella* HERRMANNSEN, 1849]. Moderately large, resembling *A. (Astraea)*, but not umbilicate. *Eoc.-Rec.*, Eu.-E.Indies-W.Indies-?S.Am.——FIG. 170, *2*. **A. (A.) calcar* (LINNÉ), Rec., IndianO.; ×1 (213).

A. (Bellastraea) IREDALE, 1924 [**B. kesteveni*]. Stellate, umbilicate, rather small. *Plio.-Rec.*, Austral.

A. (Bolma) RISSO, 1826 [**Turbo rugosus* LINNÉ, 1767] [=*Oobolma* SACCO, 1896]. More turbinate than *A. (Astraea)*, not umbilicate, with noded sutures; operculum with spiral ribs. *Mio.-Rec.*, Eu.-W.Afr.-IndoPac.——FIG. 170,*3*. **A. (B.) rugosa* (LINNÉ), Rec., Medit.; *3a,b*, ×0.7 (147).

A. (Cookia) LESSON, 1832 [**Trochus sulcatus* GMELIN, 1791 (ICZN op. 479)] [=*Tubicanthus* SWAINSON, 1840 (obj.)]. Whorls somewhat inflated, with axial folds above periphery; operculum with 2 ribs. *Rec.*, Australasia.

A. (Distellifer) IREDALE, 1937 [**D. wallisi*]. High-conical, with double row of spinose tubercles at periphery; no umbilicus. *Rec.*, Austral.

A. (Incilaster) FINLAY, 1927 [**Turbo marshalli* THOMPSON, 1907]. Whorls nodose-keeled above suture; not umbilicate. *Eoc.*, Australasia.

A. (Lithopoma) GRAY, 1850 [**Trochus tuber* LINNÉ, 1767] [=*Pachypoma* GRAY, 1850]. Periphery more rounded than in *A. (Astraea)*, sculpture subdued; no umbilicus; operculum with submarginal nucleus, with or without spiral rib, surface coarsely granulose. *Mio.-Rec.*, Carib.

A. (Micrastraea) COTTON, 1939 [**Trochus aureus* JONAS, 1844]. Like *A. (Astralium)* but smaller, more depressed. *Rec.*, Austral.

A. (Opella) FINLAY, 1927 [**A. subfimbriata* SUTER, 1917]. Like *A. (Bellastraea)* but with higher spire. *Oligo.-Mio.*, N.Z.

A. (Ormastralium) SACCO, 1896 [**Trochus fimbriatus* BORSON, 1821] [=*Tylastralium* SACCO, 1896]. Whorls with 2 keels armed with blunt spines; operculum convex, smooth. *Mio.-Plio.*, Eu.——FIG. 170,*5*. **A. (O.) fimbriata* (BORSON), Plio., Italy; ×1 (147).

A. (Pagocalcar) IREDALE, 1937 [**Trochus limbiferus* KIENER, 1850]. Periphery a wavy flange; whorls disjunct, adult pagodoid in form. *Rec.*, Austral.

A. (Pomaulax), GRAY, 1850 [**Trochus japonicus* DUNKER, 1845; SD FISCHER, 1873] [=*Pachypoma* AUCTT.; *non Pomaulax* AUCTT.]. Moderately large, solid, with coarsely granular axial sculpture; operculum ovate, convex, with terminal nucleus. *Mio.-Rec.*, W.N.Am.-Japan.——FIG. 170, *6*. **A. (P.) japonicus* (DUNKER), Rec., Japan; ×0.7 (179).

A. (Rugastella) IREDALE, 1937 [**Trochus rotularius* LAMARCK, 1822]. Like *A. (Astralium)* but periphery with puckered transverse bars. *Rec.*, Austral.

A. (Uvanilla) GRAY, 1850 [**Trochus unguis* WOOD, 1828; SD FISCHER, 1873] [=*Pomaulax* AUCTT. *non* GRAY]. Moderate-sized to large, sculptured with granular axial folds; operculum ovate, nucleus nearly terminal, outer face with 2 to 3 strong curved ribs. *Mio.-Rec.*, Eu.-E.Indies-W.N.Am.-C.Am.

Guildfordia GRAY, 1850 [**Astralium triumphans* PHILIPPI, 1841; SD FISCHER, 1873]. Depressed, periphery with spines; umbilicus covered in part. *Plio.-Rec.*, IndoPac.-E.Asia.

G. (Guildfordia). Peripheral spines long, recurved, widely spaced; operculum smooth. *Plio.-Rec.*, E.Indies-Japan.——FIG. 170,*4*. **G. triumphans* (PHILIPPI), Rec., Japan; ×0.7 (147).

G. (Pseudastralium) SCHEPMAN, 1908 [**Astralium (P.) abyssorum*]. Like *G. (Guildfordia)* but peripheral spines short and more numerous; operculum granular. *Rec.*, IndoPac.

Subfamily LIOTIINAE Adams & Adams, 1854

Relatively small, with both axial and spiral sculpture; spire low to flattened; operculum chitinous within but with outer surface calcareous or at least with calcareous granules; aperture nacreous. *Trias.-Rec.*

Eucycloscala COSSMANN, 1895 [**Trochus binodosus* MÜNSTER, 1841; SD Cox, herein] [=*Trochoscala* KOKEN, 1897; *Urceolabrum* WADE, 1917]. Small, ovate-conical, anomphalous or phaneromphalous, with moderately high spire of convex whorls bearing collabral ribs crossed by few spiral threads; aperture suborbicular, peristome continuous; outer lip varicose. *M.Trias.(Ladin.)-U.Cret.(Dan.)*, Eu.-N.Am.——FIG. 171,*10*. **E. binodosa* (MÜNSTER), M.Trias.(Ladin.), S.Tyrol; ×2.5 (89).

?Microcheilus KITTL, 1894 [**Cochlearia brauni* KLIPSTEIN, 1845] [=*Microchilus* COSSMANN, 1895 (obj.); *Pseudocochlearia* COSSMANN, 1895 (*pro Microcheilus* KITTL, *non Microchilus* BLANCHARD, 1851); *Pseudocochlearella* WENZ, 1944]. Small, turriculate, with high cyrtoconoid spire of subangular, peripherally costate whorls; coiling of last whorl irregular; aperture orbicular, with much-thickened, continuous peristome. *M.Trias. (Ladin.)*, Eu.——FIG. 171,*1*. **M. brauni* (KLIPSTEIN), S.Tyrol; *1a,b*, ×3.75 (64).

Scaevola GEMMELLARO, 1879 [**S. intermedia;* SD COSSMANN, 1918]. Sinistral, turbiniform, phaneromphalous; whorls strongly convex, last one somewhat expanded; ornament well separated collabral ribs and spiral threads; aperture orbicular, with continuous thickened peristome. *L.Jur.*, Sicily.——FIG. 171,*8*. **S. intermedia;* ×1 (147).

Pseudoliotina COSSMANN, 1925 [**Liotia sensuyi* VIDAL, 1921]. Discoidal, upper face flat; outer face limited by 2 nodose carinae, 3rd carina forming umbilical margin; aperture orbicular, not oblique, with much thickened peristome. *U.Cret. (Maastricht.)*, Eu.——FIG. 171,*6*. **P. sensuyi; 6a,b*, ×2 (18).

Liotia GRAY, 1847 [**Delphinula cancellata* GRAY, 1828]. Axial and spiral ribs well developed, forming latticed surface; umbilicus funnel-shaped, bounded by beaded cord; operculum concave, of many narrow whorls. *Mio.-Rec.*, E.Indies-W.Indies-N.Am.-S.Am.——FIG. 171,*3*. **L. cancellata* (GRAY), Rec., Chile; ×3 (213).

Arene ADAMS & ADAMS, 1854 [**Turbo cruentatus* MÜHLFELD, 1824; SD WOODRING, 1928]. With several spiral cords or carinae, smooth or with vaulted scales; remainder of surface finely beaded. *Mio.-Rec.*, N.Am.

A. (Arene). With spiral funicular cord in umbilicus and low varix at outer lip; spire moderately elevated. *Mio.-Rec.*, W.Indies-W.N.Am.——FIG. 171,*5*. **A. cruentata* (MÜHLFELD), Rec., W. Indies; ×2 (147).

A. (Marevalvata) OLSSON & HARBISON, 1953 [**Architectonica tricarinata* STEARNS, 1872]. Lacking spiral funicular cord; peristome not thickened, spire low. *Plio.-Rec.*, Fla.-W.Indies.

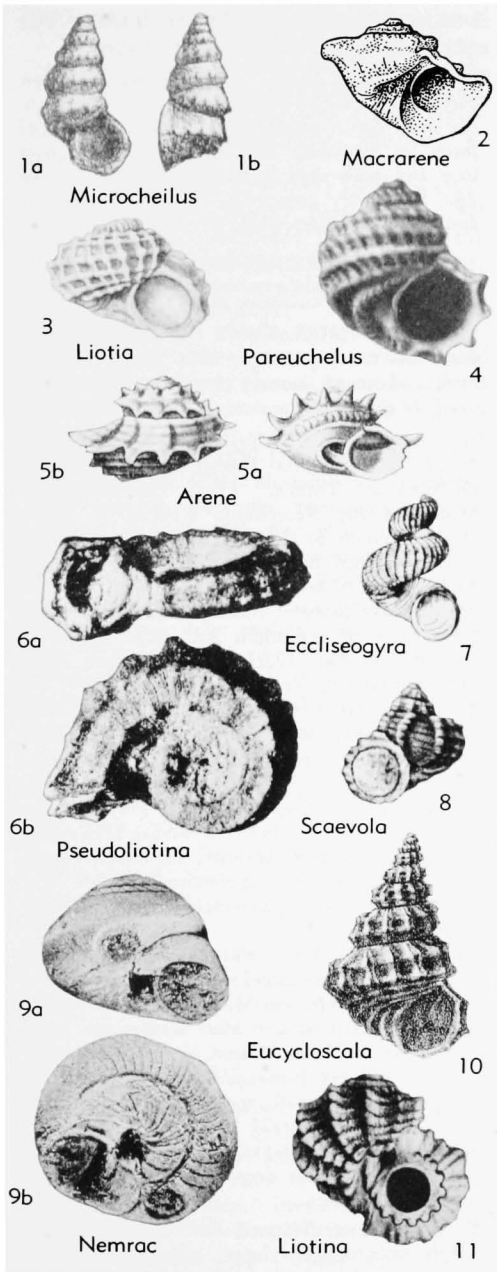


FIG. 171. Trochacea (Turbinidae——Liotiinae) (p. *I266-I267*).

Eccliseogyra DALL, 1892 [**Delphinula nitida* VERRILL, 1885]. Small, iridescent, whorls disjunct, with both axial and spiral riblets. *Rec.*, E.N.Am.——FIG. 171,*7*. **E. nitida* (VERRILL), Rec., off Md.; ×5 (172).

Ilaira ADAMS & ADAMS, 1854 [**Delphinula evoluta* REEVE, 1843] [=*Liotiaxis* IREDALE, 1936]. Depressed, openly umbilicate, with 4 tuberculate carinae. *Rec.*, E.Indies-Austral-?Atl.

Liotina FISCHER, 1885 [**Delphinula gervillei* DEFRANCE, 1818; SD COSSMANN, 1888]. Relatively large, with well-developed lip varix; umbilicus bordered by rib, pitted outside, spiral ridge within; operculum with calcareous layer, tesselated, edges bristly. *Eoc.-Rec.*, Eu.-Afr.-IndoPac.-Austral.

L. (Liotina). Axial sculpture present throughout, inner lip rounded. *Eoc.-Rec.*, Eu.-N.Afr.-E.Afr.-IndoPac.-Australasia.——FIG. 171,*11*. **L. gervillei* (DEFRANCE), M.Eoc., Fr.; ×2 (147).

L. (Austroliotia) COTTON, 1948 [**Liotia botanica* HEDLEY, 1915]. Low, sculpture latticed as in *Liotia;* umbilicus wide; operculum with faint calcareous granules. *Rec.*, Australasia.

L. (Dentarene) IREDALE, 1929 [**D. sarcina; pro Delphinula crenata* KIENER, 1839 (*non* SOWERBY, 1833)]. Axial sculpture partly obsolete or interrupted; umbilical ridge running into a twisted appendage of inner lip. *Rec.*, E.Indies-Austral.

L. (Globarene) IREDALE, 1929 [**Delphinula cidaris* REEVE, 1843]. Umbilicus small. *Rec.*, E. Indies.

L. (Liotinaria) HABE, 1955 [**Liotia solidula* GOULD, 1859]. Umbilicus narrow and deep, with pitted surface. *Rec.*, Japan.

Macrarene HERTLEIN & STRONG, 1951 [**Liotia californica* DALL, 1908]. Large for family, depressed-turbinate, periphery rounded-stellate. *Rec.*, W.N.Am.——FIG. 171,*2*. **M. californica* (DALL), Rec., W.Mex.; ×1 (223).

?Nemrac CLARK & DURHAM, 1946 [**N. carmenensis*]. Smooth except for beaded sutural band and axial grooves on base; with wide umbilical ridge crossed by grooves. *Eoc.*, S.Am.——FIG. 171,*9*. **N. carmenensis,* Eoc., Colombia; ×5 (169).

Pareuchelus BOETTGER, 1907 [**Euchelus (P.) excellens*]. With several spiral ribs latticed by axial sculpture; basal margin of aperture forming angle above last spiral keel. *Eoc.-Plio.*, Eu.-E.Indies.——FIG. 171,*4*. **P. excellens* (BOETTGER), M.Mio., Hung.; ×10 (147).

Subfamily HELICOCRYPTINAE Cox, n. subfam.

Small, smooth, lenticular, involute shells with narrow apical and very narrow basal umbilici; corner of aperture filled with callus, rendering peristome continuous and almost orbicular. Operculum unknown. *M. Jur.(Bathon.)-L.Cret.(Alb.).*

Helicocryptus D'ORBIGNY, 1850 [**Helix pusilla* ROEMER, 1836 (*non* VALLOT, 1801) (=**Rotella dubia* BUVIGNIER, 1852); SD COSSMANN, 1918] [=*Heliocryptus* WENZ, 1938 (erroneously attributed to D'ORBIGNY, 1850) (obj.)]. Characters of subfamily. Eu.——FIG. 172,*1*. **H. dubius* (BUVIGNIER), U.Jur.(Raurac.), Switz.; *1a,b,* ×4 (96).

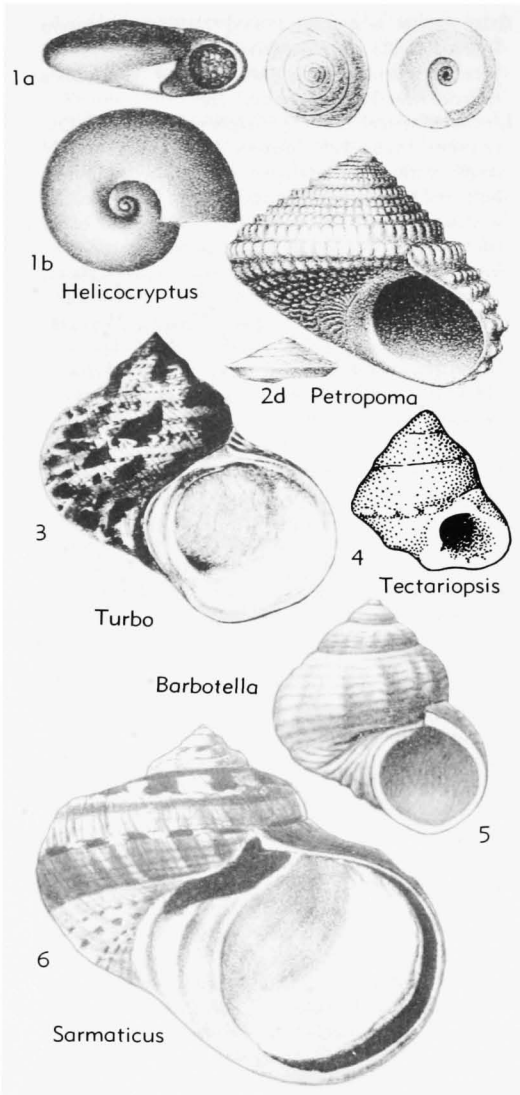


FIG. 172. Trochacea (Turbinidae——Helicocryptinae, Petropominae, Turbininae) (p. *I167-I269*).

Subfamily PETROPOMINAE Cox, n. subfam.

Low turbiniform, anomphalous; peristome discontinuous, parietal lip passing under strongly prosocline outer lip; operculum with low, conical, visibly spiral outer face and narrowly umbilicate inner face. *L.Cret. (Alb.)*.

The calcareous operculum shows that this subfamily should be included in the Turbinidae, although the interrupted peristome is more suggestive of the Trochidae. The operculum itself is of a unique type.

Petropoma GABB, 1877 [**P. peruanum*]. With low coeloconoid spire of flattened whorls bearing granose spiral cords, present also on base; callosity of inner lip extending for moderate distance over base and with distinct margin. Eu., S.Am.—— FIG. 172,*2*. **P. peruanum*, Peru; *2a-d*, aperture and 3 views of operculum, all ×4 (188).

Subfamily TURBININAE Rafinesque, 1815
[*nom. correct.* ADAMS & ADAMS, 1851 (*pro* Turbinacea RAFINESQUE, 1815)]

Generally large shells, whorls rounded, base convex; aperture round; operculum thick and heavy, nearly circular, convex outward. *U.Cret.-Rec.*

Turbo LINNÉ, 1758 [**T. petholatus;* SD MONTFORT, 1810] [=*Laeviturbo* COSSMANN, 1918 (obj.); *Bothropoma* THIELE, 1924; *Amphiboliturbo* MAGNE, 1940; *Neocollonia* KURODA & HABE, 1954]. Smooth to strongly sculptured; inner lip mostly widened or callused. *U.Cret.-Rec.*, Eu.-E. Asia-IndoPac.-N.Am.-C.Am.-Austral.-Afr.

T. (Turbo). Smooth, rounded, last whorl large; inner face of operculum flat. *Oligo.-Rec.*, Eu.-IndoPac.——FIG. 172,*3*. **T. petholatus*, Rec., Philippines; ×0.7 (147).

T. .Barbotella) COSSMANN, 1918 [**T. hoernesi* BARBOT, 1869]. With irregular radial ribs. *Mio.*, Eu.——FIG. 172,*5*. **T. (B.) hoernesi*, Sarmatian, Caucasus; ×1 (147).

T. (Batillus) SCHUMACHER, 1817 [**T. cornutus* GMELIN, 1791] [=*Angarina* BAYLE, 1878 (obj.) (*pro Delphinulopsis* WRIGHT, 1878, *non* LAUBE, 1870)]. Last whorl most commonly with 2 series of hollow spines; spiral marginal rib on operculum. *Rec.* Japan.

T. (Callopoma) GRAY, 1850 [**T. fluctuosus* WOOD, 1828]. Moderately large, with strong often noded spiral ribs; operculum with heavy spiral rib at center bordered by 2 or more weaker ribs. *Mio.-Rec.*, E.Indies-N.Am.-C.Am.

T. (Carswellena) IREDALE, 1931 [**T. exquisitus* ANGAS, 1877]. Small, with a few noded spiral ribs, operculum spirally bordered. *Rec.*, Austral.

T. (Dentallopoma) BEETS, 1942 [**T. (D.) denticolumellaris*]. With deep furrow on columella. *Neogene*, E.Indies.

T. (Dinassovica) IREDALE, 1937 [**D. verconis*]. Shell smooth, very large, globose; operculum oval, inner side elevated. *Rec.*, S.Austral.

T. (Euninella) COTTON, 1939 [**T. gruneri* PHILIPPI, 1846]. Spirally striate, anomphalous, operculum smooth. *Mio.-Rec.*, Austral.

T. (Halopsephus) REHDER, 1943 [**H. pulcher* (*non Turbo pulcher* DILLWYN, 1817) = *T. (H.) haraldi* ROBERTSON, 1958]. Small, smooth, operculum convex, sculptured with axial riblets. *Rec.*, Carib.

T. (Lunatica) RÖDING, 1798 [**T. olearius* LINNÉ, 1758 (=*T. marmoratus* LINNÉ, 1758); SD HERRMANNSEN, 1847] [=*Olearia* HERRMANNSEN, 1847, *ex* KLEIN, 1753]. Very large, heavy, spiral ribs few; umbilicate; pillar with a basal expansion; operculum semi-granular. *Plio.-Rec.*, E. Indies-Japan.

T. (Lunella) RÖDING, 1798 [**T. versicolor* GMELIN, 1791 (=*T. cinereus* BORN, 1778); SD FISCHER, 1873] [=*Ocana* H.ADAMS, 1861 (obj.)]. Whorls rounded to slightly carinate; pillar with basal lobe; operculum slightly granular. *Mio.-Rec.*, circumtropic.

T. (Marmarostoma) SWAINSON, 1829 [**T. chrysostomus* LINNÉ, 1758] [=*Marmorostoma* GRAY, 1850 (spelling error); *Senectus* SWAINSON, 1840]. With spiral ribs; operculum smooth to granular. *Mio.-Rec.*, Eu.-IndoPac.

T. (Modelia) GRAY, 1850 [**T. granosus* MARTYN, 1784 (ICZN op. 479)]. Medium-sized, sculptured with granular spiral ribs; operculum granular with smooth border. *Mio.-Rec.*, N.Z.

T. (Ninella) GRAY, 1850 [**T. torquatus* GMELIN, 1791; SD FISCHER, 1873]. Depressed, whorls lirate, rounded to carinate; operculum oval, nucleus eccentric, outer surface concave in center with 2 strong spiral ribs, outer margin thin, granulate. *Eoc.-Rec.*, Eu.-C.Am.-IndoPac.-Austral.

T. (Sarmaticus) GRAY, 1847 [**T. sarmaticus* LINNÉ, 1758] [=*Cidaris* SWAINSON, 1840 (*non* LESKE, 1778)]. Large, smooth, depressed; operculum tuberculate. *U.Cret.(Campan.)-Rec.*, Eu.-N.Afr.-S.Afr.——FIG. 172,*6*. **T. (S.) sarmaticus*, Rec., S.Afr.; ×0.7 (147).

T. (Sarmaturbo) POWELL, 1938 [**T. superbus* ZITTEL, 1864]. Near *T. (Sarmaticus)* but with operculum spirally sculptured on inner face. *U. Oligo.*, N.Z.

T. (Subninella) THIELE, 1929 [**T. undulatus* "MARTYN, 1784" (non binominal) = *T. undulatus* GMELIN, 1791]. Moderately large, globose, with fine spiral ribs; umbilicate; operculum strongly convex in middle, with thin outer margin set off by ledge. *Rec.*, Australasia.

T. (Taeniaturbo) WOODRING, 1928 [**T. canaliculatus* HERMANN, 1781]. Moderately large, whorls rounded to subangular, sculptured with closely spaced spiral cords more or less beaded; not umbilicate; operculum irregularly thickened, weakly granular. *Mio.-Rec.*, W.Indies.

?Prisogaster MÖRCH, 1850 [**Turbo niger* WOOD, 1828; SD FISCHER, 1873] [=*Amyxa* TROSCHEL, 1852 (obj.)]. Of medium size, low-spired; smooth or with spiral ribs; aperture rounded, nacreous within; inner lip wide; operculum with a marginal furrow, nucleus eccentric. *Rec.*, Pac.——FIG. 178,*6*. **P. niger* (WOOD), Rec., Chile; ×1 (147).

?Tectariopsis COSSMANN, 1888 [**Turbo henrici* CAILLAT, 1835]. Small, with noded and angulate periphery; aperture with lobed anterior expansion, bordered by several small nodes; umbilicus partly concealed by inner lip. *Eoc.*, Eu.——FIG. 172,*4*. **T. henrici* (CAILLAT), Eoc., Fr.; ×1.5 (147).

Subfamily COLLONIINAE Cossmann, 1916

[*nom. transl.* KEEN, herein (*ex* Colloniidae COSSMANN, 1916)]

Small, not nacreous; turbinate to lenticular; operculum normally paucispiral. *U. Cret.-Plio.*

Collonia GRAY, 1850 [**Delphinula marginata* LAMARCK, 1804; SD COSSMANN, 1888]. Sturdy, nearly smooth, inflated, umbilicate; outer lip thickened, peristome mostly entire; operculum with a central pit. *U.Cret.-Plio.*, Eu.-N.Am.

C. (Collonia). Umbilicus bounded by granular spiral cord. *Paleoc.-Plio.*, Eu.-N.Am.-Austral.——FIG. 173,*5*. **C. (C.) marginata* (LAMARCK), Eoc., Fr.; *5a,b*, ×2 (147).

C. (Bonnetella) COSSMANN, 1908 [**Bonnetia planispira* COSSMANN, 1907] [=*Bonnetia* COSSMANN, 1907 (*non* ROBINEAU-DESVOIDY, 1830)]. Minute, lenticular, few-whorled. *Eoc.-Oligo.*, Eu.

C. (Circulopsis) COSSMANN, 1902 [**C. (C.) megalomphalus*]. Depressed, base rounded into umbilicus. *U.Cret.(Dan.)-Mio.*, Eu.

C. (Heniastoma) COSSMANN, 1918 [**C. (H.) flammulata* COSSMANN, 1888]. Spire moderately high; umbilicus bounded by a sharp ridge. *Paleoc.-Mio.*, Eu.

C. (Parvirota) COSSMANN, 1902 [**Turbo rotatorius* DESHAYES, 1863]. Spire flattened; umbilicus set off by a ridge; sculpture axial. *Paleoc.-Plio.*, Eu.-N.Am.——FIG. 173,*7*. **C. (P.) rotatoria* (DESHAYES), U.Eoc., Fr.; *7a,b*, ×5 (147).

Coanollonia WOODRING, 1928 [**C. ambla*]. Depressed, sculpture both axial and radial; peristome incomplete. *Mio.*, W.Indies.——FIG. 173,*8*. **C. ambla*, Mio., Jamaica; ×5 (147).

Cyniscella COSSMANN, 1888 [**Cyclostoma cornupastoris* LAMARCK, 1804]. Minute; with spiral grooves; umbilicus bounded by nodose ridge. *Paleoc.-Oligo.*, Eu.——FIG. 173,*3*. **C. cornupastoris* (LAMARCK), Eoc., Fr.; *3a,b*, ×10 (147).

Gelasinostoma GARDNER, 1947 [**Collonia elegantula* DALL, 1892]. Depressed, few-whorled; umbilical pit minute, bordered by a rib. *?Eoc., Mio.-Plio.*, E.N.Am.——FIG. 173,*1*. **G. elegantulum* (DALL), Mio., Fla.; × (186).

Otollonia WOODRING, 1928 [**Liotia siderea* GUPPY, 1896]. Sculpture of fine, beaded spiral ribs. *Mio.*, W.Indies.——FIG. 173,*6*. **O. siderea* (GUPPY), Mio., Jamaica; *6a,b*, ×5 (147).

Otomphalus COSSMANN, 1902 [**O. dumasi*]. With 2 spiral carinae above and at periphery; umbilicus bordered by another carina. *Eoc.*, Eu.——FIG. 173, *4*. **O. dumasi*, Eoc., Fr.; *4a,b*, ×3 (147).

Pseudonina SACCO, 1896 [**Delphinula bellardii* MICHELOTTI, 1847]. Resembling *Otomphalus* but more conical, with carinae at and below periphery.

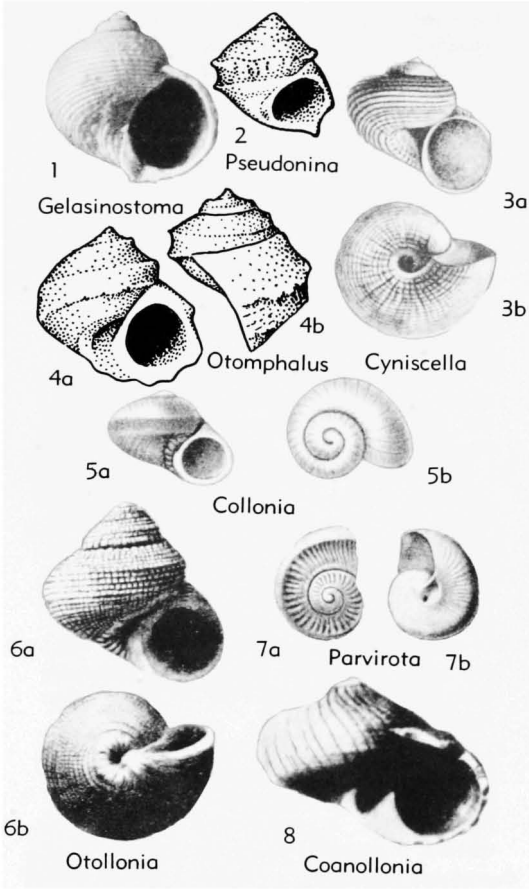


FIG. 173. Trochacea (Turbinidae——Colloniinae) (p. *I*269).

Mio.-Plio., Eu.——FIG. 173,*2*. **P. bellardii* (MICHELOTTI), Mio., Italy; ×3 (147).

Subfamily HOMALOPOMATINAE Keen, n. subfam.

Small shells; axial sculpture reduced or absent, spiral sculpture well developed. *Paleoc.-Rec.*

Homalopoma CARPENTER, 1864 [**Turbo sanguineus* LINNÉ, 1758] [=*Leptonyx* CARPENTER, 1864 (*non* SWAINSON, 1833)]. Umbilicus wanting or small; operculum with horny and shelly layers, multispiral. *Paleoc.-Rec.*, cosmop.

H. (Homalopoma). With strong spiral grooves; height equal to diameter. *Paleoc.-Rec.*, Eu.-N. Afr.-N.Am.-S.Am.——FIG. 174,*9*. **H. sanguineum* (LINNÉ), Rec., Medit.; *9a,b*, ×1.5 (147).

H. (Argalista) IREDALE, 1915 [**Cyclostrema fluctuatum* HUTTON, 1883]. Minute, depressed-globose, spirally striate, deeply umbilicate; peritreme interrupted. *Oligo.-Rec.*, Australasia.

H. (Boutillieria) COSSMANN, 1888 [**Turbo eugeni* DESHAYES, 1863] [=*Otaulax* COSSMANN, 1888]. With a small umbilicus; aperture expanded anteriorly. *L.Cret.(Apt.)-Oligo.*, Eu.-N.Afr.——FIG. 174,*3*. **H. (B.) eugeni* (DESHAYES), Eoc., Fr.; ×3 (147).

H. (Cantrainea) JEFFREYS, 1883 [**Turbo peloritanus* CANTRAINE, 1835] [=*Cantraineia*, FISCHER, 1885 (obj.)]. Relatively high-spired; umbilicus covered by columellar callus. *Mio.-Rec.*, Eu.

H. (Collonista) IREDALE, 1918 [**Collonia picta* PEASE, 1868]. Slightly umbilicate, outer lip thin, inner with small callus. *Rec.*, Pac.

H. (Eutinochilus) COSSMANN, 1918 [**Collonia miliaris* COSSMANN, 1892] [*pro Homalochilus* COSSMANN, 1892 (*non* FISCHER, 1856)]. Minute, without umbilicus; suture channeled. *Eoc.*, Eu.-N.Am.

H. (Leptothyropsis) WOODRING, 1928 [**Leptothyra philipiana* DALL, 1889]. Low-spired, umbilicus wide; peristome interrupted. *Mio.-Rec.*, W.Indies.

H. (Phanerolepida) DALL, 1907 [**Turbo transenna* WATSON, 1879]. Surface granulate, granules arranged in oblique rows. *Mio.-Rec.*, Japan.

Anadema ADAMS & ADAMS, 1854 [**Omphalius caelata* A.ADAMS, 1854]. Ovate-conical, with nodose spiral ribs and deep narrow umbilicus. *Rec.*, N.W. Afr.

Charisma HEDLEY, 1915 [**C. compacta*]. Minute, broadly conical, base rounded; umbilicus deep and wide; sculpture finely striate. *Rec.*, Austral.

C. (Charisma). Umbilicus set off by angle. *Rec.*, Austral.

C. (Cavostella) LASERON, 1954 [**C. radians*]. Umbilicus bounded by serrate ridge. *Rec.*, Austral.

C. (Cavotera) LASERON, 1954 [**C. simplex*]. Depressed, umbilical ridge weak. *Rec.*, Austral.

Cirsochilus COSSMANN, 1888 [**Delphinula striata* LAMARCK, 1804]. Spirally carinate, base with fine spiral cords; umbilicus deep, set off by ridge. *M. Jur.-Plio., ?Rec.*, Eu.-N.Am.-S.Am.

C. (Cirsochilus). Apical angle uniform; aperture ovate, varix behind outer lip. *M.Jur.(Baj.)-Plio., ?Rec.*, Eu.-E.Indies-W.Indies-S.Am.——FIG. 174, *5*. **C. striatum* (LAMARCK), Eoc., Fr.; *5a,b*, ×3 (147).

C. (Claibornia) PALMER, 1937 [**Turbo lineata* LEA, 1933]. Spire more acute in juvenile shells; aperture rounded, without varix behind lip. *Eoc.*, SE.USA.——FIG. 174,*2*. **C. (C.) lineatum* (LEA), Eoc., Ala., ×4 (209).

Leptocollonia POWELL, 1951 [**L. thielei*] [=*?Cynisca* ADAMS & ADAMS, 1854 (*non* GRAY, 1844)]. Like *Homalopoma* but umbilicate, thin, colorless, operculum concave and spirally channeled. *Rec.*, S.Atl.-?S.Afr.——FIG. 174,*8*. **L. thielei*, Rec., S. Georgia I.; ×5 (121).

Leptothyra PEASE, 1869 [**L. costata*]. Whorls angulate, axially ribbed, spirally striate; with a narrow umbilicus. *Rec.*, Hawaii.

Moelleria JEFFREYS, 1865 [**Margarita costulata* MÖLLER, 1842]. Depressed, widely umbilicate; spiral cords fine, stronger below. *Plio.-Rec.*, Eu.-N.Am. ——FIG. 174,*4*. **M. costulata* (MÖLLER), Rec., Norway; *4a,b*, ×10 (147).

?**Rangimata** MARWICK, 1928 [**R. pervia*]. Minute, depressed; umbilicus semilunar, notching inner lip. *Mio.*, S.Pac.——FIG. 174,*7*. **R. pervia*, Mio., Chatham I.; ×10 (147).

?**Tipua** MARWICK, 1943 [**Submargarita tricincta* MARSHALL, 1919]. Low-spired, with 3 weak carinae on body whorl. *M.Eoc.(Bortonian)*, N.Z.——FIG. 174,*6*. **T. tricincta* (MARSHALL), Eoc., N.Z.; ×3 (204).

Vexinia COSSMANN, 1918 [**Delphinula crassa* BAUDON, 1853]. Globose, with small umbilicus; inner lip expanded anteriorly. *Eoc.*, Eu.——FIG. 174,*1*. **V. crassa* (BAUDON), Eoc., Fr.; ×3 (147).

Subfamily UNCERTAIN

Pleuratella MOORE, 1867 [**P. prima*]. Rather small, rotelliform, phaneromphalous, smooth; spire depressed; columellar lip with outer face expanded to left and concave below, where it appears to extend to margin of a false umbilicus. [Aperture unknown intact in type species, but preserved in *P. brachyura* GEMMELLARO from Sicily. Not referable to Ataphridae.] *L.Jur.(L.Lias.)*, Eng.-Sicily.

Pterocheilos MOORE, 1867 [**P. primus*] [=*Tinochilus* FISCHER, 1885 (obj.); *Mooria* COSSMANN, 1899 (obj.)]. Small, biconical, anomphalous, smooth, with almost flattened spire whorls and carinate periphery; base extended, with obscure angulation around median part; aperture circular, reduced by expanded inner lip, which is also extended below as prominent angular projection. *L.Jur.(L.Lias.)*, Eng.——FIG. 175,*1*. **P. primus; 1a,b*, ×5 (205).

Turboidea SEELEY, 1861 [**T. nodosa*]. Founded on ill-preserved specimen of medium size, turbiniform in shape and phaneromphalous, with large tubercles on last whorl. *U.Cret.(Cenom.)*, Eng.

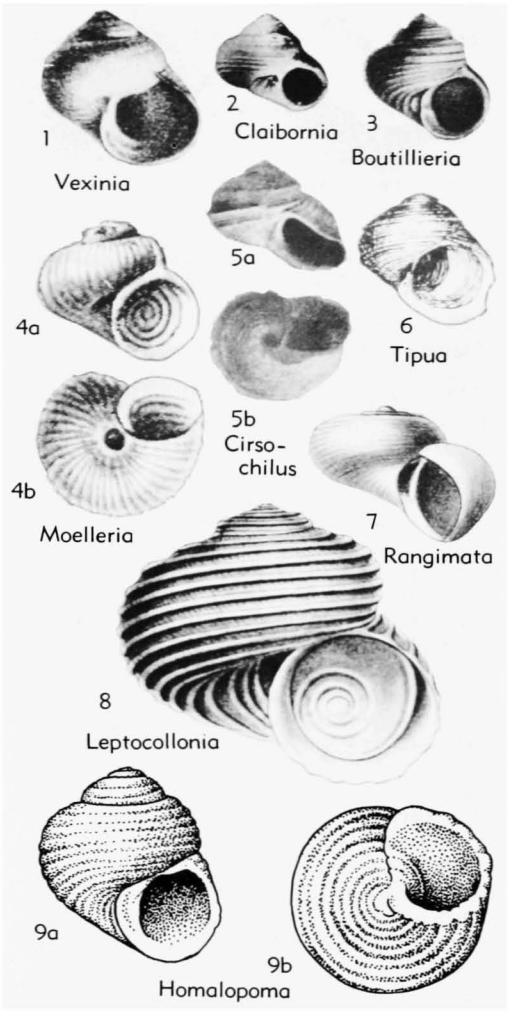


FIG. 174. Trochacea (Turbinidae——Homalopomatinae) (p. *I*270-*I*271).

Family CYCLOSTREMATIDAE Fischer, 1885

Small to minute, turbinate to lenticular, mostly widely umbilicate, smooth to strongly sculptured, porcelaneous. *U.Jur.-Rec.*

Subfamily SKENEINAE Thiele, 1929

[=Delphinoideinae THIELE, 1924]

Small, sculpture weak or wanting; radula with 4-5 marginal teeth. *U.Jur.-Rec.*

Teinostomopsis CHAVAN, 1954 [**T. saharae*]. Rotelliform, smooth, anomphalous; inner lip strongly concave, with obtuse denticle at lower end and broad outer face limited by a carina. *U.Jur.(Raurac.)*, Eu.——FIG. 176,*15*. **T. saharae*, Fr.; ×4 (167).

Cenomanella COSSMANN, 1918 [**Rotella archiaciana* D'ORBIGNY, 1843]. Low turbiniform, anomphalous, of evenly convex, spirally striated whorls with deeply canaliculate suture; base callus-coated in middle. *U.Cret.(Cenom.-L.Senon.)*, Eu.——FIG. 176,*11*. **C. archiaciana* (D'ORBIGNY), U.Cret. (Cenom.), Fr.; ×4 (110).

Skenea FLEMING, 1825 [**Helix serpuloides* MONTAGU, 1808; SD GRAY, 1847] [=*Delphinoidea* BROWN, 1827 (obj.); *Delphionoidea* BROWN, 1844 (obj.)]. Depressed, whorls rounded, smooth to spirally striate. *Pleist.-Rec.*, Eu.-N.Am.-Japan.——FIG. 176,*7*. **S. serpuloides* (MONTAGU), Rec., Eng.; ×10 (147).

Cirsonella ANGAS, 1877 [**C. australis*]. Spire somewhat elevated. *Mio.-Rec.*, S.Pac.——FIG. 176,*17*. **C. australis*, Rec., Austral.; *17a,b*, ×10 (147).

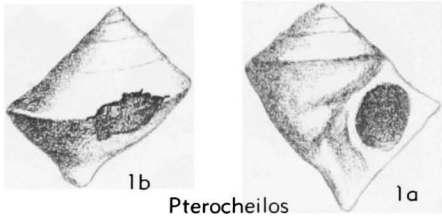


FIG. 175. Trochacea (Turbinidae——Subfamily Uncertain) (p. *I271*).

Conjectura FINLAY, 1927 [**Crossea glabella* MURDOCH, 1905]. Smooth, depressed-turbinate, with basal keel or fold, like *Crossea*. *Rec.*, N.Z.

Crossea A.ADAMS, 1865 [**C. miranda;* SD SUTER, 1913] [=*Crosseia* FISCHER, 1885 (obj.)]. Spire elevated; anterior margin of aperture with or without a projection. *Plio.-Rec.*, S.Pac.-E.Asia.

C. (Crossea). With several strong varices. *Plio.-Rec.*, S.Pac.-IndoPac.——FIG. 176,*9*. **C. miranda*, Rec., Japan; ×5 (147).

C. (Crosseola) IREDALE, 1924 [**C. concinna* ANGAS, 1868]. Sculpture cancellate, no varices. *Rec.*, S.Pac.

C. (Dolicrossea) IREDALE, 1924 [**C. labiata* TENISON-WOODS, 1876] [=*Doliocrossea*, WENZ, 1938 (spelling error)]. Outer lip varicose. *Rec.*, S.Pac.

Daronia A.ADAMS, 1861 [**Cyclostrema spirula* A. ADAMS, 1850]. Planorboid, spire sunken. *Rec.*, SW. Pac.

D. (Daronia). Peristome continuous. *Rec.*, Indo-Pac.——FIG. 176,*2*. **D. spirula* (ADAMS), Philippines; *2a,b*, ×1 (147).

D. (Eudardonia) COTTON, 1945 [**Cyclostrema taffaensis* VERCO, 1909]. Peristome discontinuous, aperture reniform. *Rec.*, S.Austral.

?Dillwynella DALL, 1889 [**D. modesta*]. Turbinate, not umbilicate. *Rec.*, W.Indies.——FIG. 176,*13*. **D. modesta*, St. Lucia; ×5 (147).

?Ganesa JEFFREYS, 1883 [**G. pruinosa;* SD COSSMANN, 1918]. Turbinate; smooth or striate. *Plio.-Rec.*, Eu.-N.Am.-SW.Pac.

G. (Ganesa). Aperture somewhat ovate. *Rec.*, Atl. ——FIG. 176,*6*. **G. (G.) pruinosa*, N.Atl.; ×3 (193).

G. (Granigyra) DALL, 1889 [**Cyclostrema limatum*]. Surface finely granulate. *Rec.*, W.Indies-Eu.

G. (Lissospira) BUSH, 1897 [**Cyclostrema proximum* TRYON, 1888]. Aperture round. *Plio.-Rec.*, N.Z.-E.N.Am.——FIG. 176,*4*. **G. (L.) proxima* (TRYON), Rec., New England; ×5 (147).

?Haplocochlias CARPENTER, 1864 [**H. cyclophoreus*]. Somewhat conical, spirally striate, outer lip thickened. *Rec.*, W.C.Am.

Kaawatina BARTRUM & POWELL, 1928 [**K. turneri*]. Pyriform, 3-whorled, with axial ribs and an umbilical chink. *Plio.*, N.Z.——FIG. 176,*16*. **K. turneri; 16a,b*, ×10 (147).

Leptogyra BUSH, 1897 [**L. verrilli*]. Lenticular, deeply umbilicate, with spiral striae. *Rec.*, E.N. Am.-W.N.Am.——FIG. 176,*5*. **L. verrilli*, Delaware Bay; *5a,b*, ×10 (147).

Leucorhynchia CROSSE, 1867 [**L. caledonica*]. Smooth, glossy, sublenticular, umbilicus deep but partly concealed by a columellar basal fold. *U. Cret.-Rec.*, Eu.-IndoPac.——FIG. 176,*8*. **L. caledonica*, Rec., New Caledonia; *8a,b*, ×5 (147).

Lissotesta IREDALE, 1915 [**Cyclostrema micra* TENISON-WOODS, 1877]. Turbinate, smooth to spirally ribbed, without varices. *Rec.*, S.Pac.

Lissotestella POWELL, 1946 [**Lissotesta tenuilirata* POWELL, 1931]. Like *Lissotesta* in shape but more solid; peristome continuous, varicose. *Rec.*, N.Z.

Lodderena IREDALE, 1924 [**Liotia minima* TENISON-WOODS, 1878]. Nearly discoidal, with heavily varied aperture, peripheral keels and crenulate suture present but no axial sculpture. *Rec.*, Australasia.

Lodderia TATE, 1899 [**Liotia lodderae* PETTERD, 1884] [=*Cyclostremella* TATE, 1898 (*non* BUSH, 1897)]. Lenticular, with several spiral keels and fine axial sculpture. *Rec.*, Australasia.——FIG. 176, *14*. **L. lodderae* (PETTERD), Austral.; ×10 (147).

Lophocochlias PILSBRY, 1921 [**Haplocochlias minutissimus*]. Minute, with 6 spiral keels and 2 spirals in umbilicus. *Rec.*, Hawaii.

Munditiella KURODA & HABE, 1954 [**Cyclostrema ammonoceras* A.ADAMS, 1863]. Minute, with regular annular varices on periphery. *Rec.*, Japan.—— FIG. 176,*12*. **M. ammonoceras* (ADAMS); ×20 (198).

Norrisella COSSMANN, 1888 [**Turbo pygmaea* DESHAYES, 1863]. Minute, umbilicate, inner lip flaring. *Eoc.-Mio.*, Eu.-E.Indies.——FIG. 176,*3*. **N. pygmaea* (DESHAYES), Eoc., Fr.; ×5 (147).

?Pakistania EAMES, 1952 [**P. antirotata*]. Sinistral, flattened above, convex below, smooth, periphery carinate; aperture kite-shaped. *Eoc.*, Asia.——FIG. 176,*18*. **P. antirotata*, Pakistan; ×20 (180).

Philorene OLIVER, 1915 [**P. texturata*]. With fine spiral striae and nodes, umbilicus spirally lirate within. *Rec.*, Pac.

Pondorbis BARTSCH, 1915 [**P. alfredensis*]. Planorboid, with sinuous axial varices. *Rec.*, S.Afr.

Pygmaerota HABE, 1958 [**Cyclostrema duplicatum* LISCHKE, 1872]. Near *Lodderia* but without axial striae. *Rec.*, Japan.

Rhodinoliotia TOMLIN & SHACKLEFORD, 1915 [**Cyclostrema roseotinctum* SMITH, 1871]. Turbinate, with strong spiral ridges. *Rec.*, W.Afr.

Teinostoma, classified here by some workers, is to be included in Vitrinellidae, in *Treatise* Part J.]

Tharsiella BUSH, 1897 [*pro Tharsis* JEFFREYS, 1883 (*non* GIEBEL, 1847)] [**Oxystele romettensis* GRANATA, 1877 (*ex* SEGUENZA, MS)] |=*Porcupinia* COSSMANN, 1900 (*non* HAECKEL, 1887) *(pro Tharsis); Porcupina* COSSMANN, 1925 (spelling error)].

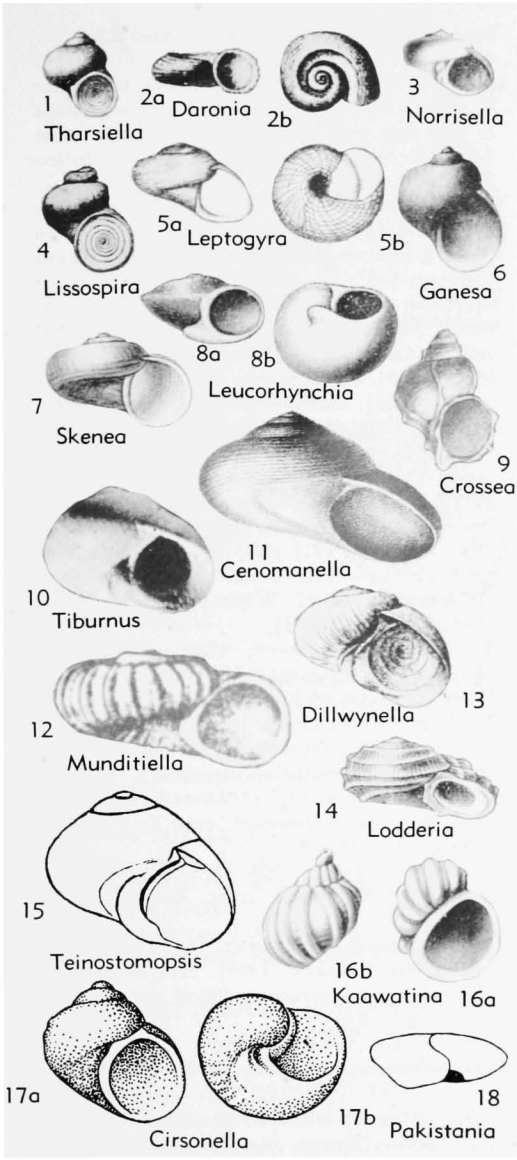


FIG. 176. Trochacea (Cyclostrematidae——Skeneinae) (p. *I271-I273*).

Turbinate, smooth, umbilicus partly concealed by columellar lip. *Plio.-Rec.,* Eu.-W.Atl.——FIG. 176, *1.* **T. romettensis* (GRANATA), Rec., E.Atl.; ×5 (147).

?Tiburnus DEGREGORIO, 1890 [**Turbo naticoides* LEA, 1833 (Dec.) = *Natica eborea* CONRAD, 1833 (Nov.)] [=*Platychilus* COSSMANN, 1888 (*non* JAKOLEV, 1874); *Simochilus* HARRIS & BURROWS, 1891 (*pro Platychilus*)]. Low-turbinate, smooth, nacreous within. *Paleoc.-Plio.,* Eu.-Afr.-N.Am.-Austral.——FIG. 176,*10.* **T. eborea* (CONRAD), Eoc., Ala.; ×4 (209).

Tubiola A.ADAMS, 1863 [**Turbo niveus* GMELIN, 1791; SD STOLICZKA, 1868 (as of CHEMNITZ, 1784, nonbinominal)]. Like *Skenea,* but with a funnel-shaped umbilicus. *Plio.-Rec.,* Atl.-Pac.-Austral.

T. (Tubiola). Low-conical, whorls with growth striae only. *Rec.,* Atl.-Pac.

T. (Partubiola) IREDALE, 1936 [**P. blancha*]. Disc-shaped; whorls with fine spiral striae, growth striae in interspaces. *Plio.-Rec.,* Austral.

Subfamily CYCLOSTREMATINAE Fischer, 1885

[*nom. transl.* COSSMANN, 1917 (*ex* Cyclostrematidae FISCHER, 1885)]

Radula with single strong marginal tooth in each row and several delicate laterals; shell mostly strongly sculptured. *U.Cret.-Rec.*

Cyclostrema MARRYAT, 1818 [**C. cancellatum;* SD GRAY, 1847] [=*Pseudoliotina* COSSMANN, 1925]. Lenticular, with axial varices. *U.Cret.-Rec.,* circumtropic.——FIG. 177,*9.* **C. cancellatum,* Rec., W.Indies; ×4 (158).

Brookula IREDALE, 1912 [**B. stibarochila*] [=*Vetulonia* DALL, 1913]. Minute, inflated, glassy. *Mio.-Rec.,* C.Pac.-S.Pac.

B. (Brookula). Spire blunt, interspaces between ribs with spiral sculpture. *Mio.-Rec.,* S.Pac.——FIG. 177,*3.* **B. (B.) stibarochila,* Rec., Kermadec I.; ×10 (147).

B. (Aequispirella) FINLAY, 1923 [**Scalaria corulum* HUTTON, 1884]. Spire pointed, interspaces of ribs spirally sculptured. *Mio.,* Australasia.

B. (Liocarinia) LASERON, 1954 [**Liotia disjuncta* HEDLEY, 1903]. Whorls strongly keeled. *Rec.,* E.Austral.-S.Austral.

B. (Liotella) IREDALE, 1915 [**Liotia polypleura* HEDLEY, 1904]. Spire low, interspaces between ribs smooth. *Rec.,* N.Z.

Chunula THIELE, 1925 [**C. typica*] [=*Chunula* THIELE, 1924 *(nom. nud.)*]. Minute, inflated, few-whorled. *Rec.,* E.Indies.——FIG. 177,*5.* **C. typica,* Sumatra; ×10 (147).

Circulus JEFFREYS, 1865 [**Delphinula duminyi* REQUIEN, 1842 = *Solarium philippii* CANTRAINE, 1842]. Minute; smooth or with spiral riblets. *Mio.-Rec.,* Medit.-W.Indies-W.C.Am. —— FIG. 177,*2.* **C. philippii* (CANTRAINE), Rec., Medit.; *2a-c,* ×5 (147).

Coronadoa BARTSCH, 1946 [**C. simonsae*]. Minute, depressed, with scalariform ridges. *Rec.,* W.N.Am. ——FIG. 177,*8.* **C. simonsae,* Rec., Calif.; ×40 (161).

Munditia FINLAY, 1927 [**Liotina tryphenensis* POWELL, 1926]. Depressed, outer lip varicate; spiral beaded cord in umbilicus. *Plio.-Rec.,* Australasia. ——FIG. 177,*4.* **M. tryphenensis* (POWELL), Rec., N.Z.; *4a,b,* ×5 (147).

Parviturbo PILSBRY & MCGINTY, 1945 [**P. rehderi*]. Minute, turbinate, spiral ribs few, heavy. *Rec.,* SE.

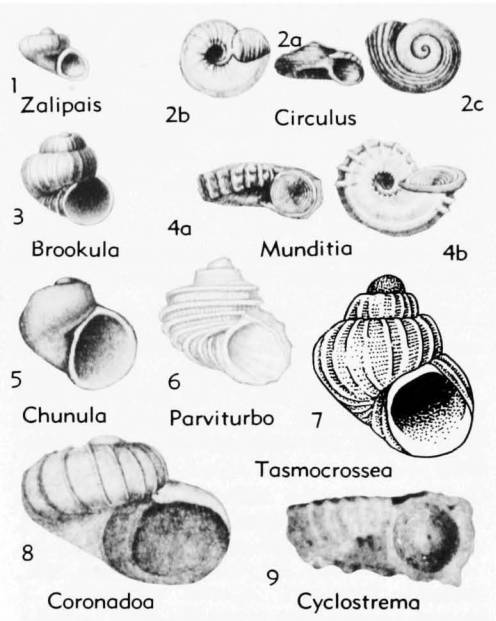


FIG. 177. Trochacea (Cyclostrematidae——Cyclostrematinae) (p. *I273-I274*).

USA.——FIG. 177,*6*. **P. rehderi*, Fla.; ×10 (214).

Tasmocrossea DELL, 1952 [**T. benthicola*]. Like *Brookula* but with a basal fold. *Rec.*, Australasia. ——FIG. 177,*7*. **T. benthicola*; ×25 (175).

Zalipais IREDALE, 1915 [**Cyclostrema lissa* SUTER, 1908]. Minute, with fine axial striae. *Rec.* Australasia.——FIG. 177,*1*. **Z. lissa* (SUTER), Rec., N.Z.; ×10 (147).

Family PHASIANELLIDAE Swainson, 1840

[*nom. transl.* COSSMANN, 1918 (*ex* Phasianellinae SWAINSON, 1840)] [=Eutropiinae ADAMS & ADAMS, 1854] [Preparation of descriptions and selection of illustrations for this family are the work of MYRA KEEN and ROBERT ROBERTSON.—Ed.]

Ovate to rounded, few-whorled, without periostracum; smooth or finely spirally sculptured, rarely spirally ribbed; shell entirely porcelaneous; small species may be umbilicate; peristome not continuous; operculum calcareous, with eccentric nucleus, either externally convex or flat and spirally ridged. *Paleoc.-Rec.*

Phasianella LAMARCK, 1804 [**Buccinum australe* GMELIN, 1791 (ICZN pend.)] [=*Phasianus* DE MONTFORT, 1810 (obj.) (*non* LINNÉ, 1758); *Bolina* RAFINESQUE, 1815 (obj.); *Eutropia* SWAINSON, 1840 (obj.); *Orthopnoea* GISTEL, 1847 (obj.); *Orthomesus* PILSBRY, 1888; *Mimelenchus* IREDALE, 1924]. Medium-sized to large, smooth, long-ovate; non-umbilicate. *Mio.-Rec.*, Java-Austral.-IndoPac.—— FIG. 178,*5*. **P. australis*, Rec., Austral.; ×0.7 (147).

Gabrielona IREDALE, 1917 [**Phasianella nepeanensis* GATLIFF & GABRIEL, 1908]. Small, globose, smooth or with fine spiral grooves, umbilicate; operculum flat and spirally ridged. *Mio.-Rec.*, W.Indies-Austral.

Tricolia RISSO, 1826 [**Turbo pullus* LINNÉ, 1758; SD GRAY, 1847] [=*Eudora* GRAY, 1852 (*non* PÉRON & LESUEUR, 1810) (obj.); *Chromotis* ADAMS & ADAMS, 1863; *Eucosmia* CARPENTER, 1864 (*non* STEPHENS, 1831); *Tricoliella* MONTEROSATO, 1884 (obj.); *Steganomphalus* HARRIS & BURROWS, 1891 (obj.); *Eulithidium* PILSBRY, 1898; *Usatricolia* HABE, 1956]. Small, globose or ovate, smooth or spirally ribbed; smaller species perforate, columellar margin arched; operculum externally convex. *Paleoc.-Rec.*, world-wide, tropics and warm temperate regions.

T. (Tricolia). Shell fairly thick; suture slightly impressed. *Paleoc.-Rec.*, Eu.-Carib.-N.Am.—— FIG. 178,*1*. **T. (T.) pulle* (LINNÉ), Rec., Eng., ×2 (147).——FIG. 178,*2*. *T. (T.) variegata* (CARPENTER), Rec., W.Mex.; type species of *Eulithidium*, ×8 (223).

T. (Aizyella) COSSMANN, 1889 [**"Phasianella herouvalensis* DESHAYES," *lapsus* for *P. suessoniensis* DESHAYES, 1863]. Spirally ribbed. *Eoc.*, Eu.

T. (Eotricolia) KURODA & HABE, 1954 [**Phasianella megastoma* PILSBRY, 1895]. Similar to *T. (Hiloa)* but radula differs slightly. *Rec.*, Japan.

T. (Hiloa) PILSBRY, 1917 [**Phasianella thaanumi*]. Shell thin, suture impressed; outer lip commonly reflexed. *Rec.*, Hawaii.

T. (Pellax) FINLAY, 1926 [**Phasianella huttoni* PILSBRY, 1888]. Apex acute. *Plio.-Rec.*, N.Z.-Austral.

T. (Phasianochilus) COSSMANN, 1918 [**Phasianella turbinoides* LAMARCK, 1804]. Long-ovate, spire pointed, aperture ovate; umbilical chink present. *Eoc.-Oligo.*, Eu.——FIG. 178,*3*. *T. (*P.) turbinoides*, Eoc., Fr.; ×1 (171).

?**Pseudophasianus** COSSMANN, 1918 [**Turbo elatus* FUCHS, 1870]. Cylindrical, last whorl relatively small; with small umbilicus. *Eoc.*, Eu.——FIG. 178, *4*. **P. elatus* (FUCHS), Eoc., Italy; ×1 (147).

Family VELAINELLIDAE Vasseur, 1880

Last whorl twisted into a slender spiral, simulating a multispiral shell but without the normal spiral septum. *Eoc.*

Velainella VASSEUR, 1880 [**V. columnaris*] [=*Velainiella* COSSMANN, 1918 (spelling error)]. Slender, aciculate, moderately large, smooth. *Eoc.*, Eu.—— FIG. 179,*1*. **V. columnaris*, Eoc., Fr.; *1a,b*, ×1, ×2 (147).

Family ORBITESTELLIDAE Iredale, 1917

Shell thin, pellucid, minute, discoidal, few-whorled; widely umbilicate, columella

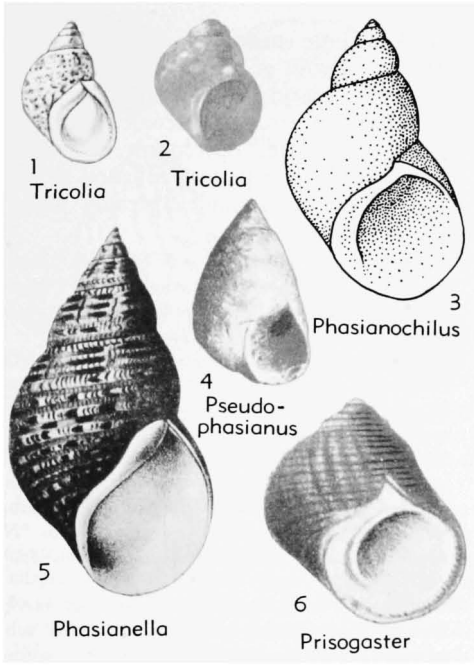


FIG. 178. Trochacea (Turbinidae——Turbininae, Phasianellidae) (p. *I269*, *I274*).

vertical; aperture irregular in shape, edges thin. *Rec.*

Orbitestella IREDALE, 1917 [**Cyclostrema bastowi* GATLIFF, 1906]. Sculpture of one or more keels crossed by axial ribs. *Rec.*, Austral.——FIG. 179,*2*. **O. bastowi* (GATLIFF); *2a-c*, ×25 (147).

?Helisalia LASERON, 1954 [**H. liliputia*]. Sculpture of growth lines only. *Rec.*, S.Austral.

Suborder NERITOPSINA Cox & Knight, 1960

[=*azygobranches orthoneuroides* BOUVIER, 1887; *mononéphridés* PERRIER, 1889]

Shell commonly coiled and ovoid or globular, more rarely capuliform or patelliform; whorls few; spire, if protruding at all, relatively low; outer shell layers calcitic, unusually stable in fossils, commonly preserving color pattern; inner layers thick, aragonitic, lamellar but not nacreous; operculum (not developed in a few genera) commonly calcareous, in many post-Paleozoic genera with processes projecting from inner face and gripping inner lip; living forms with left kidney only; single, bipectinate ctenidium present on left except in terrestrial forms, attached at its base only; single hypobranchial gland, thought to be homologue of right one of other Archaeogastropoda, also present; heart with 2 auricles, right one in some reduced or with single auricle; pallial genital organs developed and complex, fertilization internal; retractor muscles paired; radula rhipidoglossate, with outermost admedians large, capituliform. *M.Dev.-Rec.*

Superfamily NERITACEA Rafinesque, 1815

[*nom. transl.* THIELE, 1929 (*ex* Neritacea RAFINESQUE, 1815)] [Proposed as subfamily name]

Characters as defined for suborder. The superfamily includes marine, fresh-water and terrestrial forms. *M.Dev.-Rec.*

?Family PLAGIOTHYRIDAE Knight, 1956

Turbiniform, with thick shell, dominantly spiral ornament and one or more columellar teeth. *M.Dev.-L.Carb.(Miss.)*

Dirachis WHIDBORNE, 1891 [**D. atavus*]. With moderately high spire; two teeth on inner lip; outer lip convex, prosocline; ornament of spiral cords. *M.Dev.*, Eu.——FIG. 180,*2*. *D. atavus*, Eng.; ×4.

Plagiothyra WHIDBORNE, 1892 [**Monodonta purpurea* D'ARCHIAC & DEVERNEUIL, 1842; SD COSSMANN, 1916]. With single tooth on inner lip;

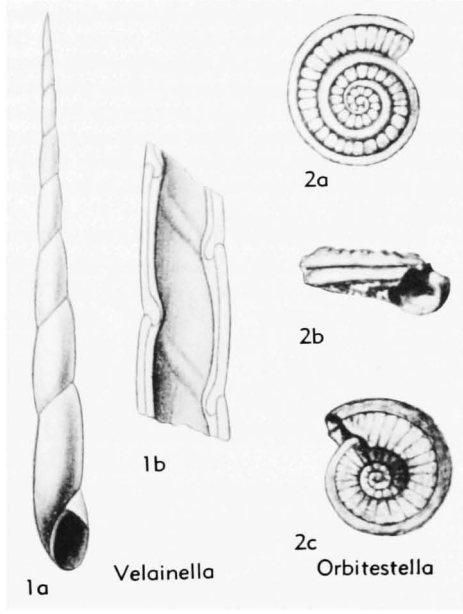


FIG. 179. Trochacea (Velainellidae, Orbitestellidae) (p. *I274-I275*).

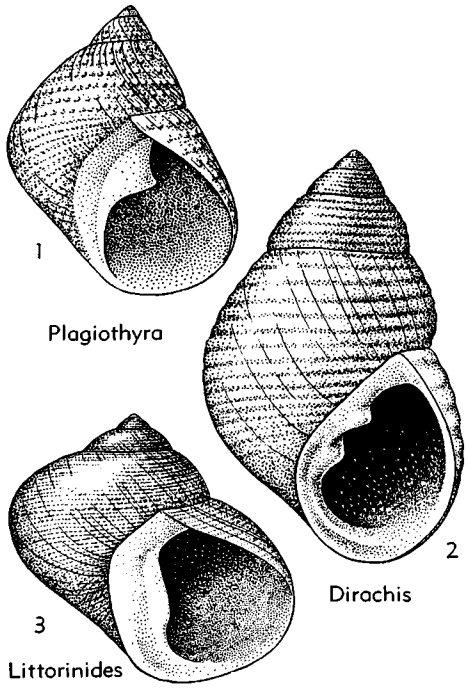


FIG. 180. Neritacea (Plagiothyridae) (p. *I*275-*I*276).

labrum convex, prosocline; ornament of fine papillae in spiral rows. *M.Dev.*, Eu.——FIG. 180, *1*. **P. purpurea* (D'ARCHIAC & DEVERNEUIL), Ger.; ×2.

Littorinides KNIGHT, 1937 [*pro Rhabdopleura* DE KONINCK, 1881 (*non* ALLMAN, 1869)] [**Littorina solida* DEKONINCK, 1843]. Low; elongate plate on inner lip culminating below in low tooth; ornament of numerous spiral threads. *L.Carb.*, Eu.——FIG. 180,*3*. **L. solida* (DEKONINCK), Belg.; ×2.

Family NERITOPSIDAE Gray, 1847

Shell globular, spire protruding but slightly or not at all, last whorl large; inner lip broad and smooth, formed by continuous inductura, or by inductura on parietal region merging into excavation of columellar lip on its outer face; inner walls of whorls not resorbed; operculum not spiral. *M.Dev.-Rec.*

Subfamily NATICOPSINAE S.A.Miller, 1889

[*nom. transl.* KNIGHT, BATTEN & YOCHELSON, herein (*ex* Naticopsidae S.A.MILLER, 1889)] [=Hologyridae KITTL, 1899)]

Without ornament except for subsutural collabral threads or cords in some species; outer lip strongly prosocline; parietal lip commonly thickened by inductura, extended in some species in plane of aperture over part of side of last whorl, and simple or rarely bearing single protuberance; columellar lip strongly arcuate, excavated on its outer face; operculum concentric, asymmetrical; color pattern collabral stripes, spiral bands, spots, and especially zigzag lines. *M.Dev.-U.Cret.*

Naticopsis M'COY, 1844 [**N. phillipsii*; SD MEEK & WORTHEN, 1866]. With moderately high-spired to low, very broad shell; divisible into intergrading subgenera. *M.Dev.-Trias.*, cosmop.

N. (Naticopsis) [=*Naticodon* RYCKHOLT, 1847; *Fedaiella* KITTL, 1894]. Commonly large; globular, but with slightly protruding spire; aperture expanded in direction oblique to axis; parietal and columellar lips moderately thickened or each with toothlike protuberance. *M.Dev.-Trias*, cosmop.——FIG. 181,*7*. **N. (N.) phillipsii*, L.Carb., Ire.; with operculum, ×0.7.——FIG. 181,*8*. **N. (N.) cuccensis*, M.Trias.(Ladin.), S.Tyrol; *8a,b*, ×1 (65).

N. (Jedria) YOCHELSON, 1952 [**Naticopsis meeki* KNIGHT, 1933]. More or less ovoid; heavy subsutural swelling generally bearing collabral cords; parietal lip in adults markedly thickened (155, p. 65)]. *M.Dev.-Perm., ?Trias.*, N.Am.-Eu.——FIG. 181,*1*. **N. (J.) meeki* (KNIGHT), *M.Penn. (U.Carb.)*, Mo.; ×2.

N. (Marmolatella) KITTL, 1894 [**N. (M.) applanata* KITTL, 1894; SD B.B.WOODWARD, 1895]. Spire more or less flattened; aperture expanded in direction perpendicular to axis; parietal and columellar lips thickened, each commonly with toothlike protuberance. *L.Carb.(Miss.)-U.Trias.*, N.Am.-Eu.——FIG. 180A,*1*. **N. (Marmolatella) applanata, M.Trias.(Ladin.)*, S.Tyrol; *1a,b*, ×1 (65).

Dicosmos CANAVARI, 1890 [**D. pulcher*] [=*Hologyra* KOKEN, 1892]. Naticiform; whole of inner lip with thick, bulging inductura; columellar lip less extended than in *Naticopsis*. *M.Trias.(Ladin.)-U.Trias.(Carn.)*, Eu.-Indonesia.——FIG. 181,*4*. **D. alpinus* (KOKEN) (=type species of *Hologyra*), U. Trias.(Carn.), S.Tyrol; *4a,b*, ×1 (10).

Planospirina KITTL, 1899 [**Nerita esinensis* STOPPANI, 1858]. Spire low in early stages, but suture descending penultimate whorl before aperture; aperture ovate, broader than high; columellar lip concave, not at all extended as in *Naticopsis;* parietal lip much thickened, columellar lip rather less so. *U.Carb.(M.Penn.)-Trias.*, Eu.-N.Am.——FIG. 181,*10*. **P. esinensis*, M.Trias.(Ladin.), S. Tyrol; *10a-c*, apertural, abapertural, and apical views, ×1.

?Vernelia J.BÖHM, 1895 [*Natica fastigiata* STOPPANI, 1858 (=*N. excelsa* HAUER, 1851); SD *B. B.* WOODWARD, 1896]. Medium-sized, littoriniform, with well-elevated spire of convex whorls; aperture

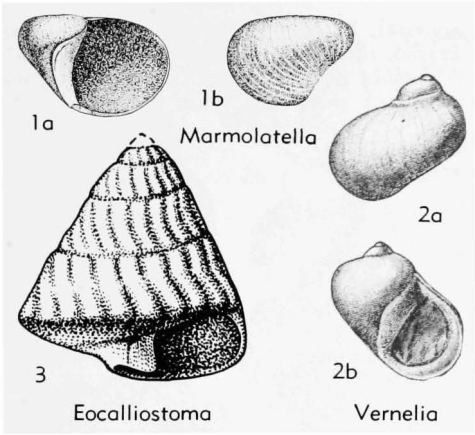


FIG. 180A. *Marmolatella, Vernelia,* and *Eocalliostoma* (p. *I*248, *I*276).

ovate, higher than broad, angular and with slight adapical channel; labrum thick, but bevelled off to margin; parietal lip much thickened above. *U. Carb.(Penn.)-Trias.,* Eu.-N.Am.——FIGS. 180A,*2*, 181,*3*. **V. excelsa* (HAUER), M.Trias.(Ladin.), S. Tyrol; 180A,*2a,b,* ×1 (195); 181,*3a,b,* ×1 (specimen in U.S. Natl. Mus.)

?Pachyomphalus J.BÖHM, 1895 [*P. concinnus;* SD COSSMANN, 1925]. Small, littoriform, with well-elevated spire of convex whorls; aperture ovate, higher than broad, relatively smaller than in *Vernelia,* angular adapically, labrum thin; inductura narrow on parietal region, more widely spread over base. *M.Trias.(Ladin.),* Eu.——FIG. 181,*2*. **P. concinnus,* S.Tyrol; *2a,b,* ×2 (6).

?Frombachia BLASCHKE, 1905 [**F. uhligi*]. Rather small, turbiniform, with fairly broad umbilicus; whorls with 2 spiral angulations; inductura of inner lip spread over base but not obscuring umbilicus. *M.Trias.(Carn.),* Eu.——FIG. 181,*5*. **F. uhligi;* S.Tyrol; *5a,b,* ×1.5 (10).

Haliotimorpha BLASCHKE, 1905 [**H. dieneri*]. Involute, auriform, of few very rapidly enlarging whorls, last one developing peripheral carina, on which are large hollow spines; aperture subrectangular, much broader than high; inner lip flattened, of moderate breadth, with sharp subparallel outer and inner margins, latter concave and without teeth. *M.Trias.(Ladin.)-U.Trias. (Carn.),* Eu.——FIG. 181,*9*. **H. dieneri,* U.Trias. (Carn.), S.Tyrol; *9a,b,* ×1 (10).

Damesia HOLZAPFEL, 1888 [**Crepidula cretacea* MÜLLER, 1851; SD WENZ, 1938]. Globose, with rapidly enlarging whorls and very eccentric, flattened spire almost level with top of aperture; ornament depressed spiral cords; aperture subrectangular, broader than high; inner lip flattened, of moderate breadth, with sharp subparallel outer and inner margins, and largely covering quite broad umbilicus; inner margin of inner lip concave and without teeth. *U.Cret.(Senon.),* Eu.——FIG. 181,*6*. **D. cretacea,* Ger.; *6a,b,* ×2 (56).

Subfamily NERITOPSINAE Gray, 1847

[*nom. transl.* KNIGHT, BATTEN & YOCHELSON, herein (*ex* Neritopsidae GRAY, 1847)]

Much like the Naticopsinae except that spire protrudes more than in most genera of that subfamily and shell is ornamented with pustules, which in many species open adaperturally; no umbilicus; operculum, where known, massive, trapeziform, symmetrical. *L.Carb.(Miss.)-Rec.*

Turbonitella DEKONINCK, 1881 [**Turbo biserialis* PHILLIPS, 1836; SD COSSMANN, 1916]. Turbiniform, with slightly flattened base; collar-like adpressed zone between suture and uppermost pustules; 2 rows of collabrally lengthened pustules, one at upper angulation of whorl face and other at lower angulation; columellar lip strongly excavated. *L. Carb.,* Eu.——FIG. 182,*1*. **T. biserialis* (PHILLIPS), Eng.; ×2.

Trachydomia MEEK & WORTHEN, 1866 [**Naticopsis nodosa* MEEK & WORTHEN, 1861] [=*Trachydomus* COSSMANN, 1918 (obj.); *Trachydoma* KNIGHT, 1933 (obj.)] Globular, with adpressed zone; surface covered with pustules that are not segregated sharply into different kinds. *Penn.(U. Carb.)-M.Perm.,* N.Am.-Eu.-NE.Asia-SE.Asia.——FIG. 182,*5*. **T. nodosa* (MEEK & WORTHEN), M. Penn., Ill.; ×1.3.

Trachyspira GEMMELLARO, 1889 [*T. delphinuloides;* SD COSSMANN, 1916] [=*Platycheilus* GEMMELLARO, 1889; *Sosiospira* GRECO, 1937]. Much like *Trachydomia* but without sutural adpressed zone and with pustules segregated into 2 different categories: numerous small pustules arranged in oblique opisthocline or spiral rows and few large ones arranged in spiral rows. *M.Perm.,* N.Am.-Eu.-NE.Asia.——FIG. 182,*6*. **T. delphinuloides,* Sicily; ×1.

Hungariella KUTASSY, 1933 [**Neritopsis pappi* KUTASSY, 1927]. Medium-sized to large, with well-protruding, acute spire; aperture ovate, higher than broad; inner lip moderately broad, smooth, with sharp protuberance on parietal region, in some shells with other blunter ones below; ornament spiral bands, some tuberculate. *U.Trias. (Nor.),* Eu.——FIG. 182,*4*. *H. stredae* KUTASSY, Hung.; *4a,b,* ×1 (200).

Seisia KUTASSY, 1934 [**S. blaschkei*]. Of medium size, with slightly protruding, very eccentric spire and rapidly increasing whorls; last whorl with 3 or 4 nodose carinae, one delimiting its flat or concave upper surface and lowest forming border of broad false umbilicus; aperture suborbicular; inner lip broad, smooth, with margin almost detached from base. *M.Trias.(Ladin.)-M.U.Trias.(Nor.),* Eu.

——Fig. 182,2. *S. spinosa* Kutassy, U.Trias. (Carn.), Hung.; *2a,b*, ×3 (84).

Neritopsis Grateloup, 1832 [**N. moniliformis*] [=*Radula* Gray, 1842; also following (based on opercula), *Peltarion* Deslongchamps & Deslongchamps, 1858; *Cyclidia, Scaphanidia* Rolle, 1862; *Rhynchidia* Laube, 1868]. Of medium size, with moderately protruding, obtuse spire; last whorl

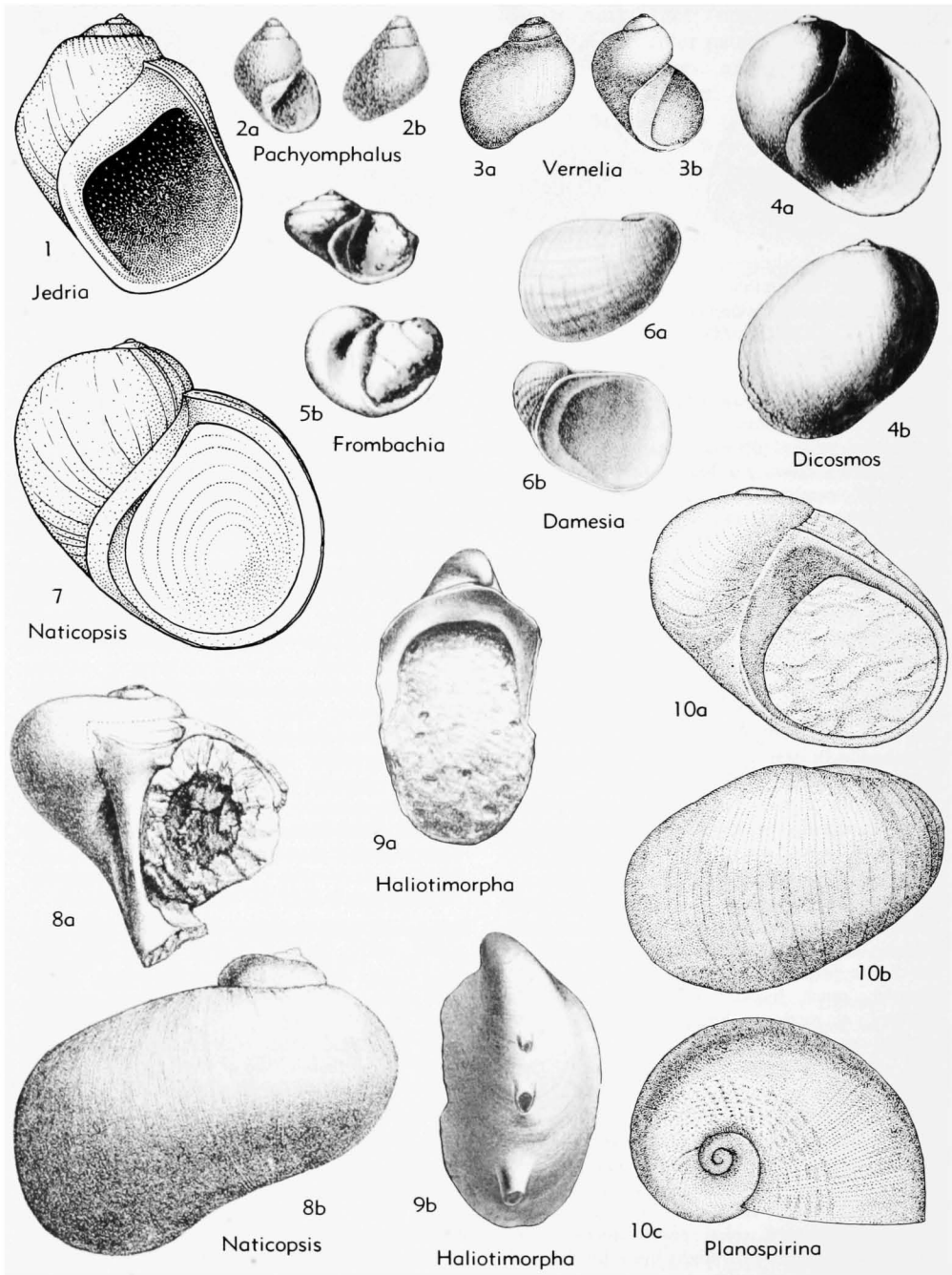


Fig. 181. Neritacea (Neritopsidae——Naticopsinae) (p. *1276-1277*).

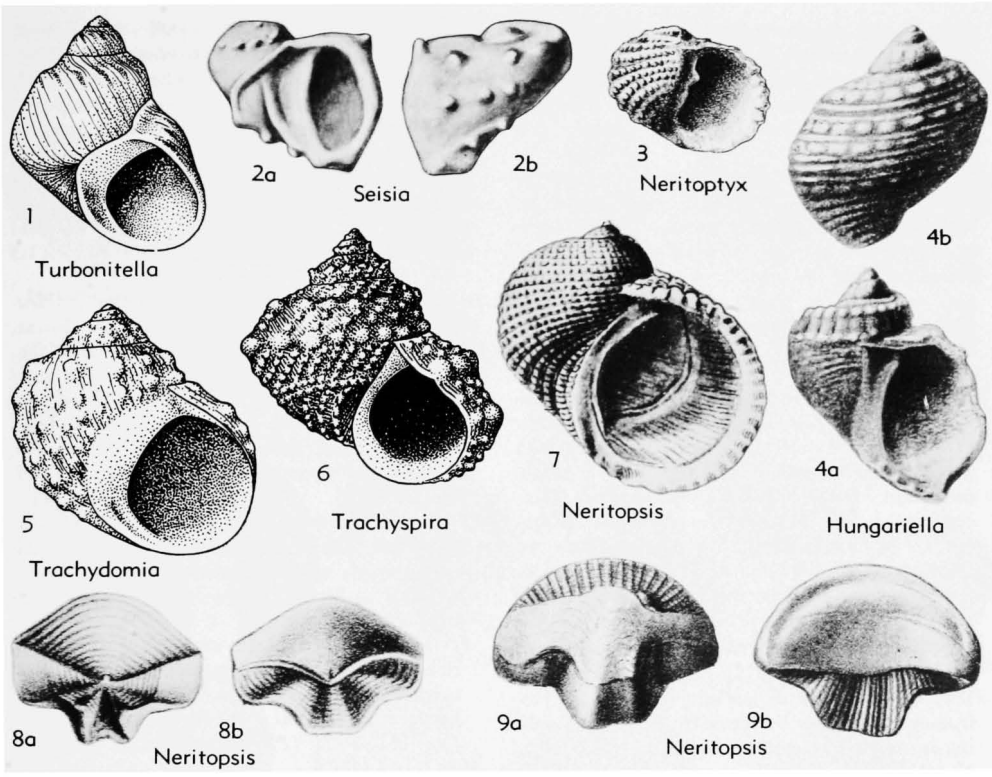


FIG. 182. Neritacea (Neritopsidae——Neritopsinae) (p. *I278*).

globose, evenly convex; ornament spiral cords and in some species collabral ribs; aperture orbicular, inner lip moderately thickened, strongly concave; operculum very solid, trapeziform. *Trias.-Rec.*, cosmop.

N. (Neritopsis). Inner lip without tubercle. *Trias.-Rec.*, cosmop.——FIG. 182,*7*. *N. (N.) radula* (LINNÉ), Rec., IndoPac.; ×1 (147).——FIG. 182, *9*. *N. (N.)* sp., Mio., C.Eu.; operculum (*"Cyclidia valida"* ROLLE), *9a,b*, ×5 (201).——FIG. 182,*8*. *N. (N.)* sp., L.Jur.(M.Lias.), Fr.; operculum (*"Peltarion bilobatum"* DESLONGCHAMPS), *8a,b*, ×2.3 (182).

N. (Neritoptyx) OPPENHEIM, 1892 [**Nerita goldfussii* KEFERSTEIN in GOLDFUSS, 1844]. With prominent parietal tubercle. *U.Cret.*, Eu.——FIG. 182,*3*. **N. (Neritoptyx) goldfussii;* Aus.; ×2.5 (208).

Family DAWSONELLIDAE Wenz, 1938

Small, heliciform, with a platelike extension of inner lip. *Penn.*

Dawsonella BRADLEY, 1874 [**Anomphalus meeki* BRADLEY, 1872] [=*Dawsoniella* FISCHER, 1887 (obj.)]. Aperture slightly expanded at final stage; with platelike extension of inner lip seemingly lying over lip of larger aperture. *M.Penn.* N.Am. [Found with *Maturipupa vermillionensis* (BRADLEY) in fresh-water limestone in a Coal Measures sequence; it may have lived in fresh water or more likely was terrestrial.]——FIG. 189,*3*. **D. meeki* (BRADLEY), Ill.; ×10.

Family NERITIDAE Rafinesque, 1815

[*nom. transl. et correct.* GRAY, 1834 (*ex* subfamily Neritacea RAFINESQUE, 1815; Neritadae FLEMING, 1822)] [=Protoneridae KITTL, 1899]

Shell globose, turbiniform, capuliform or patelliform; mostly thick-walled; no umbilicus; inner walls of whorls resorbed; inner lip more or less thickened by callus or protruding as septum that narrows aperture, commonly with dentate margin (3). *Trias.-Rec.*

Subfamily NERITINAE Rafinesque, 1815

[*nom. transl.* SWAINSON, 1840 (*ex* Neritidae RAFINESQUE, 1815, *nom. correct.* GRAY, 1834)]

Operculum, where known, with rib on inner side and an apophysis. *M.Trias.-Rec.*

Neritaria KOKEN, 1892 [**N. similis* (=**Natica plicatilis* KLIPSTEIN, 1845)] [=*Protonerita* KITTL, 1894]. Naticiform, smooth, with slightly protruding spire; aperture with slight adapical channel; inner lip not extended as septum or very

little so, not dentate at margin, commonly with protuberance where its columellar and parietal parts meet; callus narrowly spread over base. *M. Trias.-U.Trias.*, cosmop.——Fig. 183,*1*. **N. candida* (Kittl), M.Trias.(Ladin.), S.Tyrol; ×1 (65).

Cryptonerita Kittl, 1894 [**C. elliptica*] [=*Cryptonatica* Cossmann, 1925 (obj., *errore pro Cryptonerita*)]. Turbiniform, broader than high, smooth, of evenly convex whorls; aperture suborbicular; inner lip concave, not extended as septum or dentate at margin, callus extending very little over base. *M.Trias.(Ladin.)-U.Trias.(Carn.)*, Eu.——Fig. 183,*2*. **C. elliptica*, M.Trias.(Ladin.), S.Tyrol; *2a,b*, ×1.5 (65).

Oncochilus Zittel, 1882 [**Natica globulosa* Klipstein, 1845; SD Cossmann, 1925] [=*Sphaerochilus* Cossmann, 1898 (obj.)]. Globular; inner lip with smooth, bulging pad of callus bearing 2 broad, prominent folds. *?U. Carb.(Penn.), Trias.-Cret.*, cosmop.——Fig. 213,*5*. **O. globulosus* (Klipstein), M.Trias.(Ladin.), S.Tyrol; apertural, ×4 (Knight, n). [J.B.Knight, R.L.Batten & E.L. Yochelson would place this genus near *Cylindritopsis* in the Subulitacea.]

Neritoma Morris, 1849 [**Nerita sinuosa* J.Sowerby, 1818; SD Cossmann, 1925] [=*Neritoma* Fischer, 1885 (obj.)]. Globose, smooth, with slightly protruding spire; inner lip much thickened, diminishing aperture. *L.Jur.-U.Cret.*, cosmop.

N. (Neritoma). Outer lip with narrow median sinus; margin of inner lip oblique, slightly concave, not dentate. *U.Jur.(Oxford.-Portland.)*, Eu. ——Fig. 183,*9*. **N. (Neritoma) sinuosa* (J. Sowerby), U.Jur.(Portland.), Fr.; ×1 (201).

N. (Neridomus) Morris & Lycett, 1851 [**Nerita hemisphaerica* Morris & Lycett, 1851 (*non* Roemer, 1836) = **Neridomus anglica* Cox & Arkell, 1950; SD Cossmann, 1925 (ICZN pend.)] [=*Neritodomus* Fischer, 1885 (obj.)]. Outer lip without sinus; margin of inner lip bulging along parietal region, not dentate. *L.Jur.-U.Cret.(Senon.)*, cosmop.——Fig. 183,*11*. **N. (Neridomus) anglica* (Cox & Arkell), M.Jur. (Bathon.), Eng.; *11a,b*, ×1 (104).

N. (Staffinia) Anderson & Cox, 1948 [**Neritina staffinensis* Forbes, 1851]. Outer lip without sinus; inner lip only moderately thickened, but with broad, oblique protrusion near its lower end. *M.Jur.(Bathon.)*, Scot.

Trachynerita Kittl, 1894 [**T. fornoensis* (=**Turbo quadrata* Stoppani, 1858); SD Cossmann, 1925]. Globose, with low, obtuse spire and obtusely rounded periphery; narrow ramp or row of nodes below suture; aperture with slight adapical channel; inner lip well protruded, with untoothed parasigmoidal margin, and with callus widely spread over base. *M.Trias.(Anis.)-M.Jur.(Bathon.)*, cosmop.——Fig. 183,*16*. **T. depressa* (Hörnes), M.Trias.(Ladin.), S.Tyrol; *16a,b*, ×1 (66).

Platychilina Koken, 1892 [**P. wöhrmanni*] [=*Platychelyne* Tomlin, 1931 (obj.)]. Globose, with low, very eccentric spire; whorls few, rapidly expanding, last one with broad sutural ramp and 2 or more angulations coinciding with rows of tubercles; aperture subquadrangular or polygonal; inner lip moderately protruded, with straight or concave, untoothed margin. *M.Trias.(Ladin.)-U. Trias.(Carn.)*, Eu.——Fig. 183,*6*. *P. cainalloi* (Stoppani), M.Trias.(Ladin.), S.Tyrol; *6a,b*, ×1.3 (66).

Delphinulopsis Laube, 1868 [**D. arietina* (=*Pleurotomaria binodosa* Münster, 1841); SD Laube, 1870]. Of few steeply coiled, low-embracing, rapidly enlarging whorls carrying nodose or scaly spiral carinae; inner lip protruded as broad septum with untoothed, oblique margin. *M.Trias. (Ladin.)-U.Trias.(Carn.)*, Eu.——Fig. 183,*5*. **D. binodosa* (Münster), U.Trias.(Carn.), S.Tyrol; *5a,b*, ×1 (64).

Pileolus G.B.Sowerby, 1823 [**P. plicatus;* SD S.P. Woodward, 1851]. Small, patelliform or capuliform, smooth or with radial ribbing; inner lip protruded as broad septum, much reducing aperture. *L.Jur.-Eoc.*, cosmop.

P. (Pileolus). Patelliform, smooth or with radial ribbing; inner lip much protruded as septum with smooth or dentate margin, reducing aperture to lunate slit. *L.Jur.-U.Cret.(Turon.)*, cosmop.—— Fig. 183,*3*. **P. (P.) plicatus*, M.Jur.(Bathon.), *3a,b*, ×2 (147).

P. (Gargania) Guiscardi, 1857 [**G. brocchii*]. Capuliform, with raised terminal apex not appreciably incoiled; radially ribbed; inner lip septum well developed, ?not dentate; labrum thick, with broad median depression. *U.Cret.(Cenom.-Turon.)*, Eu. —— Fig. 183,*7*. *P. (G.) brocchii* (Guiscardi), U.Cret., Italy; *7a,b*, ×1, ×2 (190).

P. (Velatella) Meek, 1873 [**Neritina bellatula* Meek, 1873; SD Cossmann, 1925]. Capuliform, with depressed submarginal apex slightly incoiled and curved to one side; smooth or radially ribbed; aperture semioval; outer lip somewhat thickened, smooth or faintly crenate internally; inner lip margin not dentate. *U.Cret.(Maastricht.)*, N.Am. ——Fig. 183,*8*. **P. (V.) bellatula* (Meek), Laramie beds, Utah; *8a,b*, ×2.5, ×2 (228).

P. (Tomostoma) Deshayes, 1824 [**P. neritoides;* SD Fischer, 1885] [=*Calana* Gray, 1847]. Capuliform, smooth, apex not terminal; aperture trapezoidal, inner lip with sinus. *Eoc.*, Eu.—— Fig. 183,*4*. **P. (T.) neritoides* (Deshayes), Eoc., Fr.; *4a-c*, ×2 (147).

Trochonerita Cossmann, 1907 [**Nerita mammaeformis* d'Orbigny, 1850]. Large, trochiform, smooth; whorls feebly convex, last one subangular at periphery of rather flattened base; labrum strongly prosocline; inner lip not dentate at margin, continuous with thin callus widely spread over

base. *L.Cret.*, Eu.——Fig. 183,*15*. •*T. mammaeformis* (d'Orbigny), L.Cret.(Barrem.), Fr.; ×0.5 (170).

Lissochilus Zittel, 1882 [•*Nerita sigaretina* Buvignier, 1843; SD Cossmann, 1925]. Globose, with slightly protruding spire of shouldered whorls;

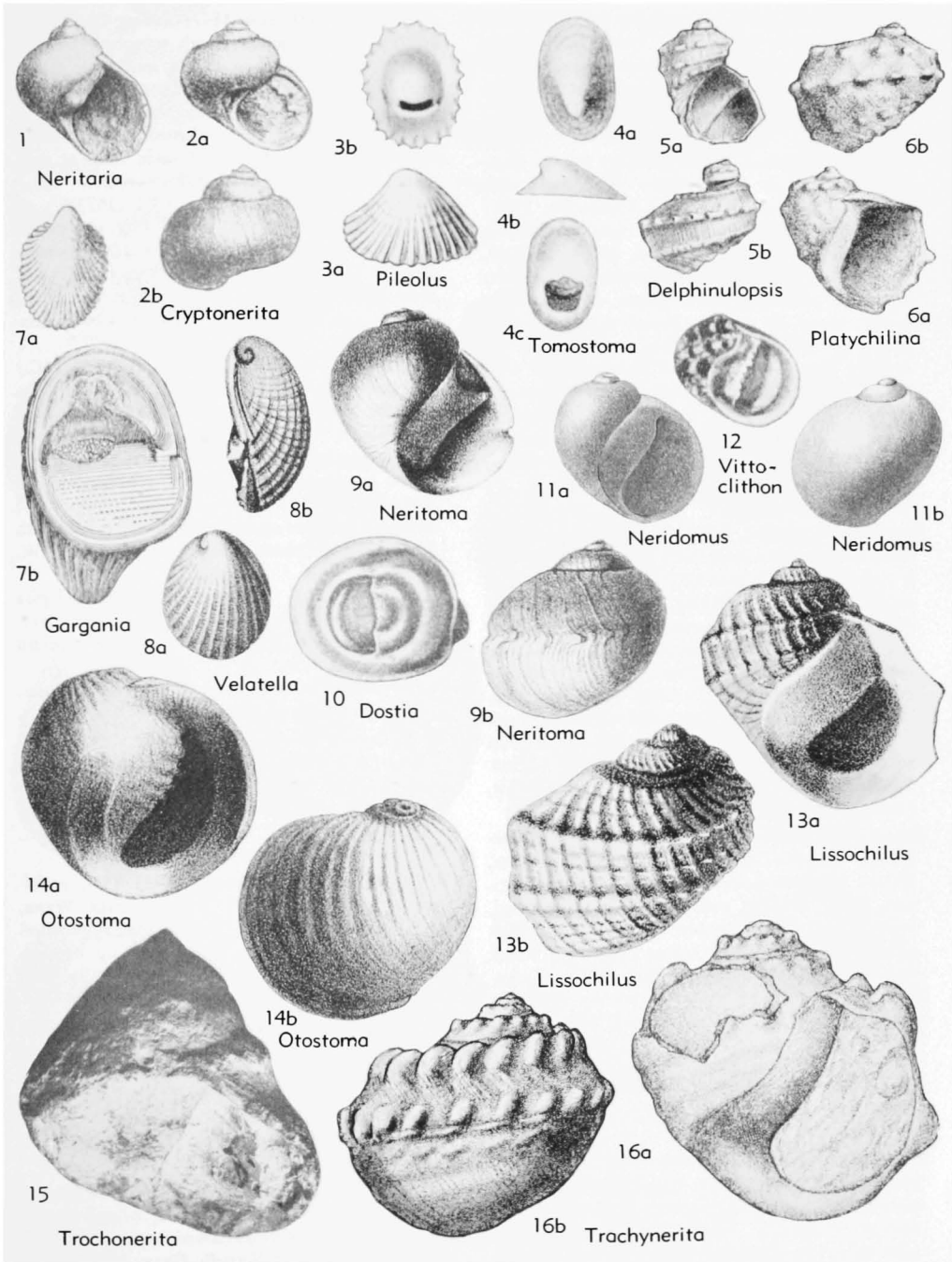


Fig. 183. Neritacea (Neritidae——Neritinae) (p. *I279-I280*, *I284-I285*).

last whorl with one or more angulations; ornament collabral ridges cancellated in same species by spirals; aperture much reduced by inner lip septum which is not dentate along its convex margin, and is continuous with callus rather widespread over base; outer lip bevelled from thick wall to thin edge; shallow adapical channel present. *M. Jur.(Bathon.) - U.Cret.(Senon.)*, cosmop. —— FIG. 183,*13*. **L. sigaretinus* (BUVIGNIER), U.Jur., Fr.; *13a,b*, ×4 (111).

Otostoma D'ARCHIAC, 1859 [**Natica rugosa* ROEMER, 1841 (*non* BOSC, 1801) (=**Natica subrugosa* D'ORBIGNY, 1850); SD COSSMANN, 1925] [=*Desmieria* DOUVILLÉ, 1904 (obj.); *Corsania* VIDAL, 1917; *?Lyosoma* WHITE, 1883]. Globose, with depressed spire and rapidly enlarging whorls; ornament narrow collabral ridges or tuberculate spirals; inner lip septum broad, much reducing aperture, with large teeth along margin; outer lip strongly prosocline. [Original description of *Otostoma*, alleging broad aperture without septum, was based on imperfect specimens; this also was probably the case with *Lyosoma*.] *U.Jur.-Paleoc.*, cosmop.——FIG. 183,*14*. *O. divaricatum* (D'ORBIGNY), U.Cret.(U.Senon.), Hung.; *14a,b*, ×1 (210).

Myagrostoma J.BÖHM, 1900 [**M. plexum*]. Small, much broader than high, with low, obtuse, strongly eccentric spire; whorls with 2 prominent granose carinae, lower one forming periphery; ornament of close-spaced collabrals and spirals; base strongly convex, its outline in apertural view continuous with basal margin of aperture; aperture obliquely extended, constricted by 4 teeth, 2 on inner lip, others respectively on internally thickened basal and outer lips; thin inductura continuous with septum spread rather widely over base. *U.Cret.(Turon.)*, SW.Asia.——FIG. 184,*7*. **M. plexum*, Israel; *7a,b*, ×3 (164).

Tournouerella MUNIER-CHALMAS, 1887 [*pro Tournoueria* MUNIER-CHALMAS, 1884 (*non* BRUSINA, 1870)] [**Tournoueria matheroni* MUNIER-CHALMAS, 1884]. Smooth, oviform, higher than broad, most of shell formed by last 1.5 whorls, to which earlier ones form small obtuse apex; last whorl descending and becoming compressed near aperture; aperture ovate, relatively narrow, appearing when viewed directly to project well below evenly rounded base; inner lip septum oblique, moderately broad, with prominent rounded teeth. *L. Cret.-U.Cret.*, Eu.——FIG. 184,*10*. **T. matheroni* (MUNIER-CHALMAS), U.Cret.(Dan.), Fr.; *10a,b*, ×2 (207).

Mesoneritina YEN, 1946 [**Neritella nebrascensis* MEEK & HAYDEN, 1862]. Small, globose, rather thin-shelled, with slightly protruding, obtuse spire; smooth, commonly retaining zigzag color pattern; inner lip somewhat thickened, with straight or concave, untoothed margin, and not appreciably protruded as septum. *L.Cret.*, N.Am.—— FIG. 184,*3*. **M. nebrascensis* (MEEK & HAYDEN), L.Cret., Wyo.; *3a,b*, ×2 (228).

Nerita LINNÉ, 1758 [**N. peloronta*; SD MONTFORT, 1810] [=*Neritarius* DUMÉRIL, 1806 (obj.); *Dontostoma* HERRMANNSEN, 1847; *Tenare* GRAY, 1858 (obj.)]. Sturdy shells, smooth to spirally ribbed; inner lip septum well developed, its surface (labial area) commonly pustulose or irregularly ribbed. [Mainly marine.] *U.Cret.-Rec.*, cosmop.

N. (Nerita). Outer lip thickened, with 2 teeth; labial area flattened, with 2 large teeth at margin. *Paleoc.-Rec.*, Eu.-IndoPac.——FIG. 185,*1*. **N. peloronta*, Rec., W.Indies; ×1 (147).

N. (Amphinerita) MARTENS, 1887 [**N. umlaasiana* KRAUSS, 1848; SD BAKER, 1923] [=*Odontostoma* MÖRCH, 1852 (*non* TURTON, 1829) (obj.); *Melanerita* MARTENS, 1887]. Smooth or finely striate, oblique; labial area smooth, margin weakly dentate. *U.Cret.-Rec.*, Eu.-IndoPac.

N. (Chingua) CLARK & DURHAM, 1946 [**N. (C.) chinguensis*]. Spiral ribs beaded; labial area smooth. *Eoc.*, S.Am.——FIG. 184,*13*. **N. (C.) chinguensis*, Eoc., Colombia; ×2 (169).

N. (Fluvinerita) PILSBRY, 1932 [**N. (F.) alticola* (=*N. tenebricosa* C. B. ADAMS, 1852)]. Smooth, inner lip straight and smooth, labial area narrow; outer lip thin; no opercular stop; operculum with minute granulations. [Fresh-water.]. *Rec., W.* Indies.

N. (Heminerita) MARTENS, 1887 [**N. pica* GOULD, 1859 (*non* GMELIN, 1791) (=*N. japonica* DUNKER, 1859)]. Finely striate; operculum granular. *Rec.*, Pac.

N. (Puperita) GRAY, 1857 [**N. pupa* LINNÉ, 1758]. Small ovate, smooth. *Mio.-Rec.*, W.Indies.

N. (Ritena) GRAY, 1858 [**N. plicata* LINNÉ, 1758] [=*Pila* MÖRCH, 1852 (*non* RÖDING, 1798); *Cymostyla* MARTENS, 1887]. Spire moderately elevated; outer lip toothed; labial area irregularly costate, with several teeth at margin. *Eoc.-Rec.*, Eu.-Afr.-trop.Am.-IndoPac.

N. (Semineritina) COSSMANN, 1925 [**N. mammaria* LAMARCK, 1804] [=*Seminerita* WENZ, 1938 (obj.)]. Small, with regularly incised growth lines; outer lip thin, inner lip dentate. *U.Cret.(Turon.)-Eoc.*, cosmop.——FIG. 184,*2*. *N. (S.) mammaria*, Eoc., Fr.; *2a,b*, ×3 (147).

N. (Theliostyla) MÖRCH, 1852 [**N. albicilla* LINNÉ, 1758; SD KOBELT, 1879] [=*Natere* GRAY, 1858 (obj.); *Ilynerita* MARTENS, 1887]. Low-spired, outer lip regularly dentate within; labial area granulate, sinuate and finely dentate at margin. *U.Cret.(Senon.)-Rec.*, Eu.-IndoPac.-trop. Am.

Neritina LAMARCK, 1816 [**Nerita pulligera* LINNÉ, 1766 (ICZN Op. 119, 1931)] [=*Laphrostoma* RAFINESQUE, 1815 (obj.); *Lamphrostoma, Lamprostoma* AUCTT. (obj.); *Neritella* GRAY, 1848 (obj.); *Chernites* GISTEL, 1848 (obj.); *Clypeolum* RÉCLUZ, 1850 (*non* RÉCLUZ, 1842); *Labialia, Onychina*

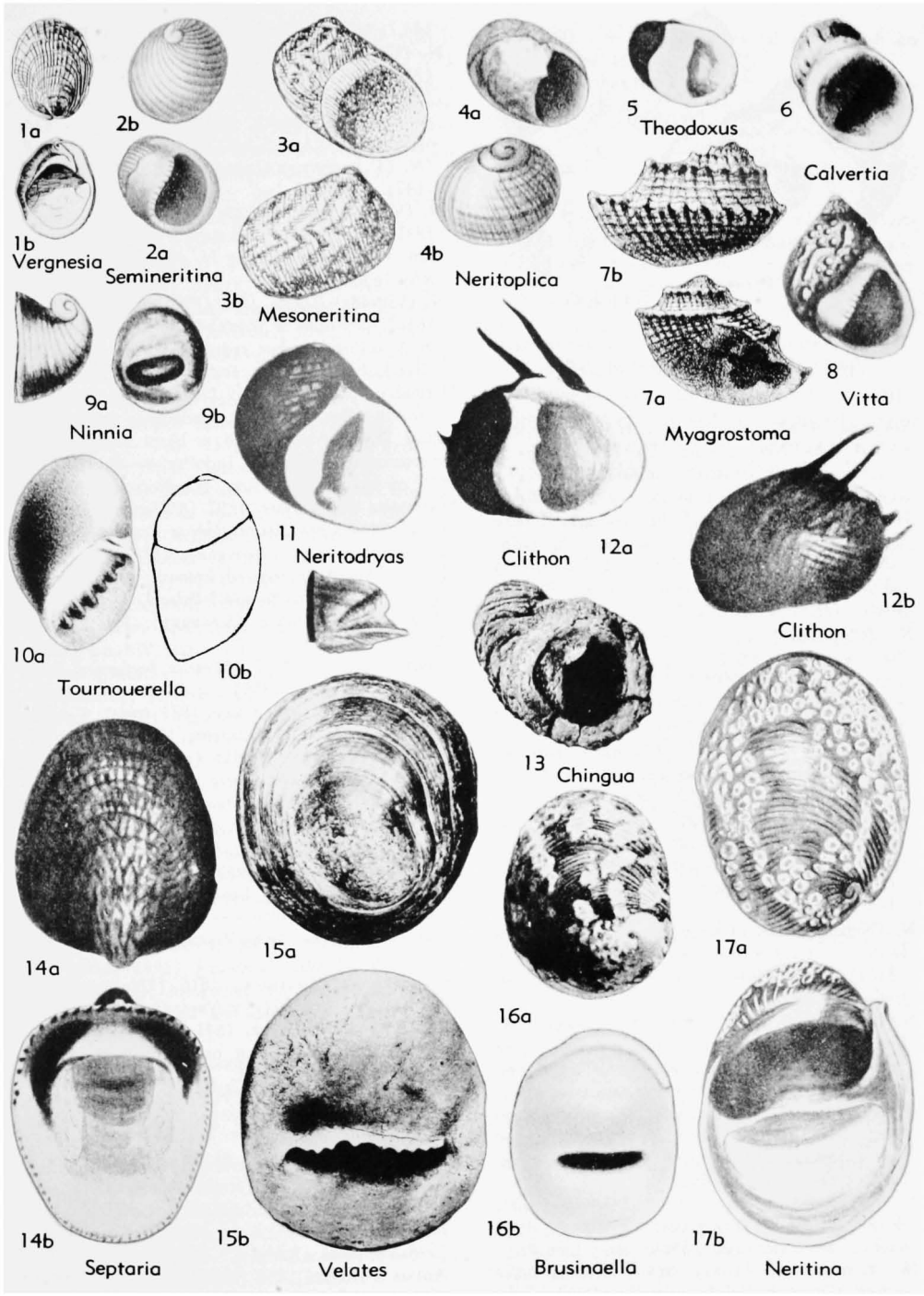


FIG. 184. Neritacea (Neritidae-Neritinae) (p. *I*282-*I*285).

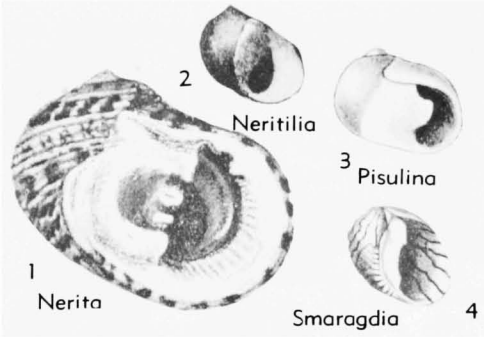


FIG. 185. Neritacea (Neritidae——Neritinae, Neritiliinae, Smaragdiinae) (p. *I*282, *I*285).

SCUDDER, 1882 (obj.)]. Smaller and thinner-shelled than *Nerita*; outer lip thin, inner lip smooth or finely dentate. [Marine, brackish, or fresh-water.] *Eoc.-Rec.*, cosmop.

N. (Neritina). Relatively large, low-spired; outer lip overriding last whorl in a projecting point; labial area broad, flat. *Rec.*, IndoPac.——FIG. 184,*17*. **N.* (*N.*) *pulligera* (LINNÉ), Rec. E. Indies; *17a,b*, ×1 (147).

N. (Clypeolum) RÉCLUZ, 1842 [**N. latissima* BRODERIP, 1833; SD PILSBRY & BEQUAERT, 1927] [=*Alina* RÉCLUZ, 1842 (*non* RISSO, 1826)]. Aperture flaring, especially posteriorly; height greater than width. *Mio.-Rec.*, C.Am.

N. (Dostia) GRAY, 1847 [**Nerita crepidularia* LAMARCK, 1822 (=*N. violacea* GMELIN, 1791)] [=*Mitrula* RÉCLUZ, 1850 (*non* GRAY, 1821) (obj.)]. Apertural margin entire, labial area shield-shaped, with arcuate and finely toothed edge. *Eoc.-Rec.*, Eu.-IndoPac.——FIG. 183,*10*. **N. (D.) violacea* (GMELIN), *Rec.*, E.Indies; ×1 (147).

N. (Nereina) CRISTOFORI & JAN, 1832 [**Nereina lacustris* (=*Neritina punctulata* LAMARCK, 1816)]. Spire bluntly elevated. *Mio.-Rec.*, W. Indies.

N. (Neripteron) LESSON, 1830 [**N. taitensis*; SD BAKER, 1923] [=*Neritopteron* FISCHER, 1885 (obj.)]. Like *N. (Dostia)* but more elongate and with labial area less symmetrical. *Rec.*, IndoPac.

N. (Neritona) MARTENS, 1869 [**N. labiosa* SOWERBY, 1841]. Larger than *N. (Dostia)*, labial area expanded above, aperture narrower; operculum ribbed. *Rec.*, IndoPac.

N. (Provittoida) BAKER, 1923 [**Nerita smithi* WOOD, 1828] [=*Provittoidea* WENZ, 1938 (obj.)]. Spire elevated, pointed. *Rec.*, Indo-Pac.

N. (Pseudonerita) BAKER, 1923 [**Neritina holosericea* GARRETT, 1872]. Small, oblique-ovate, spire elevated; inner lip sinuate, finely dentate. [Brackish water.] *Rec.*, S.Pac.

N. (Vergnesia) DELPEY, 1940 [**V. mopelleti*]. Dilated, concentrically striate. *Eoc.*, Fr.——FIG. 184,*1*. **N. (V.) morelleti* (DELPEY), U.Eoc., Fr.

N. (Vitta) MÖRCH, 1852 [**Nerita virginea* LINNÉ, 1758; SD BAKER, 1923] [=*Scapha* MÖRCH, 1852 (*non* RÉCLUZ, 1841) (obj.)]. Spire elevated, pointed; shell smooth, inflated; inner lip toothed. *Mio.-Rec.*, N.Am.-S.Am.-W.Afr.——FIG. 184,*8*. **N. (V.) virginea* (LINNÉ), Rec., W.Indies; ×1 (147).

N. (Vittina) BAKER, 1923 [**N. roissyana* RÉCLUZ, 1841] [=*Paranerita* BOURNE, 1909 (*non* HAMPSON, 1901)]. Resembling *N. (Vitta)* but smaller. *Rec.*, Indo-Pac.

N. (Vittoida) BAKER, 1923 [**N. variegata* LESSON, 1830] [=*Vittoidea* WENZ, 1938 (obj.)]. Shell as in *N. (Vittina)*, but radula differing in details. [Brackish water.] *Rec.*, Indo-Pac.

Neritodryas MARTENS, 1869 [**Nerita cornea* LINNÉ, 1758; SD BAKER, 1923]. Moderately large, spire blunt; labial area smooth, a blunt tooth below; operculum ribbed. *Rec.*, IndoPac.——FIG. 184,*11*. **N. cornea* (LINNÉ), Rec., E.Indies; ×1 (147).

Neritoplica OPPENHEIM, 1892 [*"*Neritina globulus* FÉR." (*errore pro Nerita globosa* FERUSSAC, 1823) =*Neritina uniplicata* SOWERBY, 1823; SD WENZ, 1938)]. Small, low-spired, smooth; with fold on inner lip. *M.Jur.(Bathon.)-Paleoc.*, Eu.——FIG. 184,*4*. **N. uniplicata* (SOWERBY), Paleoc., Fr.; *4a,b*, ×2 (147).

Septaria FÉRUSSAC, 1807 [**Patella borbonica* BORY DESAINT VINCENT, 1803] [=*Cimber* MONTFORT, 1810 (obj.); *Septarius* GRAY, 1821 (obj.); *Catillus* GRAY, 1847 (*non* BRONGNIART, 1822) (obj.); *Cibota* ADAMS & ADAMS, 1858 (*non* HERRMANNSEN, 1852) (obj.); *Laodia, Paria* GRAY, 1868]. Shell almost isostrophic; last whorl large; aperture expanded; thin labial septum present; subequal muscle scars visible in aperture. *Rec.*, Indo-Pac.

S. (Septaria). Apex projecting beyond left of aperture; labial septum broad. [In swift-flowing streams.] *Rec.*, IndoPac.——FIG. 184,*14*. **S. (S.) borbonica* (BORY DEST.VINCENT), Bourbon I.; *14a-c*, ×1 (147).

S. (Navicella) LAMARCK, 1816 [**N. tessellaria*; SD CHILDREN, 1823] [=*Navicellus* GRAY, 1821 (obj.); *Scapha* RÉCLUZ, 1841 (obj.); *Stenopoma* GRAY, 1868]. Apex not projecting beyond left of aperture. *Rec.*, IndoPac.

S. (Paraseptaria) RISBEC, 1942 [**P. parva*]. Patelliform; operculum horny. [Marine.] *Rec.*, New Caledonia.

S. (Sandalium) SCHUMACHER, 1817 [**Sandalium picta*; SD BAKER, 1923 (?=*Patella porcellana* LINNÉ, 1758)] [*non Sandalium* RETZIUS, 1788 *(nom. nud.); nec* OKEN, 1815 *(nom. nud.)*] [=*Sandalinum* RÉCLUZ, 1841 (obj.); *Elara* ADAMS & ADAMS, 1856 (obj.); *Elana* GRAY, 1867 (obj.)]. Like *S. (Septaria)* but with narrow labial septum. [Fluviatile, in quiet water.] *Rec.*, Indo-Pac.

Theodoxus MONTFORT, 1810 [**T. lutetianus* (=*Nerita fluviatilis* LINNÉ, 1758; ICZN Op. 335,

1955)] [=*Theodoxis* MONTFORT, 1810 (obj.); *Elea* FITZINGER, 1833; *Neritoglobus* KOBELT, 1871 (obj.); *Theodoxia* BOURGUIGNAT, 1877 (obj.); *Theodora, Theodorus* AUCTT. (obj.)]. Small, obliquely ovate, spire low or elevated; labial area smooth, with smooth or dentate margin; operculum smooth. [Fluviatile.] *Oligo.-Rec.,* cosmop.

T. (Theodoxus). Inner lip dentate; operculum without apophysis. *Oligo.-Rec.,* Eu.-W.Asia.——FIG. 184,*5*. **T. (T.) fluviatilis* (LINNÉ), Rec., Ger.; ×1.5 (147).

T. (Alinoclithon) BAKER, 1923 [**Nerita cariosus* WOOD, 1828]. Labial area expanded; opercular apophysis weak. [Fluviatile.] *Rec.,* Hawaiian Is.

T. (Brusinaella) ANDRUSSOV, 1912 [**Neritina petasata* SENINSKI, 1905] [=*Brusinaela* ANDRUSSOV, 1912 (obj.)]. Aperture a narrow slit between widely expanded labial and labral areas. *Plio.,* SW.Asia.——FIG. 184,*16*. **T. (B.) petasatus* (SENINSKI), Plio., Caucasus; *16a,b,* ×2 (147).

T. (Calvertia) BOURGUIGNAT, 1880 [**C. letournouxi* = *Neritina sinjana* BRUSINA, 1876; SD WENZ, 1929] [=*Burgersteinia, Petrettinia, Saint-Simonia, Tripaloia* BOURGUIGNAT, 1880; *Neritodonta* BRUSINA, 1884]. Obliquely ovate, spire somewhat elevated; blunt tooth or ridge on lower muscle scar; operculum with apophysis. *Mio.-Plio.,* Eu.-SW.Asia.——FIG. 184,*6*. **T. (C.) sinjanus* (BRUSINA), U.Plio., Dalmatia; ×2 (147).

T. (Clithon) DEMONTFORT, 1810 [**Nerita corona* LINNÉ, 1758] [=*Cliton* LESSON, 1830 (obj.); *Corona* RÉCLUZ, 1850 (*non* ALBER, 1850) (obj.)]. With a subsutural row of spines or nodes. [Fluviatile or brackish.]. *Plio.-Rec.,* IndoPac.-Japan.——FIG. 184,*12*. **T. (C.) corona* (LINNÉ), Rec., Mauritius; *12a,b,* ×1 (147).

T. (Meganninia) DAVIDACHVILI, 1932 [**T. corrugata* DAVIDACHVILI, 1930]. Resembling *Neritina (Neripteron)* in form but with less apparent spire. *Plio.,* SW.Asia.

T. (Neritaea) ROTH, 1855 [**Neritina jordani* SOWERBY, 1841] [=*Neritoconus* KOBELT, 1871 (obj.)]. Spire somewhat cylindrical, high; inner lip weakly arched and dentate. *Plio.-Rec.,* SW. Asia.-E.Afr.

T. (Neritoclithon) BAKER, 1923 [**Neritina neglecta* PEASE, 1860]. *Rec.,* Hawaiian Is.

T. (Neritonyx) ANDRUSSOV, 1912 [**Neritina unguiculatus* SENINSKI, 1905]. Resembling *Crepidula;* labial area finely granulate. *Plio.,* SW.Asia.

T. (Ninnia) WESTERLUND, 1903 [**Neritina schultzi* GRIMM, 1877]. Small, labial area wide and deep; aperture contracted. *Plio.-Rec.,* SW. Asia.——FIG. 184,*9*. **T. (N.) schultzi* (GRIMM), Rec., Caspian Sea; *9a,b,* ×2 (147).

T. (Ninniopsis) TOMLIN, 1930 [**Neritaea colchica* ANDRUSSOV, 1912]. Resembling *T. (Ninnia)* but larger; labial area flatter. *Plio.,* SW.Asia.

T. (Pictoneritina) IREDALE, 1936 [**Neritina oualaniensis* LESSON, 1831]. Like *T. (Vittoclithon)* but with one large and several small teeth on inner lip. *U.Mio.-Rec.,* IndoPac.

T. (Vittoclithon) BAKER, 1923 [**Neritina meleagris* LAMARCK, 1822]. Small, smooth; inner lip weakly arched, with one tooth. *Paleoc.-Rec.,* Eu. trop.Am.-IndoPac.——FIG. 183,*12*. **T. (V.) meleagris* (LAMARCK), Rec., Sumatra; ×1.5 (147).

Velates DEMONTFORT, 1810 [**V. conoideus* (=*Nerita perversa* GMELIN, 1791)]. Large, spire concealed; resembling *Crepidula;* inner lip serrate. *U.Cret.(Cenom.)-Eoc.,* Eu.-Asia-Afr.-N.Am.——FIG. 184,*15*. **V. perversus* (GMELIN), Eoc., Fr.; *15a,b,* ×0.7 (147).

Subfamily NERITILIINAE Baker, 1923

[*nom. correct.* WENZ, 1938 (*ex* Neritilinae BAKER, 1923)]

Small, ovate, smooth, unicolored; inner lip smooth; operculum without ribs or apophyses. [Fresh-water.] *Rec.*

Neritilia MARTENS, 1879 [**Neritina rubida* PEASE, 1867]. Aperture oblique. *Rec.,* tropics.——FIG. 185,*2*. **N. rubida* (PEASE), Rec., Tahiti; ×3 (147).

?**Septariellina** BEQUAERT & CLENCH, 1936 [**S. congolensis*]. Minute; aperture large, ovate-quadrate. *Rec.,* W.Afr.

Subfamily SMARAGDIINAE Baker, 1923

[*nom. correct.* WENZ, 1938 (*ex* Smaragdinae BAKER, 1923)]

Small, obliquely ovate; operculum with ribs and an apophysis. [Marine.] *Mio.-Rec.*

Smaragdia ISSEL, 1869 [**Nerita viridis* LINNÉ, 1758; SD KOBELT, 1879] [=*Gaillardotia* BOURGUIGNAT, 1877 (obj.)]. Spire low, aperture narrow. *Mio.-Rec.,* Carib.-IndoPac.-Medit.

S. (Smaragdia). Aperture nearly the height of the shell. *Mio.-Rec.,* Carib.-IndoPac.——FIG. 185,*4*. **S. viridis* (LINNÉ), *Rec.,* Medit.; ×2 (147).

S. (Smaragdella) BAKER, 1923 [**Neritina hellvillensis* CROSSE, 1881]. *Rec.,* IndoPac.

S. (Smaragdista) IREDALE, 1936 [**Smaragdista tragena*]. Aperture 0.75 height of shell. *Rec.,* IndoPac.

?**Magadis** MELVILL & STANDEN, 1899 [**M. eumerintha*]. Spire low, aperture large; sculpture of irregular axial folds. *Rec.,* Austral.

Pisulina NEVILL & NEVILL, 1869 [**P. adamsiana*]. Smooth, with 1 or 2 large teeth on inner lip. *Rec.,* India.——FIG. 185,*3*. **P. adamsiana,* Ceylon; ×3 (147).

Family HELICINIDAE Latreille, 1825

[*nom. correct.* GRAY, 1840 (*ex* Helicinides LATREILLE, 1825)] [=Helicinadae GUILDING, 1828; Helicinaceae MENKE, 1828; Oligogyradae GRAY, 1847] [Acknowledgment of information and advice generously furnished on the Helicinidae by Dr. H. BURRINGTON BAKER is here recorded with appreciation]

Land snails of small to medium size, few-whorled, conical to lenticular; inner walls of whorls resorbed; umbilicus mostly

concealed by columellar lip or filled with a callus pad; operculum semicircular to rhombic, without apophyses, horny, nearly always reinforced exteriorly by a calcareous layer. With pulmonary cavity and no ctenidium. *U.Cret.-Rec.*

?Subfamily DIMORPHOPTYCHIINAE Wenz, 1938

[*nom. correct.* Keen, herein (*pro* Dimorphoptychinae Wenz, 1938)]

Aperture with three parallel parietal folds and basal fold. *U.Cret.-Paleoc.*

Dimorphoptychia Sandberger, 1871 [**Helix arnouldi* Michaud, 1837] [=*?Obbinula* Stache, 1889; *Pseudostrobilus* Oppenheim, 1892]. Small, lenticular, umbilicus not evident; periphery with blunt keel. *U.Cret.(Turon.)-Paleoc.*, Eu.——Fig. 187,*4*. **D. arnouldi* (Michaud), Paleoc., Fr.; ×2 (147).

Subfamily HELICININAE Latreille, 1825

[*nom. transl.* Swainson, 1840 (*ex* Helicinidae, *nom. correct.* Gray, 1840, *pro* Helicinides Latreille, 1825)]

Distinguished by details of radula; lateral teeth 5, including a comb-lateral and an accessory plate. *?Paleoc., Mio.-Rec.*

Helicina Lamarck, 1799 (gen. without sp.), 1801 [**Helix neritella* Lamarck, 1801] [=*Pitonnellus, Pitonnillus* deMontfort, 1810 (obj.); *Colyma* Rafinesque, 1815; *Pachytoma* Swainson, 1840; *Euneritella* Wagner, 1905 (obj.); "FKr"[1] *Amplia* Wagner, 1907; "FKr" *Festiva* Wagner, 1910]. Basal callus pad with a furrow. *?Paleoc., Mio.-Rec.*, N.Am.-C.Am.-S.Am.-Pac.Is.

H. (Helicina). Columella thickened below. *?Neog.-Rec.*, C.Am.-S.Am.——Fig. 186,*1*. **H. neritella* (Lamarck), Rec., Jamaica; *1a,b*, ×2 (147).

H. (Olygyra) Say, 1818 [**O. orbiculata*] [=*Oligyra* Say, 1819 (obj.); "FKr" *Subglobulosa, Succincta* Wagner, 1905]. Turbinate, basal callus large; surface smooth. *?Paleoc., Mio.-Rec.*, N. Am.-S.Am.——Fig. 186,*4*. **H. (O.) orbiculata*, Rec., Ala.; *4a-d*, ×2 (147).

H. (Oxyrhombus) Fischer & Crosse, 1893 [**H. amoena* Pfeiffer, 1845; SD Baker, 1922] [="FKr" *Angulata* Wagner, 1905; "FKr" *Tamsiana* Wagner, 1907]. *Rec.*, C.Am.

H. (Pseudoligyra) Baker, 1954 [**H. tenuis* Pfeiffer, 1849]. *Rec.*, Mex.

H. (Tristramia) Crosse, 1863 [**H. salvini* Tristram, 1861] [=*Caloplisma* Fischer & Crosse, 1893; *Retorquata* Wagner, 1905]. *Rec.*, C.Am.

Alcadia Gray, 1840 [**Helicina major* Gray, 1824; SD Gray, 1847] [=*Isoltia* Guppy, 1859; *Eualcadia* Wagner, 1907; "FKr" *Incrustata, Intusplicata, Palliata, Sericea* Wagner, 1907]. Basal callus large. *Rec.*, C.Am.-W.Indies.

A. (Alcadia). *Rec.*, C.Am.-Carib.

A. (Analcadia) Wagner, 1907 [**Helicina dysoni* Pfeiffer, 1849; SD Baker, 1922]. *Rec.*, Antilles.

A. (Emoda) Adams & Adams, 1856 [**Helicina silacea* Morelet, 1849; SD Baker, 1922] [=*Glyptemoda* Clench & Aguayo, 1950]. Periostracum with axial folds. *Rec.*, Cuba.

A. (Idesa) Adams & Adams, 1856 [**Helicina rotunda* d'Orbigny in Sagra, 1842; SD Baker, 1922] [=*Schrammia* Guppy, 1895; *Leialcadia* Wagner, 1907; "FKr" *Mammilla* Wagner, 1907 (*non* Tryon, 1883); *Hjalmarsona* Baker, 1940; *Weinlandella* Baker, 1954]. *Rec.*, Antilles.

A. (Penisoltia) Baker, 1954 [**Helicina hispida* Pfeiffer, 1839]. *Rec.*, Cuba.

A. (Striatemoda) Baker, 1940 [**Helicina striata* Lamarck, 1822 (*non* Defrance, 1821) = *H. subfusca* Menke, 1828] [=*Diaphana* Guppy, 1895 (*non* Brown, 1827)]. Intermediate between *A. (Emoda)* and *A. (Analcadia)*. *Rec.*, Puerto Rico.

Bourciera Pfeiffer, 1852 [**B. helicinaeformis*] [=*Pseudhelicina* Sykes, 1907]. With paucispiral operculum. *Rec.*, Ecuador.

Ceratopoma Möllendorff, 1893 [**Helicina caroli* Kobelt, 1886] [="FKr" *Diversicolor* Wagner, 1905; *Negopenia* Iredale, 1941 *(nom. nud.)*]. With a peripheral keel. *Rec.*, Pac. Is.

C. (Ceratopoma). *Rec.*, Pac.Is.

C. (Palaeohelicina) Wagner, 1905 [**Helicina fischeriana* Montrouzier, 1863; SD Iredale, 1937] [=*Kalokonia, Rhabdokonia* Wagner, 1905]. *Rec.*, Pac.Is.

Hemipoma Wagner, 1905 [**Helicina hakodadiensis* Hartmann, 1890; SD Wenz, 1938]. Differing only slightly from *Ceratopoma*. *Rec.*, Japan.

Orobophana Wagner, 1905 [**Helicina uberta* Gould, 1847; SD Baker, 1922]. Small, with radial and spiral sculpture; basal callus thick. *Pleist.-Rec.*, Polynesia.——Fig. 186,*2*. **O. uberta* (Gould), *Rec.*, Hawaii; ×3 (147).

Pleuropoma Möllendorff, 1893 [**Helicina dichroa* Möllendorff, 1890; SD Pilsbry & Cooke, 1934] [="FKr" *Albocincta* Wagner, 1908]. Small, periphery keeled. *Pleist.-Rec.*, Pac.

P. (Pleuropoma). Keel obtuse, operculum with cross-lamella. *Pleist.-Rec.*, Pac.——Fig. 186,*3*. **P. dichroa* (Möllendorff), Rec., Philippines; ×3 (147).

P. (Aphanoconia) Wagner, 1905 [**Helicina verecunda* Gould, 1859; SD Gude, 1914] [="FKr" *Pachystoma, Reticulata, Sculpta* Wagner, 1905; *Sphaeroconia* Wagner, 1909 (obj.)]. Keel weak. *Pleist.-Rec.*, Pac.Is.

Schasicheila Shuttleworth, 1852 [**Helicina alata* Pfeiffer, 1848; SD Kobelt, 1880] [=*Schasichila* Fischer, 1885 (obj.); *Atoyac* Baker, 1928 (obj.)]. Operculum semicircular, with strong cal-

[1] The abbreviation "FKr" indicates a name proposed by Wagner for a "Formenkreis," a group of species inferior to a subgenus in taxonomic rank. The status of such names needs clarification, although all of Wagner's names for "Formenkreise" are here regarded as subjective synonyms.

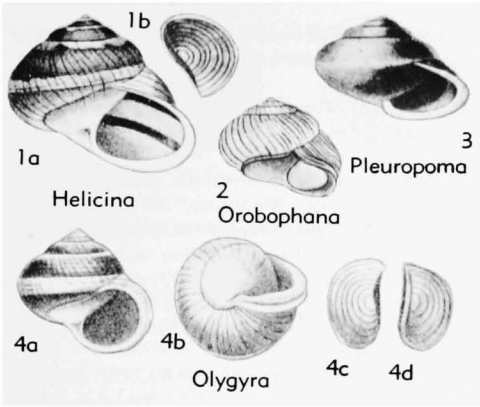


FIG. 186. Neritacea (Helicinidae——Helicininae) (p. *I*286).

careous layer and pointed extensions on edge by columella. *Rec.*, C.Am.

S. (Schasicheila). *Rec.*, C.Am.

S. (Misantla) BAKER, 1928 [**S. misantlensis* FISCHER & CROSSE, 1893]. *Rec.*, C.Am.

S. (Necaxa) BAKER, 1928 [**Helicina minuscula* PFEIFFER, 1859]. *Rec.*, C.Am.

Sturanya WAGNER, 1905 [**Helicina plicatilis* MOUSSON, 1865; SD KOBELT, 1905] [=*Sturanyella* PILSBRY & COOKE, 1934; *Sturyanella* AUCTT. (obj.)]. Basal callus thick on columella. *Rec.*, Polynesia.

Sulfurina MÖLLENDORFF, 1893 [**Helicina citrina* GRATELOUP, 1840] [=*Hypostrongyla* TOMLIN, 1930; *Pestomena* IREDALE, 1941 *(nom. nud.)*]. Thin-shelled, mostly yellow in color, callus thick. *Rec.*, SW.Pac.

S. (Sulfurina). *Rec.*, E.Indies.

S. (Kosmetopoma) WAGNER, 1905 [**Helicina amaliae* KOBELT, 1886]. *Rec.*, Philippines.

Subfamily HENDERSONIINAE Baker, 1926

Reproductive organs typically more primitive than in Helicininae. *?Paleoc., Pleist.-Rec.*

Hendersonia WAGNER, 1905 [**Helicina occulta* SAY, 1831]. Small, thick-shelled, operculum subspiral, nucleus eccentric. *?Paleoc., Pleist.-Rec.*, N.Am.——FIG. 187,*1*. **H. occulta* (SAY), Rec., Iowa; *1a,b*, apertural view and operculum, ×3 (147).

Miluna WAGNER, 1905 [**M. josephinae*]. Operculum subspiral, with submarginal nucleus; aperture without folds. *Rec.*, China.

Waldemaria WAGNER, 1905 [**Helicina japonica* A. ADAMS, 1861; SD BAKER, 1922]. Globose, with fine radial folds. *Rec.*, Japan.

Subfamily PROSERPININAE Gray, 1847

[*nom. transl.* THIELE, 1929 (*ex* Proserpinidae GRAY, 1847)] [=Despoenidae NEWTON, 1891)]

Lenticular to rounded; without operculum. *?Oligo., Rec.*

Proserpina G.B.SOWERBY, 1839 [**P. nitida* (*?=Helicina linguifera* JONAS, 1839)] [=*Despoena* NEWTON, 1891 (obj.)]. Rounded lenticular, glassy, with one or more parietal folds in aperture. *?Oligo., Rec.*, Eu.-W.Indies.

P. (Proserpina). With 2 parietal and 2 palatal folds. *Rec.*, Jamaica.

P. (Despoenella) BAKER, 1923 [**Odontostoma depressa* D'ORBIGNY in SAGRA, 1842] [=*Odontostoma* D'ORBIGNY, 1841 (*non* TURTON, 1829)]. With parietal folds only. *?Oligo., Rec.*, Eu.-W. Indies.——FIG. 187,*5*. **P. (D.) depressa* (D'ORBIGNY), Rec., Cuba; ×4 (147).

Subfamily STOASTOMATINAE C. B. Adams, 1849

[*nom. correct.* KEEN, herein (*ex* Stoastominae, *nom. transl.* BAKER, 1928, *ex* Stoastomidae C.B.ADAMS, 1849)]

Lateral teeth of radula normally with a mushroom-shaped T-lateral and reduced accessory plate; marginals many, mostly multicuspid. *Pleist.-Rec.*

Stoastoma C.B.ADAMS, 1849 [**S. pisum*] [=*Hemicyclostoma* PFEIFFER, 1865 (obj.)]. Minute, umbilicus only partly concealed. *Rec.*, W.Indies.

Eutrochatella FISCHER, 1885 [**Helicina pulchella* GRAY, 1825] [=*Trochatella* SWAINSON, 1840 (*non* LESSON, 1830); *Krebsia* GUPPY, 1895 (*non* MÖRCH, 1877); "FKr" *Excavata* WAGNER, 1907]. Apex pointed, operculum thick, calcareous layer with folds. *Rec.*, C.Am.-W.Indies.

E. (Eutrochatella). *Rec.*, Cuba.

E. (Cubaviana) BAKER, 1922 [**Helicina politula* POEY, 1852]. *Rec.*, Cuba.

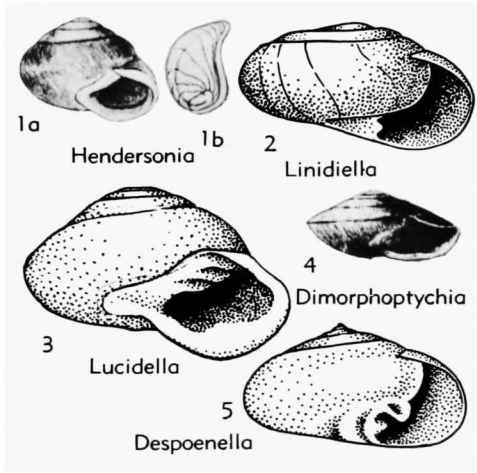


FIG. 187. Neritacea (Helicinidae——Dimorphoptychiinae, Hendersoniinae, Proserpininae, Ceratodiscinae, Proserpinellinae (p. *I*286-*I*288).

E. (Microviana) BAKER, 1928 [**Helicina rupestris* PFEIFFER, 1839]. *Rec.*, Cuba.

E. (Priotrochatella) FISCHER, 1893 [**Helicina constellata* MORELET, 1847]. *Rec.*, Cuba.

E. (Torreviana) AGUAYO, 1943 [**E. (T.) spinopoma*]. *Rec.*, Cuba.

E. (Troschelviana) BAKER, 1922 [**Helicina erythraea* SOWERBY, 1866]. *Rec.*, C.Am.-W.Ind.

E. (Ustronia) WAGNER, 1908 [**Helicina sloanei* D'ORBIGNY, 1845; SD BAKER, 1922]. *Rec.*, Cuba.

Geophorus FISCHER, 1885 [**Helicina agglutinans* SOWERBY, 1842] [=*Pecoviana* IREDALE, 1941 (*nom. nud.*)]. Operculum triangular to trapezoidal, nucleus eccentric. *Rec.*, Orient.

G. (Geophorus). *Rec.*, E.Indies.

G. (Diplopinax) BARTSCH, 1921 [**G. (D.) tagbilleranus*]. *Rec.*, Philippines.

G. (Schistopinax) BARTSCH, 1921 [**G. (S.) siquijorensis*]. *Rec.*, Philippines.

Heudeia CROSSE, 1885 [**Helicina sechuanensis* HEUDE, 1885]. Relatively high-spired, small. *Rec.*, Orient.

H. (Heudeia). Aperture with twisted outer lip. *Rec.*, China.

H. (Calybium) MORLET, 1891 [**C. massiei*]. Low-biconic, with peripheral keel and apertural folds. *Rec.*, India.

H. (Geotrochatella) FISCHER, 1891 [**Helicina mouhoti* PFEIFFER, 1862; SD BAKER, 1922]. Without folds. *Rec.*, IndoChina.

Pyrgodomus FISCHER & CROSSE, 1893 [**Helicina chryseis* TRISTRAM, 1861] [=*Artecallosa* WAGNER, 1908 (obj.)]. Small, high-spired. *Rec.*, trop.Am.

Stoastomops BAKER, 1924 [**S. walkeri*]. Minute, conic, aperture small. *Rec.*, W.Indies.

S. (Stoastomops). *Rec.*, W.Indies.

S. (Swiftella) BAKER, 1941 [**S. (S.) boriqueni*]. *Rec.*, W.Indies.

Viana ADAMS & ADAMS, 1856 [**Helicina regina* MORELET, 1849; SD BAKER, 1922] [=*Ampullina* DEBLAINVILLE, 1824 (*non* BOWDICH, 1822); *Hapata* GRAY, 1856 (obj.); *Rhynchocheila* SHUTTLEWORTH, 1878 (obj.); *Fitzia* GUPPY, 1895]. Relatively large; outer lip with a sinus above periphery. *Rec.*, Cuba.

Subfamily CERATODISCINAE Pilsbry, 1927

Discoid, few-whorled, mostly spirally sculptured. *Rec.*

Ceratodiscus SIMPSON & HENDERSON, 1901 [**C. solutus*]. With fine spiral lines, operculum with calcareous layer. *Rec.*, Antilles.

Fadyenia CHITTY, 1857 [**Stoastoma fadyenianum* C.B.ADAMS, 1849; SD BAKER, 1922] [=*Lindsleya, Metcalfeia* CHITTY, 1857]. Small, spirally sculptured. *Rec.*, W.Indies.

F. (Fadyenia). Depressed to globose-conic. *Rec.*, W.Indies.

F. (Blandia) CHITTY, 1857 [**Stoastoma blandianum* C.B.ADAMS, 1849; SD BAKER, 1922] [=*Petitia, Wilkinsonaea* CHITTY, 1857]. With periostracal expansions on spiral ribs. *Rec.*, W. Indies.

F. (Lewisia) CHITTY, 1857 [**Stoastoma philippiana* C.B.ADAMS, 1850; SD BAKER, 1922]. *Rec.*, W.Indies.

Lucidella SWAINSON, 1840 [**Helix aureola* FÉRUSSAC, 1822] [=*Prosopis* WEINLAND, 1862 (*non* FABRICIUS, 1804)]. Periostracum sculptured; aperture with internal lamellae; operculum with nearly central nucleus. *Mio.-Rec.*, C.Am.-W.Indies.

L. (Lucidella). With spiral striae. *Mio.-Rec.*, W. Indies.——FIG. 187,*3*. **L. aureola* (FÉRUSSAC), Rec., Jamaica; ×3 (147).

L. (Perenna) GUPPY, 1867 [**Helicina lamellosa* (=**H. lirata* PFEIFFER, 1849)]. Depressed, with spiral ridges and keel. *Rec.*, W.Indies.

L. (Poenia) ADAMS & ADAMS, 1856 [**Helicina depressa* GRAY, 1825; SD PILSBRY, 1912] [=*Urichia* GUPPY, 1895]. *Rec.*, W.Indies.

L. (Poeniella) BAKER, 1923 [**Helicina christophori* PILSBRY, 1897]. With radial and spiral striae. *Rec.*, C.Am.-W.Indies.

Subfamily PROSERPINELLINAE Baker, 1923

Size of shell reduced relative to that of soft parts. *Pleist.-Rec.*

Proserpinella BLAND, 1865 [**P. berendti*]. Minute, lenticular, with no apertural folds. *Rec.*, Mex.

Ceres GRAY, 1856 [**Caracolla eolina* DUCLOS, 1834; SD KOBELT, 1880]. Spire nearly flat, base rounded; 2 parietal, 2 palatal folds. *Rec.*, Mex.

Linidiella JOUSSEAUME, 1889 [**Proserpina swifti* BLAND, 1863] [=*Chersodespoena* SYKES, 1900]. With columellar fold. *Pleist.-Rec.*, S.Am.

L. (Linidiella). *Rec.*, N.S.Am.——FIG. 187,*2*. **L. swifti* (BLAND), *Rec.*, Venezuela; ×2 (147).

L. (Staffola) DALL, 1905 [**Proserpina derbyi*] [=*Cyane* H.ADAMS, 1870 (*non* FELDER, 1861)]. Rounded, columellar lamella heavy. *Pleist.*, Brazil.

Family DEIANIRIDAE Wenz, 1938

[*nom. correct* COX, herein (*pro* Dejaniridae WENZ, 1938)]

Rather small, rotelliform, anomphalous; inner walls not resorbed; spire depressed, upper face of whorls bordered by carina; base convex; aperture semicircular; outer lip oblique, notched at carina; inner lip straight, oblique, with 2 or 3 plications extending onto labial area, which is continued by callus spread broadly over base; operculum calcareous, with marginal nucleus from which curved groove runs to notch in opposite margin; color pattern commonly preserved. *U.Cret.(Campan.-Dan.)*, Eu.

Deianira STOLICZKA, 1860 [**Rotella bicarinata* ZEKELI, 1852; SD COSSMANN, 1909] [=*Dejanira* LEYMERIE, 1881 (obj.); *Leymeria* MUNIER-CHAL-

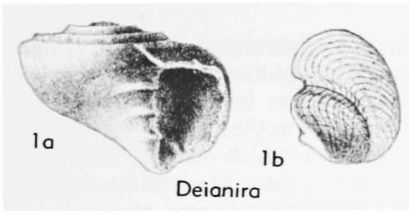


FIG. 188. Neritacea (Deianiridae) (p. *I*288).

MAS, 1884]. With characters of family.——FIG. 188,*1*. *D. bicarinata* (ZEKELI), U.Cret.(Dan.), Aus.; *1a*, apertural view, ×1.8 (apparent verticality of inner lip due to foreshortening; *1b*, operculum ×5 (222).

Family PHENACOLEPADIDAE Thiele, 1929

[=Scutellinidae DALL, 1889]

Conical or cap-shaped shells with apex turned backward and near posterior margin; muscle scar horseshoe-shaped, opening anteriorly. No operculum. *Eoc.-Rec.*

Phenacolepas PILSBRY, 1891 [**Scutella crenulata* BRODERIP, 1834] [*pro Scutella* BRODERIP, 1834 (*non* LAMARCK, 1816); *Scutellina* GRAY, 1847 (*non* AGASSIZ, 1841); *Scutulina* COSSMANN, 1912 (obj.)]. With rugose radial ribs; apertural margin arched, not in one plane. *Rec.*, tropics.-Atl.-Pac.

P. (Phenacolepas).——FIG. 189,*1*. **P. (P.) crenulata* (BRODERIP), Rec., S.Pac.; ×1 (147).

P. (Amapileus) IREDALE, 1929 [**A. immeritus*]. *Rec.*, Austral.

P. (Cinnalepeta) IREDALE, 1929 [**Patella cinnamomea* GOULD, 1848]. *Rec.*, Pac.

P. (Zacalantica) IREDALE, 1921 [**P. linguaviverrae* MELVILL & STANDEN, 1899]. *Rec.*, Pac.

Plesiothyreus COSSMANN, 1888 [**Capulus parmophoroides* COSSMANN, 1885]. Low, apex overhanging margin. *Eoc.-Rec.*, Eu.-China.——FIG. 189,*2*. **P. parmophoroides* (COSSMANN), Eoc., Fr.; ×2 (147).

Family HYDROCENIDAE Troschel, 1856

[*nom. correct.* GILL, 1871 (*ex* Hydrocenacea TROSCHEL, 1856)]

Small or minute shells, ovate, slender-spired, inner whorls resorbed; no umbilicus; operculum calcareous, semicircular, with eccentric, terminal nucleus, strong apophysis within. [Air-breathing land forms with pulmonary cavity; mostly living near coast.] *Pleist.-Rec.*

Hydrocena PFEIFFER, 1847 [**Cyclostoma cattaroense* PFEIFFER, 1841]. Smooth or spirally sculptured. *Pleist.-Rec.*, Medit.-Afr.-Pac.-E.Asia.

H. (Hydrocena). Thin, broadly conical, spire of several whorls; smooth. *Pleist.-Rec.*, Medit.-Afr.-SE.Asia-Pac.——FIG. 189,*4*. **H. cattaroensis* (PFEIFFER), Rec., Dalmatia; *4a*, apertural view, ×5; *4b,c*, operculum, exterior and side views, ×10 (147).

H. (Chondrella) PEASE, 1871 [**Cyclostoma parvum* PEASE, 1864]. Operculum ribbed within. *Rec.*, S.Pac.

H. (Georissa) BLANFORD, 1864 [**Hydrocena pyxis* BENSON, 1856] [=*Omphalorissa* IREDALE, 1933 (*nom.nud.*)]. Spirally ribbed. *Rec.*, SE.Asia-Pac.

H. (Georissopsis) PILSBRY & HIRASE, 1908 [**Georissa (Georissopsis) heudei* PILSBRY & HIRASE, 1908]. Operculum large. *Rec.*, China.

Family TITISCANIIDAE Bergh, 1890

[*nom. correct.* PILSBRY, 1892 (*pro* Titiscaniien BERGH, 1890)]

Marine snails without shell or operculum, anatomically related to Neritidae, with pallial cavity and ctenidium. *Rec.*

Titiscania BERGH, 1890 [**T. limacina*]. *Rec.*, Mauritius-Pac.Is.

NERITACEA Family UNCERTAIN

Neritacean fossils are particularly difficult to classify if the systematic descriptions are based on fragmentary or badly preserved material. The following generic names have been proposed for material that is certainly neritacean but quite impossible to assign more closely. Probably all are synonymous with other names and most of them belong to the Neritopsidae.

Hypodema DE KONINCK, 1853 [**Calceola dumontiana* DE KONINCK, 1843; SD KNIGHT, 1937]. Genus based on heavy, thick conical naticopsoid opercula; associated shell unknown. *L. Carb.*, Eu.

Platyostomella ETHERIDGE, JR., 1880 [**Littorina scotoburdigalensis* ETHERIDGE, 1878] [=*Platystomella* LINDSTRÖM, 1884 (obj.)]. Genus based on

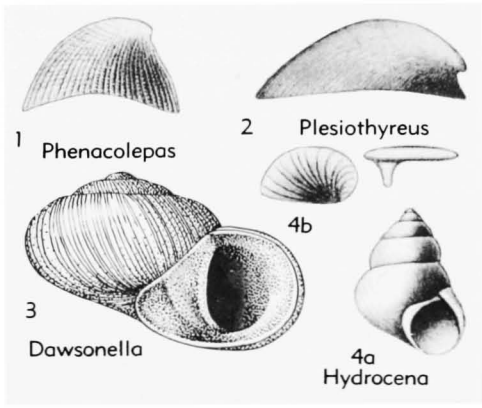


FIG. 189. Neritacea (Dawsonellidae, Phenacolepadidae, Hydrocenidae) (p. *I*279, *I*289).

juvenile specimens probably referable to one or more subgenera of *Naticopsis*. *L.Carb.*, Eu.

Catinella STACHE, 1877 [*non* PEASE, 1871] [**C. depressa*]. Name invalid; genus based on unrecognizable steinkerns. *M.Perm.*, Eu.

Neritomopsis WAAGEN, 1880 [**N. minuta*]. Based on a single badly preserved and unrecognizable specimen. *M.Perm.*, SC.Asia.

Catubrina CANEVA, 1906 [**Neritomopsis (Catubrina) solitaria*]. Based on steinkerns, supposedly with resorbed inner whorls, a neritid feature. Even if this is true, the species and genus are unrecognizable. *M.Perm.*, Eu.

Proboscidia MERLA, 1931 [*non Proboskidia* BORY DE ST.VINCENT, 1827] [**Neritomopsis (Proboscidia) elongata*]. Name invalid; applied to a species represented by steinkerns supposedly with resorbed inner whorls. Species and genus unrecognizable. *M.Perm.*, Eu.

?ARCHAEOGASTROPODA
Suborder MURCHISONIINA
Cox & Knight, 1960

Shell commonly high-spired, with numerous whorls; outer lip with submedian sinus which may culminate in slit or notch and which was presumably exhalant in function; inner shell layers seemingly not nacreous; some genera with incipient abapical apertural canal; paired ctenidia are inferred to have been present by analogy with the Pleurotomariina, but if the abapical canal was inhalant in function, the respiratory system may have undergone evolutionary advances beyond the condition characteristic of that suborder. *?U.Cam., L.Ord.-U.Trias.*

This suborder has been erected for reception of the superfamily Murchisoniacea. It is thought that this was a stock derived from the Archaeogastropoda and still retaining certain features of that order, but showing advances in some characters along lines of evolution that led to Caenogastropoda (= Pectinibranchia). The question of transferring this group from the Archaeogastropoda (in which it has been included previously) to the Caenogastropoda has been considered, but owing to the difficulty of deciding from the available evidence if archaeogastropod or caenogastropod characters predominated, it has been decided to retain the assemblage in the more primitive order, querying such reference in order to emphasize the borderline position that it occupied.

The Murchisoniacea have a labral slit or notch thought to have been exhalant in function. This indentation lies slightly above or below the middle of the labrum in a position which strongly supports the view that a pair of ctenidia inside the mantle cavity were located on opposite sides of the slit, with the anal opening between them, as in the Pleurotomariacea, from which they were probably derived. If, in accordance with past general practice, we consider the presence of the labral emargination to indicate that the Murchisoniacea were essentially pleurotomarian in nature, it would be presumed that they possessed aspidobranch ctenidia and a rhipidoglossate radula; that is, that they agreed with the Archaeogastropoda in a combination of important anatomical characters. This conclusion, however, is not inevitable. Conchologically, the Murchisoniacea show so many points of resemblance to the Cerithiacea that it may be suggested that they were ancestral to that superfamily. As in the Cerithiacea, for instance, murchisoniacean shells seem to lack a nacreous lining; moreover, they are markedly high-spired, many-whorled forms that commonly exhibit a tendency to develop an inhalant canal. Hence there is at least a possibility that in soft anatomy, as well as in shell characters, they were measurably advanced towards a cerithiacean organization; that is, they may well have had ctenidia of pectinibranch type and a taenioglossate radula, or structures transitional thereto.

The Murchisoniacea appear to have been closely related and probably ancestral to the Loxonematacea, and it may well be that the Cerithiacea were more immediately derived from the Loxonematacea, wherein a deep U-shaped labral sinus, present in earlier genera, gradually disappears, suggesting progressive loss of the right-hand ctenidium and consequent adjustments in the pallial complex. If this was the case, transition from a partly archaeogastropod to a caenogastropod organization may have taken place during the evolutionary history of the Loxonematacea. This superfamily here is assigned to the Caenogastropoda.

It must, however, be remembered that the high-spired forms included in the Cerithiacea form only one group of the Caenogastropoda. We do not suggest that

all caenogastropods were descended from Murchisoniacea, whether directly or through the Loxonematacea. The turbiniform and other low-spired caenogastropods were probably derived from such archaeogastropod groups as the Trochonematacea, in which the right-hand ctenidium had, apparently, already disappeared.

Superfamily MURCHISONIACEA Koken, 1896

[*nom. transl.* Knight, Batten & Yochelson, herein (*ex* Murchisoniidae Koken, 1896)]

Labral sinus culminating in a sharp notch or short slit; incipient inhalant canal present in some genera. *?U.Cam., L.Ord.-U.Trias.*

Family MURCHISONIIDAE Koken, 1896

[=Hormotominae Wenz, 1938]

With labral sinus, commonly culminating in short slit or notch that generates a selenizone. *?U.Cam., L-Ord.-U.Trias.*

?Protospira Ruedemann, 1916 [**P. minuta*]. Small, moderately high-spired, with relatively high whorls; apertural lips unknown. [Genus based on species now represented by a single poorly preserved specimen. It is the only high-spired gastropod known from Cambrian rocks, and this is all that can be said about it. Tentatively placed in the Murchisoniidae, the form could as well be loxonematacean.] *U.Cam.,* N.Am.

?Gasconadia Ulrich in Weller & St. Clair, 1928 [**Murchisonia putilla* Sardeson, 1896]. Small, with spire not quite so high as usual in family; labrum with angular sinus that culminates at bluntly angular periphery without slit or selenizone, gerontic aperture with widely flaring lips; with radially elongate internal tooth on floor of whorl about half-whorl back from aperture (possibly marking attachment for left-hand member of a pair of retractor muscles). *L.Ord.,* N.Am.—Fig. 190,*1*. **G. putilla* (Sardeson), Mo.; *1a,* apertural view, ×2.7; *1b,* base of steinkern with impression of internal tooth, ×4.

Murchisonia d'Archiac & deVerneuil, 1841 [**Turritella bilineata* Dechen, 1832, *pro Murex turbinatus* (Schlotheim) Dechen, 1832 (*non Murex turbinatus* Brocchi, 1814) =*Muricites turbinatus* Schlotheim, 1820; SD Woodward, 1856]. With labral sinus culminating at about middle of labrum in shallow slit or notch; commonly without ornament other than margins of selenizone and growth lines. [In Middle Devonian close relatives of type species display a burst of forms with elaborate, in part bizarre, shapes and ornament quite incongruous with usual conservatism shown by genus. Recognized subgenera are more or less intergrading.] *Ord.-Trias.,* N.Am.-Eu.-NE.Asia-SE.Asia-Austral.

M. (Turritoma) Ulrich in Ulrich & Scofield, 1897 [**Murchisonia acrea* Billings, 1865] [= *Turritospira* Ulrich in Ulrich & Scofield, 1897 (obj.)]. Slit and selenizone at periphery, relatively low on whorl. *L.Ord.-Sil.,* N.Am.—Fig. 190,*2*. **M. (T.) acrea* (Billings), L.Ord., Can.(Newf.); ×2.

M. (Hormotoma) Salter, 1859 [**Murchisonia gracilis* Hall, 1847; SD Donald, 1885]. Whorls rounded, with relatively deep sutures, mid-whorl periphery with slit and selenizone. *Ord.Sil.,* N. Am.-Eu.-NE.Asia.—Fig. 190,*3*. **M. (H.) gracilis* (Hall), M.Ord., Can.(Que.); ×2.

M. (Murchisonia) [=*Goniostropha* Oehlert, 1888; *Cyrtostropha* Donald, 1902; *Mesocoelia* Perner, 1907]. Selenizone between pair of cords; periphery at mid-whorl, somewhat angular; sutures relatively shallow. [The Middle Devonian burst of bizarre forms occurs in this subgenus.] *L.Sil.-Perm., ?Trias.,* N.Am.-Eu.-SE.Asia-Austral. —Fig. 190,*5*. **M. (M.) bilineata* (Dechen), M.Dev., Ger.; ×2.7.

M. (Sinuspira) Perner, 1907 [**S. tenera*] [= *Morania* Horny, 1953 (57, p. 190)]. Sinus culminating in narrow notch with sides not quite parallel and hence not properly defined as slit. *U.Sil.,* Eu.—Fig. 190,*8*. **M. (S.) tenera,* Czech.; ×2.7.

M. (Hormotomina) Grabau & Shimer, 1909 [**Murchisonia maia* Hall, 1861]. Selenizone with median spiral thread between bordering threads. *M.Dev.,* N.Am.—Fig. 190,*4*. **M. (H.) maia* (Hall), Ohio; ×1.3.

Ectomaria Koken, 1896 [**Murchisonia nieszkowskii* F. Schmidt, 1858] [=*Solenospira* Ulrich & Scofield, 1897]. With deep angular labral sinus culminating between pair of strong spiral cords, without slit, rounded apex of the sinus generating a pseudoselenizone. *M.Ord.-U.Ord.,* N.Am.-Eu. —Fig. 190,*11*. *E. pagoda* (Salter), M.Ord., Can.(Que.); ×2.7.

Catazone Perner, 1907 [**Murchisonia (Catazone) cuneus*]. Differs from *Michelia* in having true slit that generates relatively broad selenizone low on whorls. *U.Sil.,* Eu.—Fig. 190,*6*. **C. cuneus* (Perner), Czech.; ×1.

Biangularia Spitz, 1907 [**Pleurotomaria (Biangularia) frechi*]. Spire laterally compressed and twisted in clockwise direction; selenizone arched, bordered by deep striae. *L.Dev.,* Eu.—Fig. 190,*9*. **B. frechi* (Spitz), Aus.; ×1 (132).

Lodanaria Dahmer, 1925 [**L. munda*]. With widely expanded aperture at gerontic stage; whorls angular; ornament of spiral threads. *L.Dev.,* Eu. —Fig. 190,*10*. **L. munda,* Ger.; posterior view showing spire and cast of expanded aperture, ×0.5.

Ptychocaulus Perner, 1907 [**Murchisonia verneuili*

KOKEN, 1889]. Large, very high-spired, narrowly phaneromphalous; whorls wide, flat-sided with flat selenizone bordered by striae; base flat; with flange spiralling up columella within whorls. [Structural details of the columellar flange are not well understood; it may have been partly membranous and not simply shelly. Nothing is known of its function.] *L.Dev.*, Eu.——FIG. 190,*12*. **P. verneuili* (KOKEN), Czech.; posterior view with window showing columellar ridge, ×1.3.

Michelia F.A.ROEMER, 1852 [**M. cylindrica*; SD KNIGHT, 1937] [=*Coelocaulus* OEHLERT, 1888;

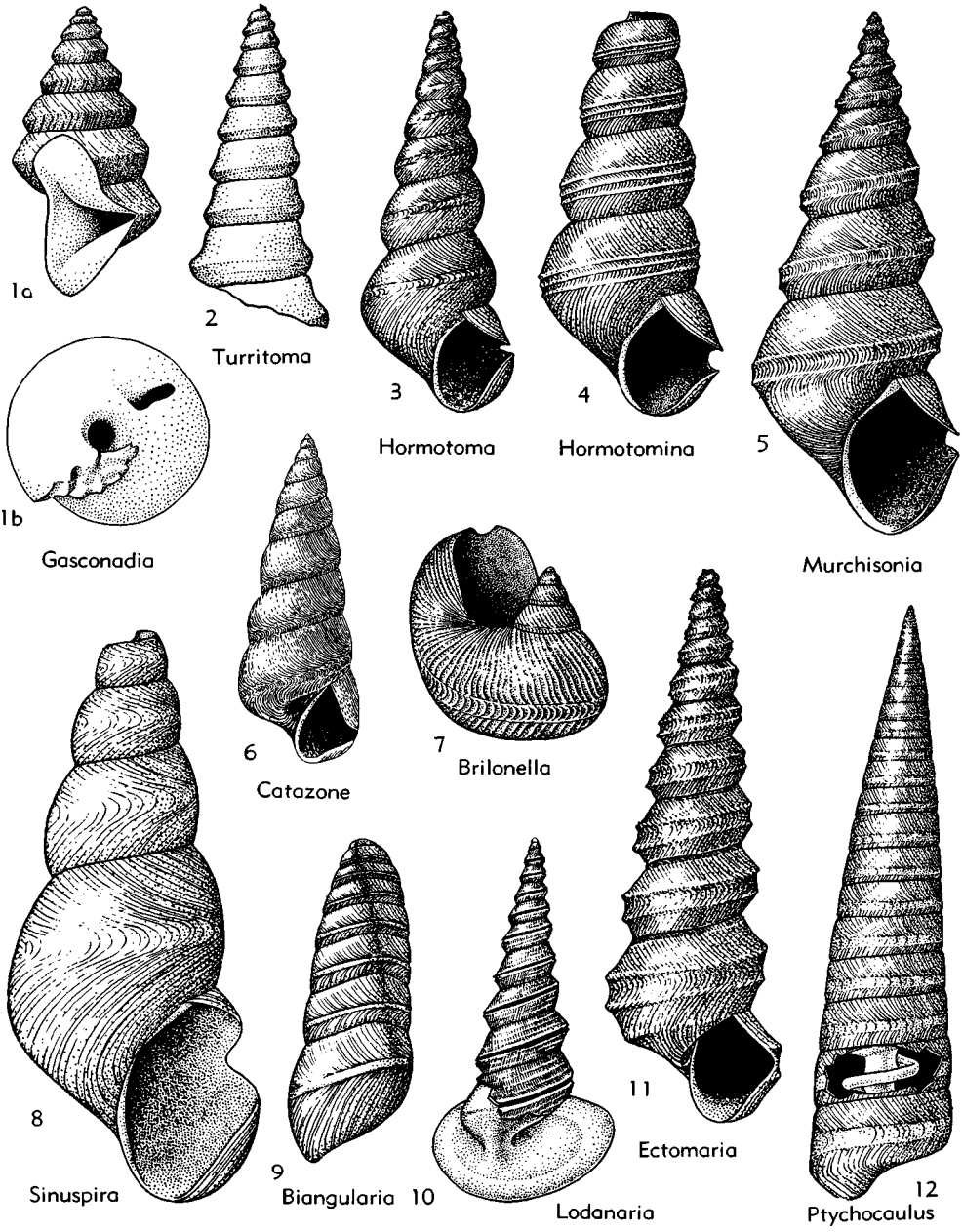


FIG. 190. Murchisoniacea (Murchisoniidae) (p. *I291-I293*).

Vetotuba ETHERIDGE, JR., 1890; *Coelidium* CLARKE & RUEDEMANN, 1903; ?*Melissosoa* CLARKE, 1909]. Narrowly phaneromphalous; with angular sinus culminating in short small notch without parallel sides, resulting pseudoselenizone not sharply limited; sutures shallow. *Ord.-Dev.*, N.Am.-Eu.-Austral.——FIG. 191,*1*. *M. davidsoni* (OEHLERT), L.Dev., Fr.; ×1.3.

?Brilonella KAYSER, 1873 [**Scoliostoma serpens* KAYSER, 1872]. Spire relatively low and whorls few, final one turning upward and backward so that aperture faces backward; slit seemingly shallow, bordered by sharp threads; with collabral ornament of sharp threads. *M.Dev.*, Eu.——FIG. 190,*7*. **B. serpens* (KAYSER), Ger.; posterior view showing twisted final whorl, ×2.7.

Aclisina DEKONINCK, 1881 [**Murchisonia striatula* DEKONINCK, 1843; SD S.A.MILLER, 1889] [= *Aclisoides* DONALD, 1898 (obj.); *Rhabdospira* DONALD, 1898]. Whole whorl, including selenizone, covered by numerous spiral threads; slit short. *L.Carb.(Miss.)*, N.Am.-Eu.-NC.Asia.——FIG. 191, *4*. **A. striatula* (DEKONINCK), Belg.; ×2.7.

Micrentoma DONALD, 1898 [**Aclisina nana* DE KONINCK, 1881]. Small, with attenuated apex, anomphalous; sinus shallow, apparently culminating in notch that generates a pseudoselenizone; ornament 5 or 6 spiral cords cut into nodes by collabral striae. *L.Carb.*, Eu.——FIG. 191,*2*. **M. nana* (DEKONINCK), Belg.; ×4.

Cerithioides HAUGHTON, 1859 [**C. telescopium*] [=*Glyptobasis* DEKONINCK, 1881 (*non* MCLACHLAN, 1871)]. Large, with tapering apex, moderately high whorls and shallow sutures; base nearly flat, anomphalous; ornamented with spiral grooves; shallow slit somewhat below middle of labrum gives rise to flat selenizone not bordered by threads or striae. *L.Carb.*, Eu.——FIG. 191,*10*. **C. telescopium*, Ire.; ×0.7.

Glyphodeta DONALD, 1895 [**Murchisonia zonata* DONALD, 1887]. Selenizone arched gently and bordered by striae; with several broad spiral low cords separated by striae below selenizone but without ornament above it. *L.Carb.(Miss.)-M. Perm.*, Eu.-N.Am.——FIG. 191,*7*. *G. terebriformis* (HALL), M.Miss., Ind.; ×4.7.

Stegocoelia DONALD, 1889 [**Murchisonia (Stegocoelia) compacta*]. With spiral threads or carinae; short slit and selenizone above periphery; shape variable, basis of differentiation of intergrading subgenera. *L.Carb.(Miss.)-M.Perm.*, Eu.-N.Am.-SE.Asia.

S. (Stegocoelia). Spire relatively low, whorls commonly rounded. *L.Carb.(Miss.)-U.Carb.(Penn.)*, Eu.-N.Am.-SE.Asia.——FIG. 191,*5*. **S (S.) compacta* (DONALD), L.Carb., Scot.; ×12.

S. (Hypergonia) DONALD, 1892 [**Murchisonia quadricarinata* M'COY, 1844]. Spire high, relatively slender. *L.Carb.(Miss.)-U.Carb.(Penn.)*, Eu.-N.Am.-SE.Asia.——FIG. 191,*12*. **S. (H.) quadricarinata* (M'COY), L.Carb., Ire.; ×4.

S. (Taosia) GIRTY, 1939 [**Murchisonia copei* WHITE, 1881]. Spire relatively high, with projecting angulation around base and selenizone in flat area above; in some species basal angulation bears row of nodes (47, p. 21). *Penn.(U.Carb.)-M.Perm.*, N.Am.-Eu.-SE.Asia.——FIG. 191,*14*. **S. (T.) copei* (WHITE), M.Penn., N.Mex.; ×1.3.

Goniasma TOMLIN, 1930 [*pro Goniospira* GIRTY, 1915 (*non* COSSMANN, 1895; *nec* DONALD, 1902)] [**Murchisonia lasallensis* WORTHEN, 1890]. Whorls with smooth slope above angular periphery; labrum with angular sinus that culminates just below periphery in short slit which generates slightly concave, inwardly sloping selenizone; with pair of spiral threads below selenizone, upper one located at or above lower suture; some species with faint indication of siphonal canal. *Penn.(U.Carb.)-M.Perm.*, N.Am.-S.Am.-Eu.——FIG. 191,*11*. **G. lasallense* (WORTHEN), U.Penn., Ill.; ×4.

Cibecuia WINTERS, 1956 [**C. cedarensis*]. Side of whorls flat, conformable to sides of spire; sutures linear; shallow labral sinus culminating in short slit; base anomphalous; convex columellar lip reflexed; ornament faint subsutural nodes and spiral threads on base (151, p.44). *M.Perm.*, N.Am.——FIG. 191,*3*. **C. cedarensis*, Ariz.; ×2.7.

Helicospira GIRTY, 1915 [**Murchisonia buttersi* GIRTY, 1912]. Whorls with angular periphery bearing a wavy double-crested selenizone; ornament very fine spiral and widely spaced collabral threads. [Somewhat resembles Triassic *Trypanocochlea* TOMLIN, 1931.] *Perm.* or *Trias.*, N.Am. ——FIG. 191,*13*. **H. buttersi* (GIRTY), Colo.; ×2.7.

Cheilotomona STRAND, 1928 [*pro Cheilotoma* KOKEN, 1889 (*non* DEJEAN, 1835)] [**Pleurotoma blumi* MÜNSTER, 1841; SD DIENER, 1926]. Small; periphery at mid-whorl and carinate in most forms, carrying or forming lower border of well-marked slit and selenizone, which are also bordered above by spiral cord; ornament spiral cords and collabral threads; aperture with distinct spout as incipient inhalant canal. *M.Trias.(Anis.)-U.Trias.(Carn.)*, Eu.——FIG. 191,*6*. **C. blumi* (MÜNSTER), M. Trias.(Ladin.), S. Tyrol; *6a,b*, apertural views, ×2 (64,89).

Trypanocochlea TOMLIN, 1931 [*pro Verania* KOKEN, 1896 (*non* KROHN, 1846)] [**Verania cerithioides* KOKEN, 1896]. Small, anomphalous; whorls angular with periphery at mid-height carrying raised selenizone bearing pointed nodes at intervals and bordered by pair of cords; sutures with spiral cord each side; slit unknown; columella with about 6 weak folds. *U.Trias.(Carn.)*, Aus.——FIG. 191,*9*. **T. cerithioides*; ×5 (79).

Vistilia KOKEN, 1896 [**V. klipsteini*; SD WOODWARD, 1897]. Narrowly phaneromphalous or cryptomphalous; whorls angular, with sharp periphery at mid-height carrying or forming lower border of

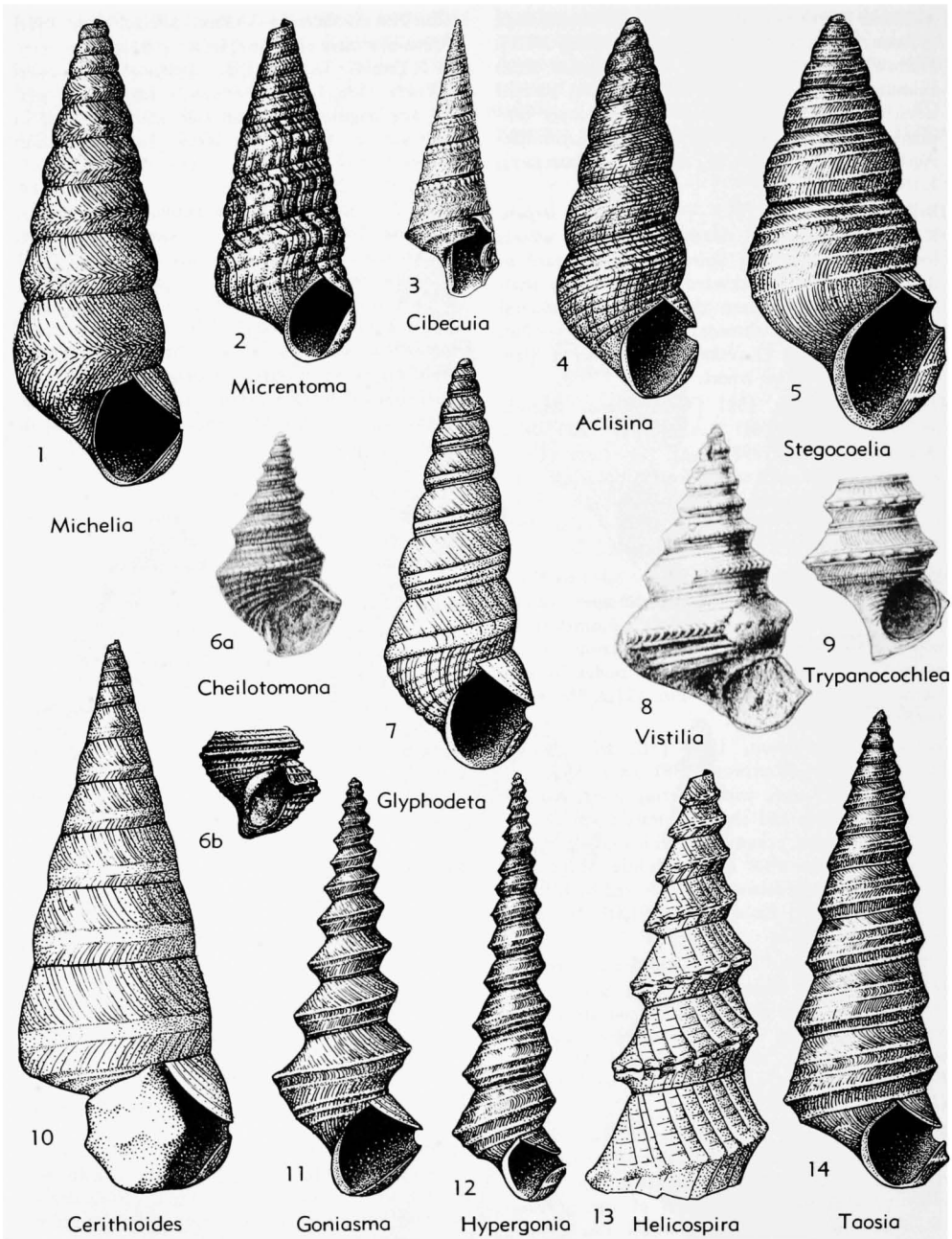


FIG. 191. Murchisoniacea (Murchisoniidae) (p. *I292-I293*).

selenizone with conspicuous lunulae; slit unknown; ornament spiral cords. *M.Trias.(Anis.)-U.Trias.(Nor.)*, Eu.——Fig. 191,*8*. **V. klipsteini* (Koken), U.Trias.(Nor.), Aus.; ×2 (79).

Family PLETHOSPIRIDAE Wenz, 1938

[*nom. transl.* Knight, Batten & Yochelson, herein (*ex* Plethospirinae Wenz, 1938)]

Spire height variable, mostly not high; with ill-defined siphonal canal. *L.Ord.-U.Trias.*

Subfamily PLETHOSPIRINAE Wenz, 1938

Broadly fusiform, with ill-defined siphonal canal; shallow slit occurring rather high on labrum but with selenizone approximately at mid-whorl between sutures. *L.Ord.-L.Dev.*

Plethospira Ulrich in Ulrich & Scofield, 1897 [**Holopea cassina* Whitfield, 1886]. Base narrow, canal relatively broad; ornament wanting except for growth lines. *L.Ord.-M.Sil.*, N.Am.-Eu.——Fig. 192,*1*. **P. cassina* (Whitfield), L.Ord., USA(Vt.); apertural view showing siphonal canal, ×0.7.

Seelya Ulrich in Ulrich & Scofield, 1897 [**S. ventricosa*]. Rounder than *Plethospira* and with raised selenizone; ornament low spiral cords. *L. Ord.-M.Sil.*, N.Am.-Eu.——Fig. 192,*8*. **S. ventricosa*, L. Ord., USA(Vt.); ×1.3.

Diplozone Perner, 1907 [**D. innocens*]. Base relatively broad, canal narrow; ornament sharp collabral threads. *U.Sil.-L.Dev.*, Eu.——Fig. 192,*4*. **D. innocens*, L.Dev., Czech.; apertural view of juvenile shell showing siphonal canal, ×5.3.

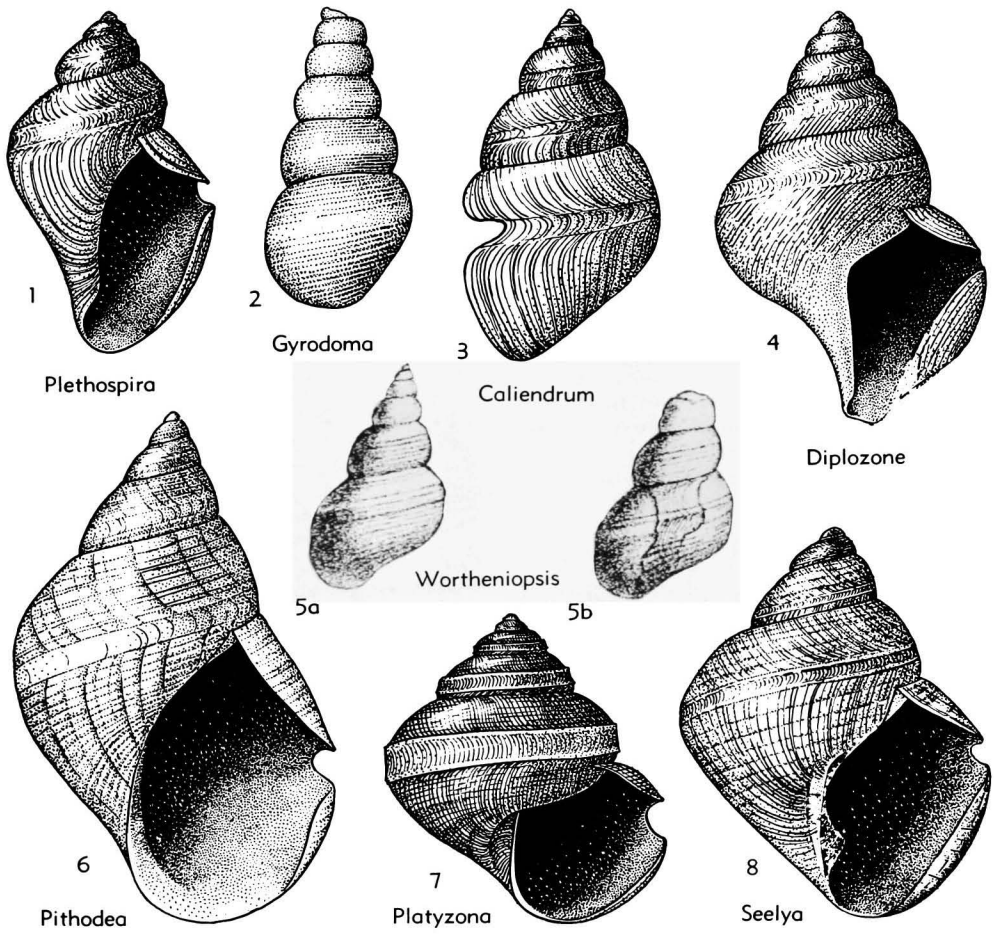


Fig. 192. Murchisoniacea (Plethospiridae——Plethospirinae, Pithodeinae) (p. *1295-1296*).

Subfamily PITHODEINAE Wenz, 1938

Base with little or no development of a canal; slit shallow and relatively wide, selenizone wide and flat. *Dev.-U.Trias.*

?**Gyrodoma** ETHERIDGE, JR., 1898 [**Eunema etheridgei* CRESSWELL, 1893]. Relatively high-spired, with rounded whorls and deep sutures; selenizone broad, flat; ornament numerous spiral threads, except on selenizone. [Little is known of apertural margins.] *Dev.*, Austral.——FIG. 192,*2*. **G. etheridgei* (CRESSWELL); ×0.7 (69).

Platyzona KNIGHT, 1945 [**Pleurotomaria trilineata* HALL, 1858]. Moderately high-spired to turbiniform, minutely phaneromphalous; ornament dominantly spiral cords which commonly are separated by faint grooves into groups of 3 on base, but also including sparse faint collabral growth lines; suggestion of a canal in some species (72, p.579). *Dev.-M.Perm.*, N.Am.-Eu.——FIG. 192,*7*. **P. trilineata* (HALL), M.Miss., Ind.; ×3.3.

Pithodea DEKONINCK, 1881 [**P. amplissima*]. Robust, somewhat fusiform, anomphalous; ornament numerous spiral cords. *L.Carb.*, Eu.——FIG. 192,*6*. **P. amplissima*, Belg.; ×0.5.

Caliendrum BROWN, 1838 [**Buccinum vittatum* PHILLIPS, 1836 [=*Foordella* LONGSTAFF, 1912]. Much like *Pithodea* but with somewhat deeper sutures and lacking spiral ornament. *L.Carb.(Miss.)-U.Carb.(Penn.)*, Eu.-N.Am.——FIG. 192, *3*. **C. vittatum* (PHILLIPS), L.Carb., Eng.; ×1.

Wortheniopsis J.BÖHM, 1895 [**Pleurotomaria margarethae* KITTL, 1894]. Ovate-conical, acute-spired, anomphalous; whorls evenly convex or with narrow sutural ramp; selenizone narrow, high on whorl side, bordered above by ramp angle when present; ornament spiral threads and growth lines symmetrically recurved to selenizone. *M.Trias.(Ladin.)-U.Trias.(Nor.)*, Eu.——FIG. 192,*5*. **W. margarethae* (KITTL), M.Trias.(Ladin.), S. Tyrol; *5a,b*, abapertural views, ×1.5 (65).

?ARCHAEOGASTROPODA
Superfamilies of Doubtful Subordinal Position

Superfamily CLISOSPIRACEA S. A. Miller, 1889

[*nom. transl.* KNIGHT, BATTEN & YOCHELSON, herein (*ex* Clisospiridae MILLER, 1889)]

Trochiform or patelliform, with base seemingly represented by a narrow but gradually widening lamella that spirals upward inside shell; Shell structure unknown. *L.Ord.-M.Dev.*

These curious gastropods are not well known or understood, and there is not much evidence as to their systematic position. Certain resemblances to some of the Calyptraeacea are thought to indicate convergence rather than relationship.

Family CLISOSPIRIDAE S. A. Miller, 1889

With characters of superfamily. *L.Ord.-M.Dev.*

Subfamily CLISOSPIRINAE S. A. Miller, 1889

[*nom. transl.* KNIGHT, BATTEN & YOCHELSON, herein (*ex* Clisospiridae S.A.MILLER, 1889)]

Shell sinistral. *L.Ord.-Sil.*

Mimospira KOKEN, 1925 [**Onychochilus helmhackeri* PERNER, 1900; SD KNIGHT, 1937]. Without (?or with only a very narrow) frill; sutures mod-

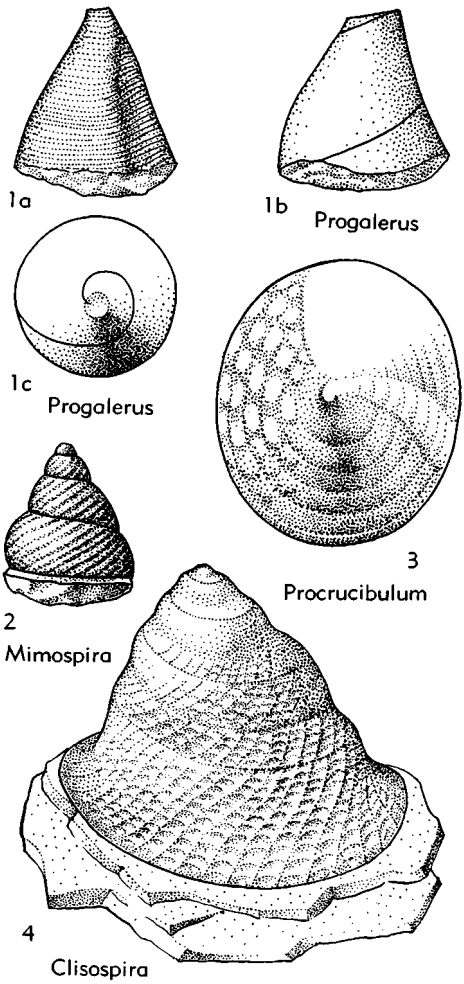


FIG. 193. Clisospiracea (Clisospiridae——Clisospirinae, Progalerinae) (p. *I296-I297*).

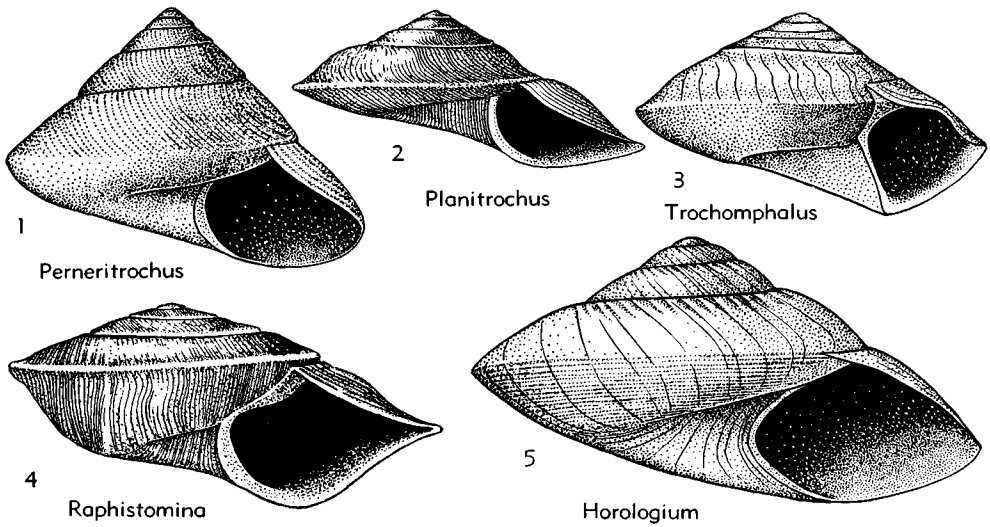


FIG. 194. Pseudophoracea (Planitrochidae) (p. *I*297-*I*298).

erately deep; outer lip and collabral ornament strongly prosocline; base and aperture unknown. *L.Ord.*, Eu.——FIG. 193,*2*. **M. helmhackeri* (PERNER), Czech.; ×2 (80).

Clisospira BILLINGS, 1865 [**C. curiosa*]. With wide frill; sutures shallow; outer lip prosocline; ornament obliquely cancellate; base and aperture unknown. *L.Ord.-Sil.*, N.Am.-Eu.-NE.Asia.——FIG. 193,*4*. **C. curiosa*, Can.(Que.); ×2.7.

Subfamily PROGALERINAE Knight, 1956

Shell dextral. *L.Dev.-M.Dev.*

?Procrucibulum PERNER, 1911 [**Calyptraea simplex* PERNER, 1903; SD COSSMANN, 1911]. Patelliform, with slightly twisted apex and low sharp ridge within running in a broad clockwise curve from apex to margin. *L.Dev.*, Eu.——FIG. 193,*3*. **P. simplex* (PERNER), Czech.; apical view, ×2.

?Paragalerus PERNER, 1903 [**P. holzapfeli*]. Sutures rather deep, outer lip strongly prosocline; ornament fine collabral threads. [Too poorly known to warrant a restoration.] *L. Dev.*, Eu.

Progalerus HOLZAPFEL, 1895 [**P. conoideus*]. High conical, with base represented by a lamella spiralling up inside shell; ornament fine growth lines encircling test. *M.Dev.*, Eu.——FIG. 193,*1*. **P. conoideus* (HOLZAPFEL), Ger.; *1a*, side view; *1b,c*, steinkern, inside and apical view showing spiral suture, ×1.3.

Superfamily PSEUDOPHORACEA S. A. Miller, 1889

[*nom. transl.* KNIGHT, BATTEN & YOCHELSON, herein (*ex* Pseudophoridae S.A.MILLER, 1889)]

Trochiform, with either gently rounded phaneromphalous base and subangular periphery or concave base within a more or less extended frill; evidence of nacreous inner shell layers found in some genera referred to each subfamily, but information wholly lacking for others. *L.Ord.-Miss.*

Family PLANITROCHIDAE Knight, 1956

With gently rounded phaneromphalous base and subangular periphery. *L.Ord.-U.Sil.*

Raphistomina ULRICH & SCOFIELD, 1897 [**Raphistoma lapicida* SALTER, 1859] [=*Rotellomphalus* PERNER, 1903]. Lenticular, with sharp carina at periphery, suture falling beneath carina; with channel inside angular periphery and upper surface of peripheral carina flattened. *L.Ord.-Sil.*, N.Am.-Eu.——FIG. 194,*4*. **R. lapicida* (SALTER), M.Ord. Can.(Que.); ×2.7.

Trochomphalus KOKEN, 1925 [**Euomphalus dimidiatus* KOKEN, 1896]. Somewhat lenticular, with suture falling above sharp periphery; upper whorl surface with low rounded spiral ridge; umbilicus moderately wide, bordered by sharp angles. *U. Ord.*, Eu.——FIG. 194,*3*. **T. dimidiatus* (KOKEN), Est.; ×2.5 (80).

?Nematrochus PERNER, 1903 [**N. concurrens*]. High trochiform, with strongly prosocline outer lip and umbilicus plugged with a concave callus. [Too poorly known to warrant reconstruction.] *U.Sil.*, Eu.

Planitrochus PERNER, 1903 [**P. amicus*; SD PERNER, 1907]. Depressed trochiform, with sharp carinate periphery and moderately wide umbilicus; outer lip prosocline above and below periphery; ornament above periphery consisting of collabral

threads, below of growth lines only. *U.Sil.*, Eu. ——FIG. 194,2. **P. amicus*, Czech.; ×1.3.

Horologium PERNER, 1907 [**H. kokeni*]. Somewhat like *Planitrochus* but larger and less depressed; ornament above periphery wide radiating undulations or narrow subsutural ramp and below periphery numerous fine spiral threads. *U.Sil.*, Eu.——FIG. 194,5. **H. kokeni*, Czech.; ×1.

Perneritrochus COSSMANN, 1909 [*pro Conotrochus* PERNER, 1907 (*non* PILSBRY, 1889)] [**Trochus? venalis* PERNER, 1903]. Similar to *Plantitrochus* but higher and with more rounded noncarinate periphery and narrower umbilicus; ornament above suture collabral threads, below suture unknown. *U.Sil.*, Eu.——FIG. 194,1. **P. venalis* (PERNER), Czech.; ×2.

Family PSEUDOPHORIDAE S. A. Miller, 1889

[=Palaeonustidae WENZ, 1938)

Conical, base flat or concave within surrounding frill. *Sil.-M.Perm.*

Siluriphorus COSSMANN, 1918 [**Trochus gotlandicus* LINDSTRÖM, 1884]. Trochiform, with flat or concave cryptomphalous base; periphery commonly bluntly angular but in some specimens with a blunt, frill-like border; ornament strong, irregular growth lamellae, weaker on base and strongly prosocline. *M.Sil.*, Eu.——FIG. 195,9. **S. gotlandicus* (LINDSTRÖM), Gotl.; ×2.

Hystricoceras JAHN, 1894 [**H. spinosum*]. With concave, anomphalous base surrounded by about 12 semitubular projections on frill-like edge of upper whorl surface. *U.Sil.*, Eu.——FIG. 195,4. **H. spinosum*, U.Sil., Czech.; ×1.

Pseudophorus MEEK, 1873 [**Trochita antiqua* MEEK, 1872] [=*Flemingia* DEKONINCK, 1881 (*non* JOHNSTON, 1845); *Flemingella* KNIGHT, 1936 (*pro Flemingia* DEKONINCK, 1881)]. With narrowly phaneromphalous base surrounded by wide frill formed by extension of upper whorl surface; collabral ornament strongly prosocline growth lines above periphery. *Sil.-Miss.(L.Carb.)*, N.Am.-Eu. ——FIG. 195,2. *P. profundus* (LINDSTRÖM), M.Sil., Gotl.; ×2 (90).

Pseudotectus PERNER, 1903 [**P. carinatus*] [= *Palaeonustus* PERNER, 1903]. High, with gently convex anomphalous base surrounded by a moderately wide frill. *L.Dev.*, Eu.——FIG. 195,7. **P. carinatus*, Czech.; ×1.3.

Scalaetrochus ETHERIDGE, JR., 1890 [**Trochus (Scalaetrochus) lindstroemi*]. Trochiform, with rather low whorls and nearly flat cryptomphalous base surrounded by narrow frill; callus deposit beginning in aperture and filling peripheral angle; collabral lines moderately prosocline on upper surfaces. *Dev.*, Austral.——FIG. 195,1. **S. lindstroemi* (ETHERIDGE, JR.), ×0.7.

Astralites WHITEAVES, 1892 [**A. fimbriatus*]. With nearly flat cryptomphalous base surrounded by digitate and fluted frill; columellar lip with 2 internal grooves passing back about 0.5 whorl and separated by ridge; ornament of upper whorl surface consisting of broadly convex prosocline collabral undulations crossed by discontinuous spiral cords; base with growth lines alone. [The 2 grooves passing inward around the columella strongly suggest by their position and abrupt inward termination that they were loci of a pair of retractor muscles.] *M.Dev.*, N.Am.-Eu.——FIG. 195,3. **A. fimbriatus*, Can.(Man.); ×1.3.

Protocalyptraea CLARKE, 1894 [**P. marshalli*]. Fragile; with very strongly prosocline outer lip; base rather deep within frill but without narrow lamella spiralling up conical shell. [Present interpretation differs somewhat from that of KNIGHT (69) and even more markedly from that of CLARKE, who interpreted it as having the characters here attributed to *Progalarus*.] *U. Dev.*, N.Am. ——FIG. 195,5. **P. marshalli*, USA(N.Y.); ×10.

Eotrochus WHITFIELD, 1882 [**Pleurotomaria concava* HALL, 1858 =*Pleurotomaria tenuimarginata* S.A.MILLER, 1877, *pro P. concava* HALL, 1858 (*non* DESHAYES, 1836)]. With flat base within short frill; narrowly phaneromphalous with lamella spiralling up within umbilicus from base of inner lip; ornament spiral threads on base and growth lines above. *M.Miss.*, N.Am.——FIG. 195,6. **E. tenuimarginatus* (S.A.MILLER), Ind.; apertural view, with window showing spiral umbilical lamella, ×5.5.

Sallya YOCHELSON, 1956 [**S. linsa*]. With very gently convex narrowly phaneromphalous base within narrow frill; no spiral lamella within umbilicus; labrum strongly prosocline to margin of frill; labium entirely within frill; ornament growth lines alone or spiral lines on base and ripple-like structures or radiating buttress-like ribs on sides (154, p.205). *M.Perm.*, N.Am.——FIG. 195,8. **S. linsa*, Tex., ×4.

Superfamily CRASPEDOSTOMATACEA Wenz, 1938

[*nom. transl.* COX & KNIGHT, herein (*ex* Craspedostomatidae WENZ, 1938) ICZN pend.]

Little-known, problematic gastropods mostly with expanded apertures in gerontic stages; shell structure unknown. *U.Ord.-Jur.*

This probably polyphyletic and artificial group is imperfectly known and the taxonomic positions of the various genera are insecure.

Family CRASPEDOSTOMATIDAE Wenz, 1938

[=Brochidiinae, Dichostasiinae YOCHELSON, 1956]

Mostly naticiform, with deep sutures and strong collabral ornament. *U.Ord.-Jur.*

?**Umbonellina** KOKEN, 1925 [**U. infrasilurica*]. Naticiform, umbilicus plugged with callus; otherwise little known. *U.Ord.*, Eu.——FIG. 196,*3*. **U. infrasilurica*, Est.; ?×1 (80).

?**Bucanospira** ULRICH in ULRICH & SCOFIELD, 1897 [**B. expansa*]. Naticiform, with final quarter of last whorl in some specimens disjunct; apertural margins explanate at irregular intervals; ornament of spiral cords and collabral threads. *M.Sil.*, N.Am. ——FIG. 196,*1*. **B. expansa*, Tenn.; ×2.

Craspedostoma LINDSTRÖM, 1884 [**C. elegantulum*; SD PERNER, 1907]. Naticiform; outer lip explanate

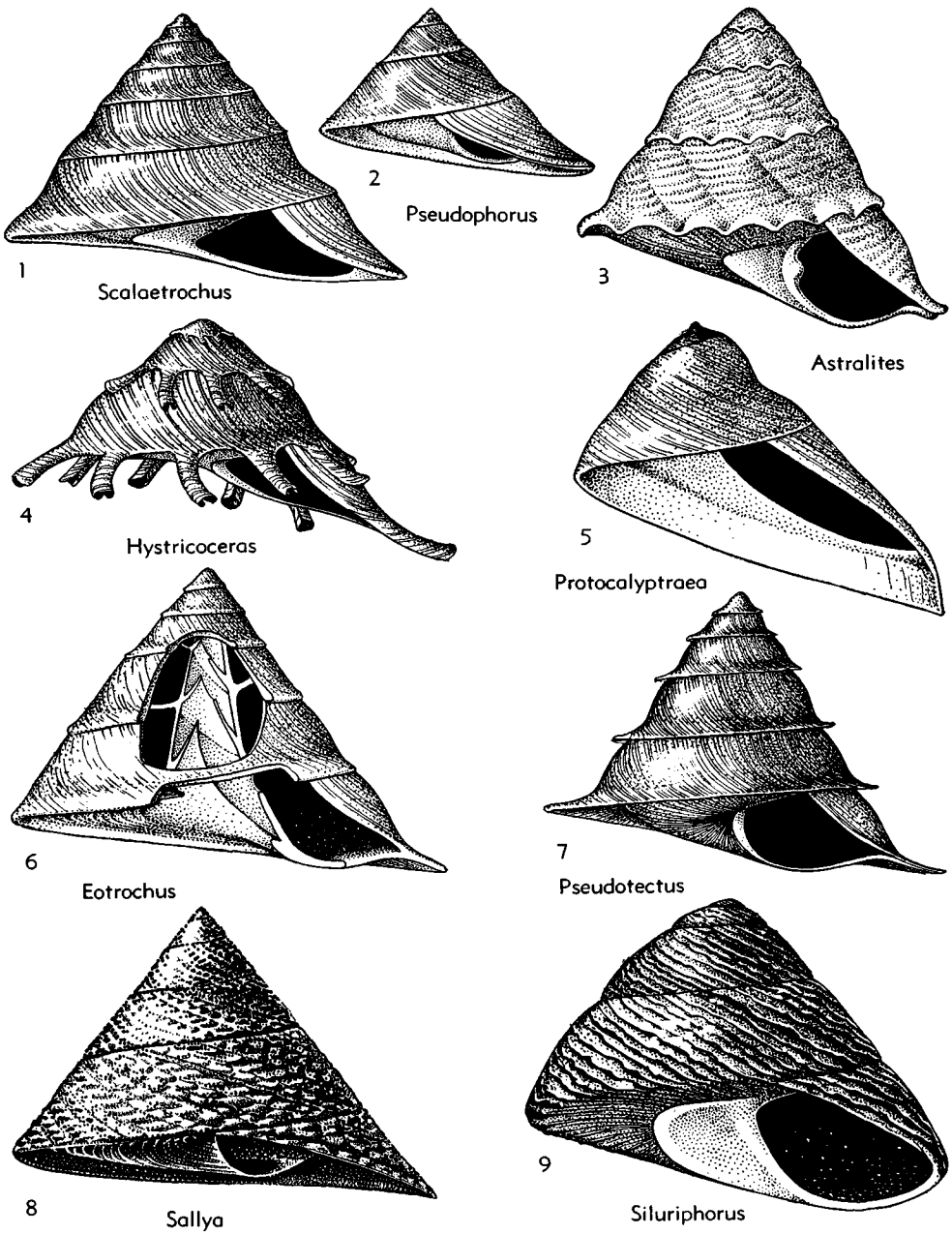


FIG. 195. Pseudophoracea (Pseudophoridae) (p. *1298*).

at late growth stages, with expansion later thickened by numerous lamellae; umbilicus narrow, with sharp funicle; ornament dominantly collabral but with spiral elements in some species. *M.Sil.-U.Sil.*, Eu.——Fig. 196,7. **C. elegantulum*, M.Sil., Gotl.; ×2.7.

Temnospira Perner, 1903 [**Brochidium (Temnospira) monile*; SD Knight, 1937]. Depressed, with rounded whorls; umbilicus narrow; ornament of collabral lamellar ribs separated by wider interspaces, ribs coalescing to form thickened expansion of aperture at gerontic stages. *M.Sil.*, Eu.——Fig. 196,6. **T. monilis* (Perner), Czech.; *6a,b*, apical and umbilical views, ×2.7.

Spirina Kayser, 1889 [**S. brilonensis*]. Helicocone disjunct, expanding rapidly to explanate aperture; coiling of only slightly more than single whorl, slightly asymmetrical, with umbilicus pierced; ornament of collabral cords. *M.Sil.-M.Dev.*, Eu.——Fig. 196,8. **S. brilonensis*, M.Dev., Ger.; *8a,b*, abapertural and apical views, ×1.

Natiria deKoninck, 1881 [**Natica lirata* Phillips, 1836] [=*Fritschia* Picard, 1904]. Naticiform, whorls barely in contact; collabral ornament widely spaced thin lamellae with numerous finer threads between, spiral ornament poorly developed or wanting. *L.Carb.-Trias.*, Eu.——Fig. 196,2. **N. lirata* (Phillips), L.Carb., Eng.; ×1.3.

Dichostasia Yochelson, 1956 [**D. complex*]. Small, umboniform; narrowly phaneromphalous; with greatly thickened gerontic apertural margins; ornament differing above and below periphery, of various transverse (not strictly collabral) elements above and spiral and collabral below; labrum prosocline, without sinus (154, p. 208). *L.Perm.-M. Perm.*, N.Am.——Fig. 196,4. **D. complex*, M. Perm., Tex.; *4a-c*, abapertural, umbilical, and apical views, ×6.

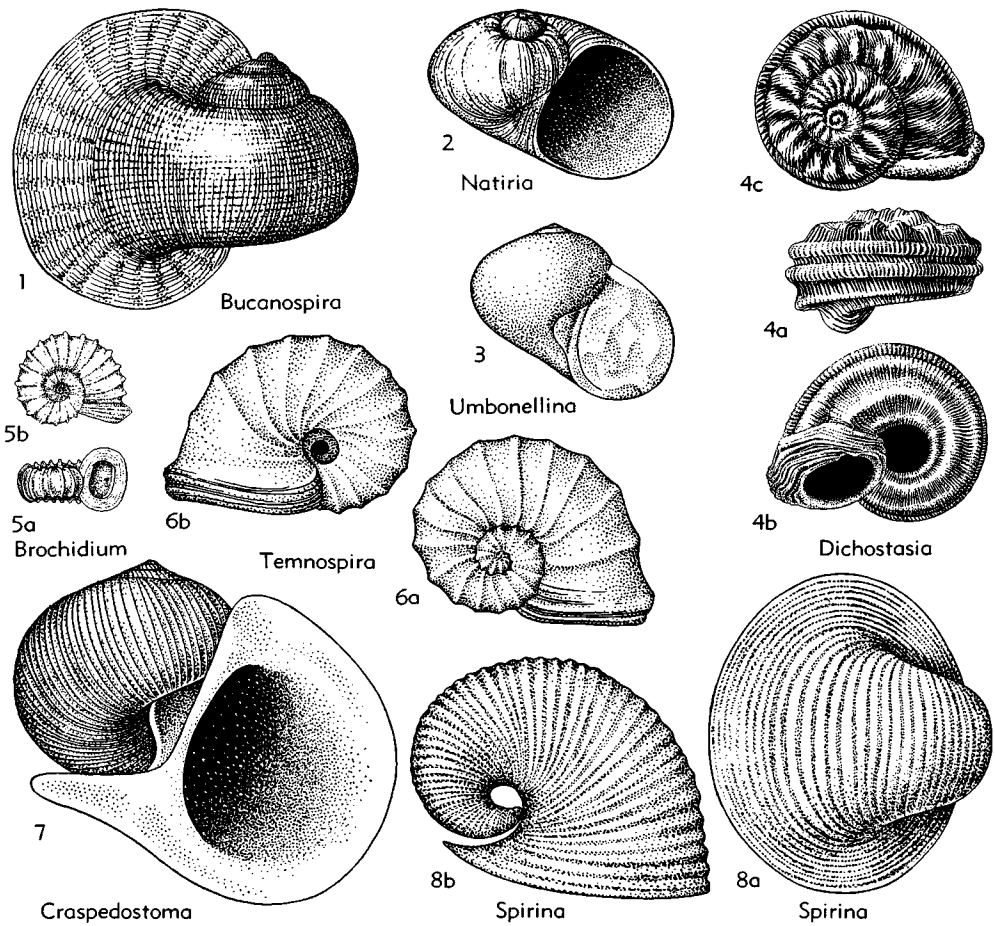


Fig. 196. Craspedostomatacea (Craspedostomatidae) (p. *I*298-*I*301).

Brochidium KOKEN, 1889 [**Ceratites? cingulatus* MÜNSTER, 1834; SD COSSMANN, 1916]. Resembling *Temnospira* but more nearly discoidal and with more lamellar collabral ornament and more sharply differentiated aperture thickening. *M.Perm.-Jur.*, Eu.-N.Am.——FIG. 196,*5*. **B. cingulatum* (MÜNSTER), M.Trias.(Ladin), S.Tyrol; *5a,b*, apertural and apical views, ×2 (64).

Family CODONOCHEILIDAE S. A. Miller, 1889

[*nom. correct.* KNIGHT, BATTEN & YOCHELSON, herein (*pro* Codonocheilidae S.A.MILLER, 1889]

Turriculate, with shallow sutures. *U.Sil.-M.Jur.*

Codonocheilus WHITEAVES, 1884 [**C. striatum*] [=*Codonochilus* LINDSTRÖM, 1884 (obj.)]. Spire cyrtoconoid; whorls very low, with very shallow sutures; last whorl disjunct; aperture circular and slightly explanate. *U.Sil.*, N.Am.-Eu.——FIG. 197, *3*. **C. striatum*, Can.(Ont.); ×6.

?Dihelice W.E.SCHMIDT, 1905 [**D. dathei*]. Pupiform, with notably flat protoconch and cancellate ornament; whorls low; aperture unknown. *M.Dev.*, Eu.——FIG. 197,*5*. **D. dathei*, Ger.; ×2.7.

Scoliostoma BRAUN, 1838 [**S. dannenbergi*] [= *Mitchellia* DEKONINCK, 1877]. Last whorl twisted upward and on its own axis so that explanate aperture is well above mid-height on spire and facing opposite to usual direction. *M.Dev.-U.Dev.*, Eu.-Austral.——FIG. 197,*2*. **S. dannenbergi*, M. Dev., Ger.; *2a*, rear view, showing aperture; *2b*, front view, aperture turned away; ×2.

Bathyclides STRAND, 1928 [*pro Bathycles* KOKEN, 1896 (*non* DISTANT, 1893)] [**Bathycles acuminatus* KOKEN, 1896; SD DIENER, 1926] [= *Bathycla* STRAND, 1928 (obj.)]. Small, ovate-conical, broad, phaneromphalous, with sharply pointed apex and smooth, convex whorls; outer lip prosocline, thickened externally and internally when full-grown and at intervals during growth. *U.Trias.(Carn.-Nor.)*, Eu.——FIG. 197,*1*. **B. acuminatus*, U.Trias.(Carn.), Aus.; ×4 (79).

Ventricaria KOKEN, 1896 [**Phasianella acuminata* HÖRNES, 1856; SD DIENER, 1926] Broadly turriculate or phasianelliform, cryptomphalous, with sharply pointed apex and feebly convex, spirally striated whorls; outer lip prosocline, thickened externally. *U.Trias.(Carn.-Nor.)*, Eu.——FIG. 197,*4*. **V. tumida* (HÖRNES), Nor., Aus.; *4a,b*, ×3, ×1 (79).

Pirper DEGREGARIO, 1886 [**Stylifer? (Pirper) caplus*]. Founded on imperfect, low-cyrtoconoid, paucispiral specimen of medium size with smooth, convex whorls and externally thickened outer lip. *M.Jur.(Baj.)*, Eu.(Italy).

Family CROSSOSTOMATIDAE Cox, n. fam.

Rotelliform or low-turbiniform, thick-shelled, of smooth, strongly convex whorls; aperture circular, with uninterrupted peristome and outer lip strongly thickened externally. *M.Trias.(Ladin.)-M.Jur.(Baj.)*, Eu.

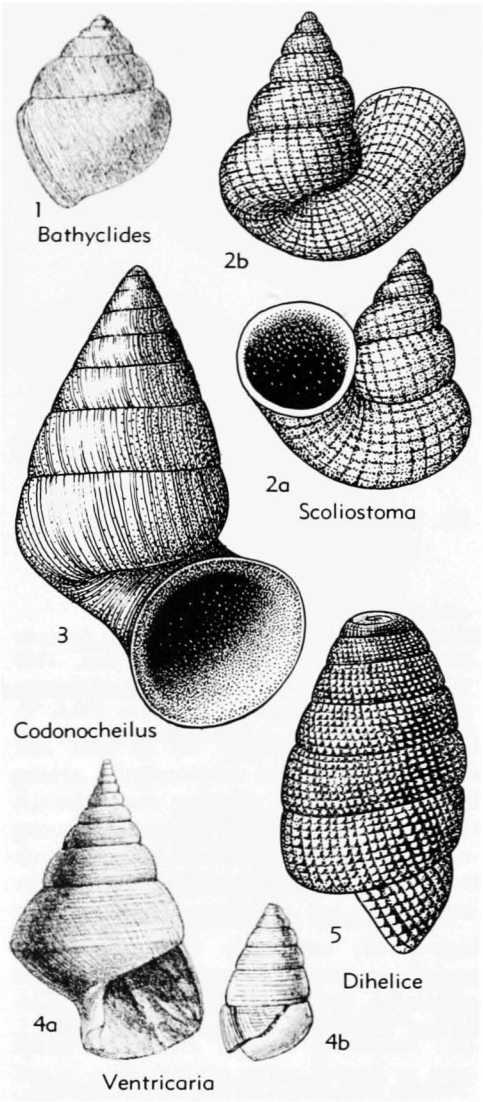


FIG. 197. Craspedostomatacea (Codonocheilidae) (p. *1*301).

Crossostoma MORRIS & LYCETT, 1851 [**C. pratti*]. Anomphalous; aperture contracted, particularly from inner lip; reflected part of outer lip continued above, where it adheres to penultimate whorl. *L.Jur.-M.Jur.(Baj.)*, Eu.——FIG. 198,*2*. **C. reflexilabrum* (D'ORBIGNY), M. Lias, Fr.; *2a,b*, ap-

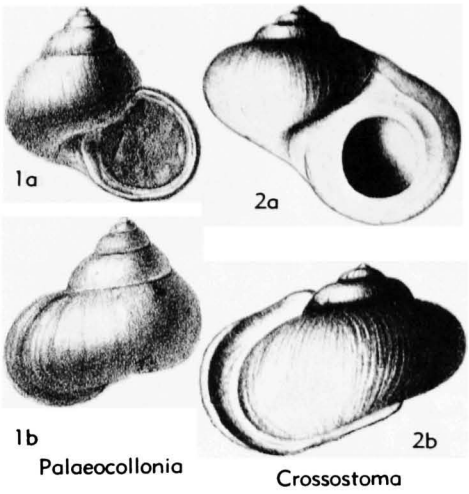


FIG. 198. Craspedostomatacea (Crossostomatidae) (p. I302).

ertural and abapertural views, ×2 (111).

Palaeocollonia KITTL, 1899 [**Delphinula laevigata* MÜNSTER, 1841] [=*Paleocolonia* WENZ, 1938 (obj.)]. Small, turbiniform, broadly phaneromphalous. *M.Trias.(Ladin.)*, Eu.——FIG. 198,*1*. **P. laevigata* (MÜNSTER), S.Tyrol.; *1a,b*, apertural and abapertural views, ×3 (89).

Superfamily PALAEOTROCHACEA Knight, 1956

Turbiniform, trochiform, or moderately high-spired; commonly thick-shelled, especially in parts generated by parietal and columellar lips; shell structure and operculum unknown. *L.Dev.-U.Cret.(Senon.)*.

Family PALAEOTROCHIDAE Knight, 1956

With characters of superfamily; shell large. *L.Dev.-U.Dev.*

Turbonopsis GRABAU & SHIMER, 1909 [**Turbo shumardi* HALL, 1879]. Turbiniform, with convexly prosocline labrum; ornament comprising strong spiral cord just above suture and heavy opisthocline ridges above cord. *L.Dev.*, N.Am.——FIG. 199,*4*. **T. shumardi* (HALL), USA(Ky.); ×0.7.

Palaeotrochus HALL, 1879 [**Pleurotomaria kearneyi* HALL, 1861]. Trochiform, with sinuous prosocline outer lip; ornament consisting of a strong spiral cord just above suture; growth lines irregular. *L.Dev.*, N.Am.——FIG. 199,*3*. **P. kearneyi* (HALL), USA(N.Y.); ×0.7.

Floyda WEBSTER, 1905 [**F. concentrica*] [=*Floydia* C.L.FENTON, 1918 (obj.); *Scaliconus* WENZ, 1938 (*pro Pileolus* SPRIESTERSBACH, 1919, *non* COOKSON in J.SOWERBY, 1823; *nec* LESSON, 1831; *nec* EHRENBERG, 1843) (147, p.260)]. Trochiform or turbiniform; ornament of broad, low undulations below upper suture. *M.Dev.-U.Dev.*, N.Am.-Eu.——FIG. 199,*2*. **F. concentrica*, U.Dev., USA(Iowa); ×0.5.

?Westerna WEBSTER, 1905 [**Loxonema gigantea* WEBSTER, 1888; SD KNIGHT, 1941 (69, p.385)] [=*Westernia* C.L.FENTON, 1918 (obj.)]. Much like *Floyda* but with higher spire. *U.Dev.*, N.Am.——FIG. 199,*1*. **W. gigantea* (WEBSTER), USA (Iowa); ×0.5.

Family PARATURBINIDAE Cossmann, 1916

Turbiniform, including large and small forms; anomphalous or narrowly phaneromphalous; aperture suborbicular. *Trias.-U.Cret.*

Paraturbo COSSMANN, 1907 [**Turbo (Paraturbo) heptagoniatus*] [?=*Turboidea* SEELEY, 1861]. Large, thick, anomphalous; whorls with transversely elongated nodes or transverse costae and subordinate spiral cords; base coated with callus, obscuring ornament in some species. *L.Jur.-U.Cret.(Senon.)*, cosmop.——FIG. 200,*1*. **P. stephanophorus* (ZITTEL), U.Jur.(Tithon.), Czech.; *1a,b*, ×1 (157).

Chartronella COSSMANN, 1902 [*pro Chartronia* COSSMANN, 1902 (*non* S.S.BUCKMAN, 1898)] [**Chartronia digoniata* COSSMANN, 1902] [=*Chartroniella* COSSMANN, 1916 (obj.)]. Rather small, anomphalous or narrowly phaneromphalous, last whorl bicarinate at periphery; other spiral carinae also present in most species; base smooth, convex. *Trias.-U.Jur.(Portl.)*, Eu., S.Am.——FIG. 200,*2*. **C. zetes* (D'ORBIGNY), M.Jur.(Baj.), Eng.; *2a,b*, ×2 (59).

Creniturbo COSSMANN, 1918 [**Trochus dirce* D'ORBIGNY, 1850]. Small, anomphalous; ornament spiral cords cut up by collabral grooves; broad band with two rows of depressed nodes forming flattened periphery; basal ornament not obscured by callus. *U.Jur.(Raurac.)*, Fr.——FIG. 200,*3*. **C. dirce* (D'ORBIGNY); ×5 (111).

Superfamily AMBERLEYACEA Wenz, 1938

[*nom. transl.* COX, herein (*ex* Amberleyidae WENZ, 1938)]

Shell dextral or sinistral; commonly littoriniform or turbiniform, more rarely with expanded, discoidal last whorl but protruding apex; aperture orbicular or with margin subangular at foot of columella;

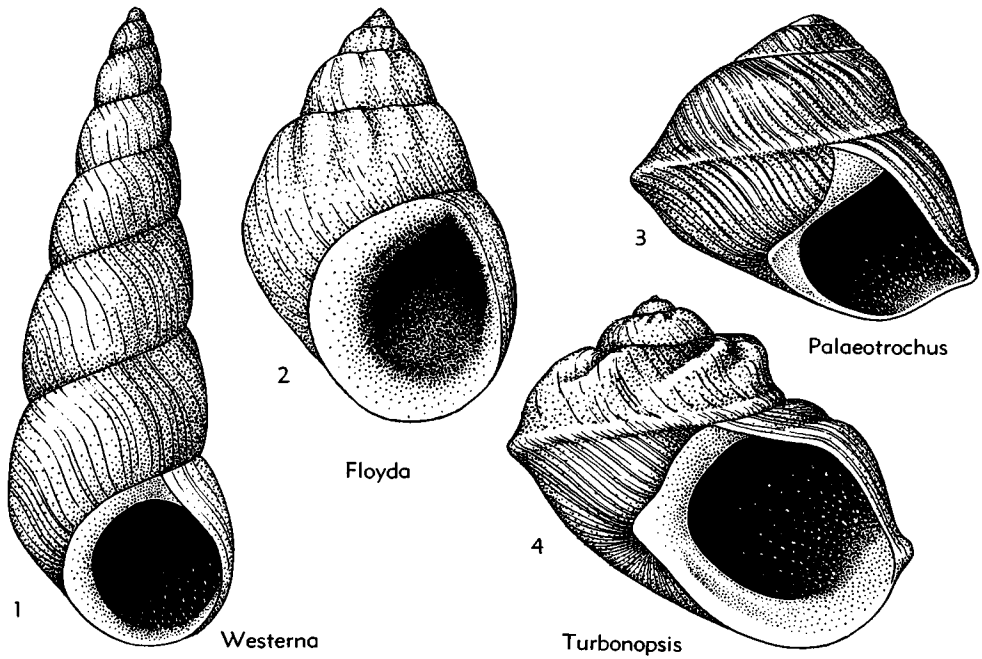


FIG. 199. Palaeotrochacea (Palaeotrochidae) (p. *1302*).

spiral element of ornament dominant in most forms, spirals commonly being noded or cancellated by transverse elements; shell structure, where known (in some Amberleyidae), nacreous; operculum unknown. *M.Trias.-Olig.*

While the characters of the genus *Cirrus*, with its usually acute, protruding apex and progressively broadening and more fully embracing whorls, are unique, the similarity to the Amberleyidae of other genera that have been included in the Cirridae is unmistakable. COSSMANN included the Cirridae in the Euomphalacea on account of the subdiscoidal last whorl of *Cirrus*, maintaining that this was an instance in which ontogeny was no guide to affinity. Union of the Cirridae with the Amberleyidae in a single new superfamily serves to bring together a number of genera with obvious similarities, although *Cirrus* itself stands apart from the other included forms. The Platyacridae also seem better included in this superfamily than in the Euomphalacea, where they were placed by WENZ. A tendency for the initial whorls to be planispiral, so well displayed in this family, is also seen in the South American cirrid genera, *Hesperocirrus* and *Sororcula*. Most Amberleyacea resemble the caenogastropod group Littorinacea in many features of the shell, but the nacreous structure (observable in the Amberleyidae) suggests that they are best included in the Archaeogastropoda.

Family PLATYACRIDAE Wenz, 1938

Shell turbinate, phaneromphalous, with apical truncation due to planispiral coiling of early whorls; either dextral or sinistral; aperture orbicular. *M.Trias.-U.Jur.*

Platyacra ZITTEL, 1882 [**Trochus impressus* SCHAFHÄUTL, 1863]. Sinistral; high-turbinate with early whorls planispiral; later whorls with inframedian carina, forming periphery of base; umbilicus moderately broad, with carinate margin. *U.Trias.(Rhaetic)-L.Jur.*, Eu.——FIG. 201,*1*. **P. impressa* (SCHAFHÄUTL), U.Trias.(Nor.), Bavaria; ×1.3 (233).

Lepidotrochus KOKEN, 1894 [**L. bittneri*; SD COSSMANN, 1916]. Shell form as in *Platyacra*, but dextral and with narrower umbilicus; ornament of cancellating spiral and collabral threads; *M.Trias.-U.Trias.*, Eu., N.Z.——FIG. 201,*4*. **Lepidotrochus bittneri*, M.Trias., Aus.; ×1.3 (79).

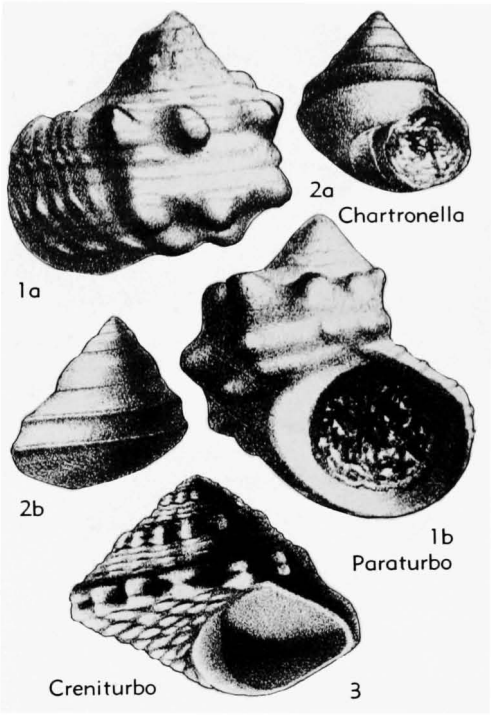


FIG. 200. Palaeotrochacea (Paraturbinidae) (p. *I*302).

Drepanoconcha ZILCH, 1949 [*pro Drepania* DE-GREGORIO, 1930 (*non* HUEBNER, 1816, *nec* LAFONT, 1874] [**Drepania pulchra* DEGREGORIO]. Rather small, sinistral, elevated, but broadly truncated at apex, with early whorls planispiral; later whorls convex, steeply coiled, with narrow collabral riblets. *L.Jur.*, Eu.——FIG. 201,*2*. **D. pulchra* (DE GREGORIO), Sicily; *2a,b*, ×2 (174).

Hyperacanthus KOKEN, 1894 [**Cirrus superbus* HÖRNES, 1855]. High-turbinate with earliest whorls planispiral; later whorls strongly convex, obscurely biangulate, last 2 with nodes or spines at angulations; base convex, with nodose spiral cords; whole surface with dense collabral threads; umbilicus moderately broad; aperture very oblique. *U.Trias.(Nor.)-L.Jur.*, Eu.——FIG. 201,*5*. **H. superbus* (HÖRNES), U.Trias.(Nor.), Aus.; *5a,b*, ×1 (79).

Acrosolarium KOKEN, 1896 [**A. superbum*]. Turbinate with earliest whorls planispiral; later whorls with carina at edge of broad, horizontal sutural shelf; last whorls with 2 further angulations, lower crenate and forming margin of rather narrow umbilicus; aperture unknown. *U.Trias.(Nor.)*, Eu. ——FIG. 201,*3*. **A. superbum*, Aus.; ×1.3 (79).

Family CIRRIDAE Cossmann, 1916

Littoriniform or with expanded, discoidal last whorl, sinistral; aperture suborbicular. *U.Trias.-M.Jur.(Bathon.)*.

Cirrus J.SOWERBY, 1815 [**C. nodosus*; SD S.P. WOODWARD, 1851] [=*Cirrhus* FÉRUSSAC, 1821 (obj.)]. Moderately large, broadly phaneromphalous, ranging from high-spired with only slightly expanded last whorl to subdiscoidal; aperture with uninterrupted margin. *U.Trias.-M.Jur. (Bathon.)*, Eu.-S.Am.

C. (Cirrus). Apex very acute, but relative whorl diameter and overlap increasing progressively during growth to an extent varying in different species; coiling slightly irregular in some forms; ornament nodose spiral cords or coarse cancellating spiral and collabral ridges. *L.Jur.-M.Jur. (Bathon.)*, Eu.——FIG. 202,*4*. **C. (C.) nodosus*, M.Jur.(Baj.), Eng.; *4a,b*, ×0.8 (59)——FIG. 202, *1*. **C (C.) leachi* J.SOWERBY, M.Jur.(Baj.), Eng.; ×1 (59).

C. (Discocirrus) VONAMMON, 1892 [**Porcellia tricarinata* GÜMBEL, 1861]. Discoidal, without protruding apex. *L.Jur.(L.Lias.)*, Eu.

Hamusina GEMELLARO, 1878 [**Turbo bertheloti* D'ORBIGNY, 1850; SD COSSMANN, 1916]. High conical, anomphalous, shell wall thin; whorls, apart from ornament, almost flat, last with sharp peripheral carina continuing line of suture; base

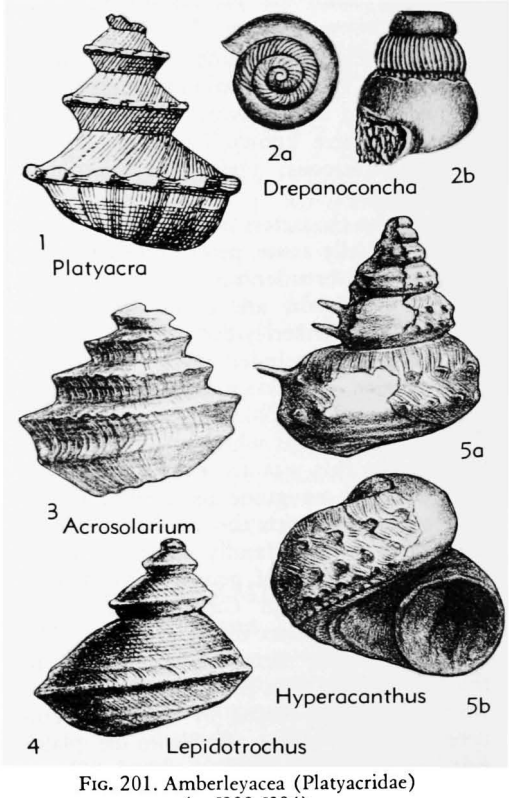


FIG. 201. Amberleyacea (Platyacridae) (p. *I*303-*I*304).

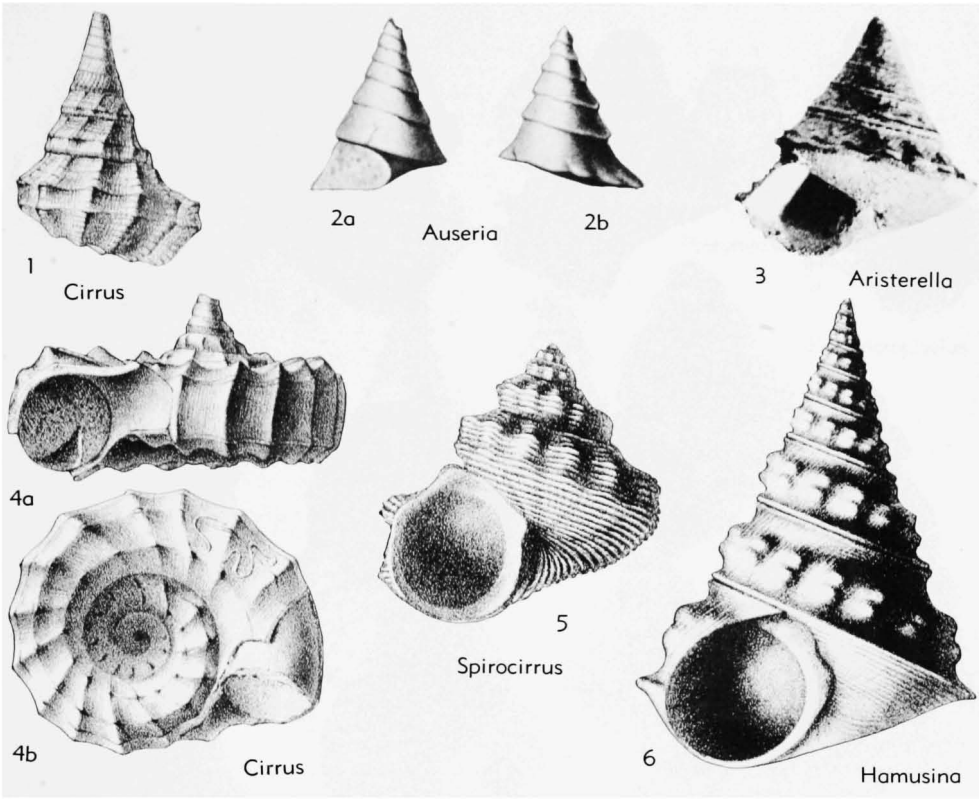


FIG. 202. Amberleyacea (Cirridae) (p. *I*304-*I*305).

feebly convex; ornament nodes or spiral threads, some nodose. *L.Jur.-M.Jur.(Baj.)*, Eu., S.Am.——FIG. 202,*6*. **H. bertheloti* (D'ORBIGNY), U.Lias., Fr.; ×1 (111).

Spirocirrus COSSMANN, 1916 [**Turbo calisto* D'ORBIGNY, 1850]. Turbiniform or conical, with moderately broad umbilicus, later whorls not expanded as in *Cirrus*; ornament strong axial ribs crossed by spiral threads, base with spiral threads only; columellar lip slightly reflected. *L.Jur.-M.Jur.(Bathon.)*, Eu.——FIG. 202,*5*. **S. calisto* (D'ORBIGNY), M.Jur.(Bathon.), Fr.; ×1 (111).

Auseria FUCINI, 1895 [**Trochus (Auseria) pseudonustus*; SD WENZ, 1938]. High conical, anomphalous; whorls smooth, flat-sided, with sharply carinate, crenulated periphery situated just above suture, producing an imbricate spire; base depressed. *L.Jur.(L.Lias.)*, Eu.——FIG. 202,*2*. **A. pseudonustus*, L.Lias., Italy; *2a,b*, ×1 (147).

Hesperocirrus HAAS, 1953 [**H. robusteornatus*]. Littoriniform, small-medium size, phaneromphalous, carinate at periphery of flat or gently convex base; protoconch planispiral; whorls convex, not overlapping; sutures incised; ornament spiral cords bearing nodes where crossed by collabral ribs; aperture orbicular or quadrangular; inner lip more or less reflected over umbilical opening. *U.Trias.*, Peru.——FIG. 202A,*1*. **H. robusteornatus*; *1a,b*, apertural, abapertural views, ×5; *1c*, abapertural view of another specimen, ×3 (50).

Sororcula HAAS, 1953 [**S. gracilis*]. Small, high conical, narrowly phaneromphalous, carinate at periphery of flattened base; protoconch planispiral; whorls flat or slightly concave, not overlapping; sutures incised; ornament spiral row of tubercles adjoining each suture, tubercles joined in one species by transverse ribs; aperture broader than high, with inner lip reflected over umbilicus. *U. Trias.*, Peru.——FIG. 202A,*3*. **S. gracilis; 3a-c*, apertural, abapertural, basal views, ×6 (50).

Aristerella DUBAR, 1948 [**Amphitrochilia (Aristerella) undata*]. Medium size, slightly coeloconoid, narrowly phaneromphalous, sharply carinate at periphery of feebly convex base; whorls flat, not overlapping; sutures incised; ornament nodose or undulating spiral cord adjoining each suture and spiral threads on remainder of surface; aperture quadrangular. *L.Jur.(M.Lias.)*, N.Afr.——FIG. 202,*3*. **A. undata*, Morocco; ×1 (36).

Family AMBERLEYIDAE Wenz, 1938

[=Eucyclidae KOKEN, 1896]

Dextral, turbiniform, littoriniform or low turriculate, with convex or imbricat-

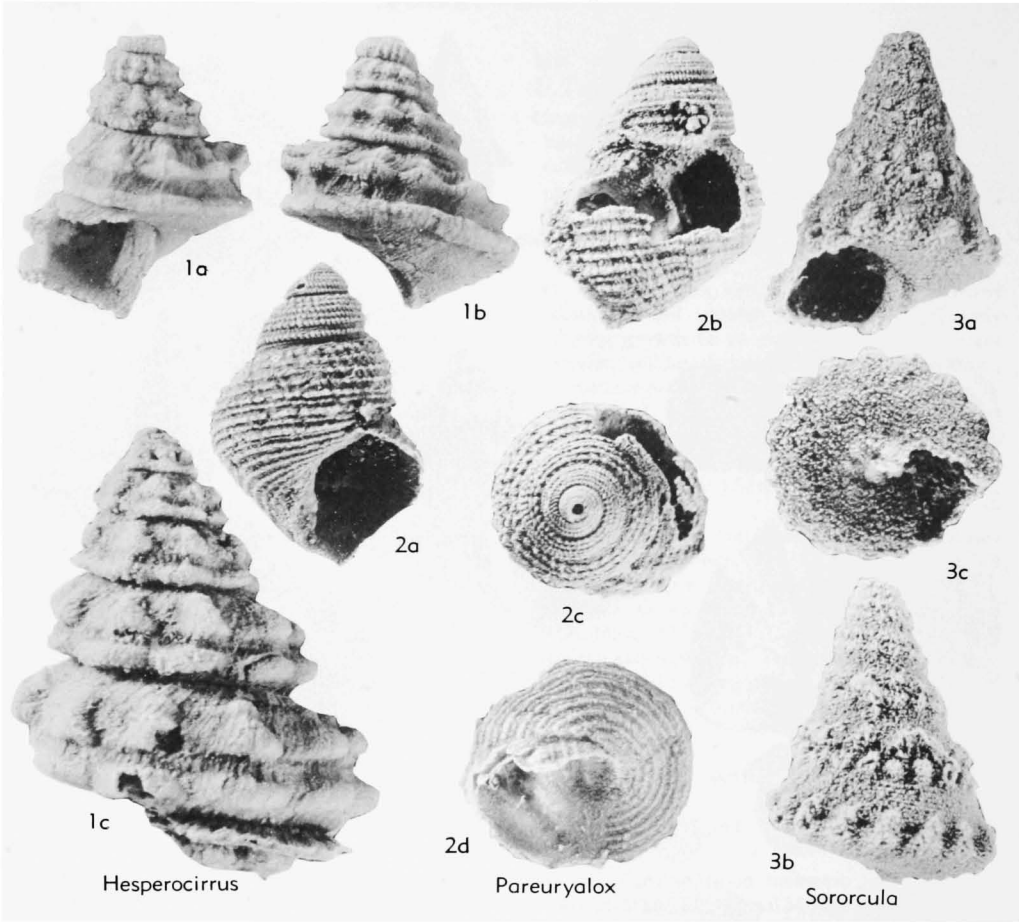


FIG. 202A. Amberleyacea (Cirridae) (p. 1207, 1305).

ing whorls; apertural margin not continuous across parietal region in most forms; shell structure nacreous. *M.Trias.-Oligo.*

Amberleya MORRIS & LYCETT, 1851 [**A. bathonica* COX & ARKELL, 1950 (=**A. nodosa* MORRIS & LYCETT, *non Terebra nodosa* BUCKMAN, ICZN *pend.*)]. Littoriniform to subturriculate, anomphalous. *Trias.-Oligo.*

A. (Amberleya). Ornament nodose; columellar lip concave, its margin joining that of basal lip in even curve. *Trias.-U.Jur.(Raurac.),* Eu.-N.Afr. ——FIG. 203,*5*. **A. (A.) bathonica* COX & ARKELL, M.Jur.(Bathon.), Eng.; ×1 (202).

A. (Eucyclus) J.A.EUDES-DESLONGCHAMPS, 1860 [**E. obeliscus*]. Ornament spiral carinae; columellar lip more or less straight and vertical, its margin commonly meeting that of basal lip in angle or spoutlike protrusion. *Trias.-Oligo.,* Eu.-S.Am.——FIG. 203,*6*. **A. (E.) obeliscus* (J.A. EUDES-DESLONGCHAMPS), M. Lias., Fr.; ×1 (182).

Eunemopsis KITTL, 1891 [**Turbo epaphus* LAUBE, 1869; SD COSSMANN, 1916]. Small, with moderately acute, conical spire and convex base with small pseudumbilicus; ornament narrow axial costellae ending in nodule near each suture; small denticle at upper end of columellar lip. *M.Trias.(Ladin.)-U.Trias.(Carn.),* Eu.——FIG. 203,*7*. **E. epaphus* (LAUBE), M.Trias.(Ladin.), S.Tyrol; ×5 (89).

Paleunema KITTL, 1891 [**Pleurotomaria nodosa* MÜNSTER, 1841]. High turbiniform, almost turriculate, anomphalous; whorls imbricate, with prominent peripheral carina just above suture bearing growth lines that form series of back-pointing scales generated by notch in outer lip; base strongly convex, with spiral cords; columellar lip slightly concave. *M.Trias.(Ladin.),* Eu.——FIG. 203,*3*. **P. nodosa* (MÜNSTER), S. Tyrol; ×1.5 (64).

Tectospira PICARD, 1904 [**T. chopi*]. Rather small, turbiniform, anomphalous; whorls imbricate, with

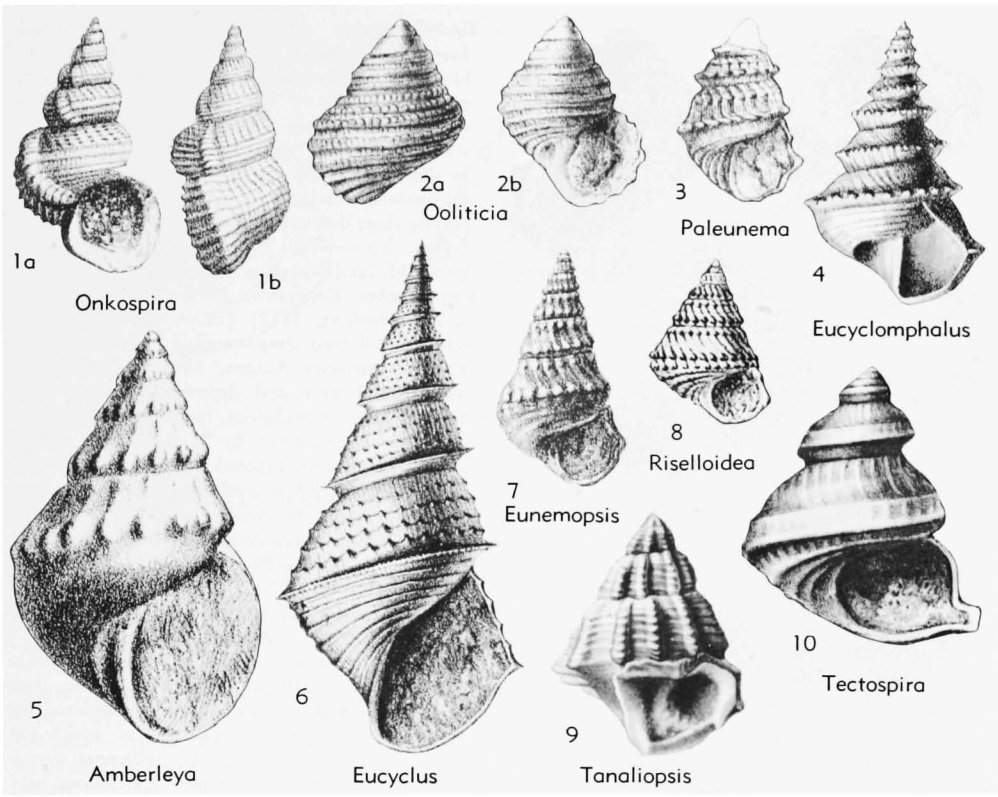


FIG. 203. Amberleyacea (Amberleyidae) (p. *I*306-*I*307).

prominent peripheral carina just above suture and, above it, about 2 weak spiral angulations crossed by collabral threads; base depressed, convex, with spiral cords; aperture oval, broader than high; outer lip notched at peripheral carina; columellar lip strongly concave. *M.Trias.*, Eu.——FIG. 203,*10*. **T. chopi*, Muschelkalk, Ger.; ×3 (212).

Riselloidea COSSMANN, 1909 [*pro Risellopsis* COSSMANN, 1908 (*non* KESTEVEN, 1902)] [**Risellopsis subdisjuncta* COSSMANN, 1908] [=*Risselloidea* COSSMANN, 1909 (? misprint)]. Small, trochiform, anomphalous, with conical spire and flattened base with carinate periphery; whorls with nodose carina adjoining each suture, sutures thus occupying deep channel; ornament axial ridges on whorl side between carinae and spiral cords on base. *Trias.-L.Cret.(Neocom.)*, Eu.——FIG. 203,*8*. **R. biarmata* (MÜNSTER), M.Jur., Ger.; ×3 (11).

Eucyclomphalus VONAMMON, 1892 [**Trochus cupido* D'ORBIGNY, 1850; SD COSSMANN, 1916]. Medium-sized, rather broadly phaneromphalous, with high conical spire of whorls with sharp nodose peripheral carina, and convex base bearing spiral cords; columellar lip straight, vertical, not reflected. *L.Jur.*, Eu.——FIG. 203,*4*. **E. cupido* (D'ORBIGNY), M.Lias., Fr.; ×3 (111).

Ooliticia COSSMANN, 1893 [**Turbo phillipsi* MORRIS & LYCETT, 1851]. Medium-sized, stoutly littoriniform, anomphalous, with conical spire slightly exceeding height of aperture, evenly convex periphery, and convex base; ornament broad nodose spiral cords; columellar lip thickened, with blunt fold at its upper end. *L.Jur.-U.Cret.(Maastricht.)*, cosmop.——FIG. 203,*2*. **O. phillipsi* (MORRIS & LYCETT), M.Jur.(Baj.), Eng., *2a,b*, ×2 (59).

Onkospira ZITTEL, 1873 [**Turbo ranellatus* QUENSTEDT, 1858 (=**Turbo anchurus* MÜNSTER in GOLDFUSS, 1844)] [=*Oncospira* COSSMANN, 1916 (obj.); *Tritonilla* KOKEN, 1896]. High turbiniform, anomphalous; whorls strongly convex, with spiral cords, collabral riblets, and either 1 or 2 series of varices almost in alignment on successive whorls, last varix situated behind outer lip; inner lip rather broadly reflected. *U.Jur.-L.Cret.*, Eu.——FIG. 203,*1*. **O. gracilis* ZITTEL, U.Jur. (Tithon.), Czech.; *1a,b*, ×1.2, ×1.5 (157).

Tanaliopsis COSSMANN, 1916 [**Trochus spiniger* J.DEC.SOWERBY, 1833 (cited as *Turbo spiniger* ZEKELI)]. With stoutly conical spire and depressed, feebly convex base; spire with 8 to 10 axial costae aligned on successive whorls and forming nodes at periphery of last; aperture orbicular,

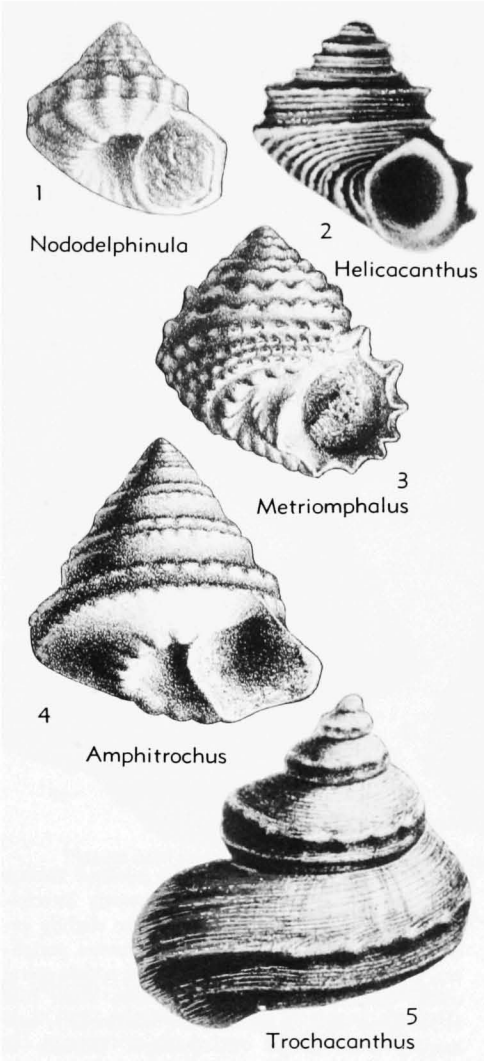


FIG. 204. Amberleyacea (Nododelphinulidae) (p. I308).

with continuous peristome. *U.Cret.(Turon.)*, Aus. ——FIG. 203,9. **T. spinigera* (J.DEC.SOWERBY), aperture imperfect; ×2 (147).

Family NODODELPHINULIDAE Cox, n. fam.

Small to medium-sized, turbiniform, with height and breadth almost equal, phaneromphalous; spiral ornament dominant; aperture orbicular (except in *Amphitrochus*), not very oblique, with continuous peristome; operculum and shell structure unknown. *U.Trias.-U.Cret.(Senon.)*.

Nododelphinula COSSMANN, 1916 [**Delphinula buckmani* MORRIS & LYCETT, 1851]. Turbiniform, broadly phaneromphalous; last whorl with concave, vertical outer face bordered by 2 nodose spiral carinae, upper of which is exposed on spire whorls; ornament spiral threads or cords crossed in some species by collabral threads or ribs; circumumbilical carina with nodes continued by ribs passing short distance into umbilicus. *M.Jur.(Baj.)-L.Cret.*, Eu.——FIG. 204,1. **N. hudlestoni* COSSMANN, M. Jur.(Baj.), Eng.; ×2.5 (59).

Amphitrochus COSSMANN, 1907 [**Trochus duplicatus* J.SOWERBY, 1817] [=*Amphitrochilia* COSSMANN, 1909 (*pro Amphitrochus* COSSMANN, 1907, *non Amphitrocha* AGASSIZ, 1862)]. Trochiform, with conical spire and depressed, concave base; narrowly phaneromphalous; last whorl with prominent periphery formed by 2 conspicuous nodose cords, one or both exposed on spire whorls just above suture which is bordered by further nodose cord; crenulated or nodose carina at umbilical margin; aperture quadrate. *U.Trias.(Nor.)-L.Cret.(Neocom.)*, Eu.——FIG. 204,4. **A. duplicatus* (J.SOWERBY), M.Jur.(Baj.), Eng.; ×2.5 (59).

Helicacanthus DACQUÉ in WENZ, 1938 [*pro Metacanthus* DACQUÉ, 1936 (*non* COSTA, 1847)] [**Turbo thurmanni* PICTET & CAMPICHE, 1863]. Turbiniform, narrowly phaneromphalous; last whorl with broad, concave outer face bordered by two prominent spiral carinae both of which are exposed on later spire whorls; ornament strong spiral cords present also on base and within umbilicus. *U.Jur.-L.Cret.*, Eu.——FIG. 204,2. **H. thurmanni* (PICTET & CAMPICHE), L. Cret.(Apt.), Switz.; ×2 (147).

Trochacanthus DACQUÉ, 1936 [**Trochus tuberculatocinctus* MÜNSTER in GOLDFUSS, 1844; SD WENZ, 1938]. Turbiniform, rather large; last whorl strongly convex except peripherally, where it is flattened between 2 obscurely nodose spiral angulations, both exposed on later spire whorls; ornament fine spiral threads. *M.Cret.-U.Cret.*, Eu.——FIG. 204,5. **T. tuberculatocinctus* (MÜNSTER), U.Cret.(Senon.), Ger.; ×1 (147).

Metriomphalus COSSMANN, 1916 [**Turbo davoustii* D'ORBIGNY, 1850]. Small, turbiniform, narrowly to broadly phaneromphalous, with convex whorls and base bearing a small number of spiral cords, one forming margin of umbilicus, carrying nodes or short prickles, terminal one of each cord forming projection of outer lip. *U.Trias.-U.Cret.(Senon.)*, Eu.-Asia.——FIG. 204,3. **M. davoustii* (D'ORBIGNY), M.Jur.(Baj.), Eng.; ×2.5 (59).

?ARCHAEOGASTROPODA Genera Inquirenda

Atlantobellerophon TRECHMANN, 1930 [**A. zealandicus*]. Large, apparently depressed-conispiral, with last whorl disjunct (*fide* MARWICK); anal slit deep, peripheral. [Founded on a single imperfect last whorl; apparently pleurotomarian

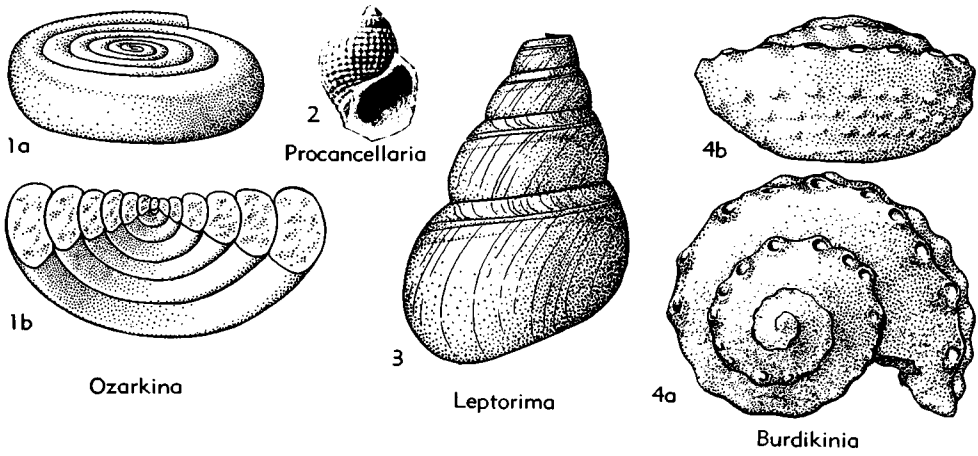


FIG. 205. Archaeogastropoda (Superfamily and Family Uncertain; Genera Inquirenda) (p. 1309).

rather than bellerophont.] *U.Trias.(Rhaetic, Otapirian)*, N.Z.

Burdikinia KNIGHT, 1937 [*pro Polyamma* ETHERIDGE, JR., 1917 (*non* KRIECHBAUMER, 1894)] [**Polyamma burdikiensis* ETHERIDGE, JR., 1917]. Large, discoidal, with broad ramp above and narrow base; seemingly with row of hollow spines of unknown length opening adapertually on outer edge of ramp; base turning inward rapidly below ramp, ornamented with about 4 rows of spirally elongated pustules. [There should be no trouble in recognizing this striking genus, but placing it systematically is impossible without more information.] *Dev.*, Austral.——FIG. 205,*4*. **B. burdikiensis* (ETHERIDGE, JR.); *4a,b*, apical and side views, ×0.7 (69).

Cinctaspira POWELL, 1933 [**C. conica*]. Trochiform, with wide umbilicus and sharp spiral flange at about mid-whorl height. *L.Ord.*, N.Am.

Conchula STEININGER, 1849 [*non* HERRMANNSEN, 1847] [**C. cylindracea*]. Type not figured; unrecognizable; name invalid. *M.Dev.*, Eu.

Cyclora HALL, 1845 [**C. minuta*]. Very minute, naticiform. [Probably based on steinkerns of protoconchs of some other genus, possibly *Cyclonema*; locally very abundant.] *U.Ord.*, N.Am.

Geinitzia DIETZ, 1911 [*non* GEMMELLARO, 1892; *nec* HANDLIRSCH, 1906] [**G. carinata*]. Inadequately described and figured; name invalid. *Perm.*, Eu.

Kebina VOLOGDIN, 1955 [**K. pulchra*]. High-spired, narrowly phaneromphalous, with spiral carinae; very minute. [Known only from section of one specimen (143, p. 355)]. *?L.Cam.*, Russia.

Leptorima PERNER, 1907 [**Murchisonia oehlerti* PERNER, 1903]. Rather high turbiniform; with sharp sinus in outer lip culminating only slightly below suture in deep slit that generates narrow selenizone which is gently convex outside and more strongly convex within; sutures shallow, covered by adpressed zone; columellar and parietal lips little known; ornament other than growth lines seemingly a slight stria below selenizone. [This remarkable species is so very different from any other known that it defies classification; foundation of a new major category is thought to be unwise in the present state of knowledge.] *U.Sil.*, Eu.——FIG. 205,*3*. **L. oehlerti* (PERNER), Czech.; ×2.

Ozarkina ULRICH & BRIDGE, 1931 [*pro Ozarkispira* ULRICH & BRIDGE, 1931 (*non* WALCOTT, 1924)] [**Ozarkispira typica* ULRICH & BRIDGE, 1931]. Known from discoidal steinkerns which show numerous narrow, rounded whorls but no surface or apertural features that would permit classification. *L.Ord.*, N.Am.——FIG. 205,*1*. **O. typica* (ULRICH & BRIDGE), Mo.; *1a,b*, oblique view from above and below, latter showing cross section, ×2.

Ozarkocanus HELLER, 1956 [**O. prearcuatus*]. With high conical, slightly curved, cap-shaped shell; aperture oval; ornament longitudinal costae or threads. [Possibly not a gastropod.] *L.Ord.*, USA.

Pichynella RUSCONI, 1954 [**P. annulata*]. Very minute (1 mm.), possibly a protoconch. [Too little known for systematic assignment.] *L.Ord.*, S.Am.

Pondia ODER, 1932 [**P. powelli*]. Based on 2 fragments, seemingly of a calcareous operculum, possibly of *Maclurites*. *L.Ord.*, N.Am.

Procancellaria WILCKENS, 1922 [**P. parkiana*]. Ovate, with low spire, anomphalous; whorls convex; ornament cancellating collabral and spiral grooves, the former feebly prosocline; aperture ovate, with uninterrupted peristome, subangular adapically; columellar lip vertical, moderately ex-

panded, without folds. *U.Cret.*, N.Z.——FIG. 205, 2. **P. parkiana*; ×1 (229).

Pythmenema LAMONT & GILBERT, 1945 [**Euomphalus praenantius* PHILLIPS, 1848]. Turbiniform, with strong spiral carinae above periphery and finer ones below. [The original diagnosis of this genus and the description and figures of the type species are quite inadequate for systematic placement more closely than in the Archaeogastropoda.] (86, p. 643.) *U.Sil.*, Eu.

Trochotremaria RYCKHOLT, 1860. No species was ever assigned to this genus.

Umbotrochus PERNER, 1903 [**U. aspersus*] [= *Umbonitrochus* COSSMANN, 1918 (obj.)]. Trochiform, with shallow sutures; roundly angulated periphery; base nearly flat, anomphalous; apertural margins not certainly known. [The single specimen known is not well enough preserved to allow a restoration, nor is it possible to classify the genus. Perhaps it might be referred to the Microdomatacea.] *M.Sil.*, Eu.

SUPPLEMENT
PALEOZOIC AND SOME MESOZOIC CAENOGASTROPODA AND OPISTHOBRANCHIA

By J. BROOKES KNIGHT[1], R. L. BATTEN[2], E. L. YOCHELSON[3], and L. R. COX[4]

INTRODUCTION

When the *Treatise* was first conceived, the senior author, whose field of special study is the gastropods of the Paleozoic, undertook to cover all orders represented in that era, including supposed patelloid gastropods now classified as Monoplacophora. Almost from the beginning R. L. BATTEN and E. L. YOCHELSON were associated with him.

As work on the *Treatise* progressed it became apparent that Part I, covering Scaphopoda, Amphineura, Monoplacophora, and the gastropod order Archaeogastropoda would be ready for publication in a reasonable time. However, manuscript for Part J, planned to include the prosobranch taxa Mesogastropoda and Neogastropoda (here combined as an order named Caenogastropoda), large divisions that are very abundant and varied in post-Paleozoic time, and the subclasses Opisthobranchia and Pulmonata, has been so delayed that it might not appear during the senior author's lifetime.

The authors recognize that no final treatment of the predominantly post-Paleozoic orders can be successful without including consideration of the vast amount of information that will be presented by specialists in these overwhelmingly post-Paleozoic groups. Nevertheless, the authors concerned with Paleozoic groups which include the more primitive members, perhaps ancestral to the better-known ones of later times, feel that they can contribute important matter too frequently overlooked by students of the younger fossil genera and especially by neontologists.

For this reason and because the student of Paleozoic Gastropoda will profit from having current data on all the orders in his field even though not in final form, consent was obtained to include them in Part I as a Supplement.

With the exceptions to be noted, the three authors already mentioned are responsible for the material here presented, especially the systematics. Dr. L. R. Cox, British Museum (Natural History), who has supervision over sections of the *Treatise* dealing with all gastropods, has examined the manuscript of the Supplement and has been kind enough to add data on authorship and to suggest diagnoses for several taxa that are best known to workers on post-Paleozoic mollusks. Cox has prepared the diagnosis and synonymy for the order Caenogastropoda (replacing Mesogastropoda and Neogastropoda of previously written text) and he is author of the division of the Loxonematacea included in the Family Zygopleuridae; this family, although entirely Mesozoic, has been included here to make the account of the superfamily

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complete. The diagnosis of the subclass Opisthobranchia was drafted after a discussion with Prof. ALASTAIR GRAHAM and Dr. VERA FRETTER, leading authorities on this group. For these kindnesses the authors are grateful.

It is planned that when Part J appears the groups covered in this Supplement will be reviewed and integrated systematically with the post-Paleozoic forms by the authors engaged in the task; accordingly, it is not intended that the arrangements here presented will be binding upon them. In the meantime, the arrangement of the suprafamilial taxa is not materially altered from those current in recent years. WENZ (1938) in particular has been followed. However, several large familial categories assigned by that author to the Archaeogastropoda have been placed in the Caenogastropoda and even in the Opisthobranchia. The authors are unable at this time to recognize any compelling reasons for classifying any Paleozoic taxa in the Pulmonata.

Order CAENOGASTROPODA Cox, 1959

[=pectinibranches DEBLAINVILLE, 1814 *(partim)*; Siphonobranchia+Pectinibranchia *(partim)* GOLDFUSS, 1820; Ctenobranchiata SCHWEIGGER, 1820 *(partim)*; Hemipomatostoma+Apomatostoma MENKE, 1830; Pectinibranchiata GRAY, 1850 *(partim)*; Monotocardia Exophallia MÖRCH, 1865; Streptoneura Azygobranchia SPENGEL, 1881 *(partim)*; monotocardes BOUVIER, 1887; Ctenobranchia PELSENEER, 1893; Pectinibranchia PELSENEER, 1906; Mesogastropoda + Stenoglossa THIELE, 1929; Mesogastropoda+Neogastropoda WENZ, 1938]

Shell asymmetrical, of many shapes, porcelaneous; right ctenidium absent, the left monopectinate (but absent in certain families); inhalant siphon present or absent; heart with one auricle; one kidney only; pallial genital organs present in most forms, forming a penis in the male; nervous system moderately to highly concentrated; proboscis present in many forms; radula of several types, mostly with relatively few teeth in a row. Marine, freshwater and terrestrial. *Ord.-Rec.*

Superfamily LOXONEMATACEA Koken, 1889

[*nom. transl.* COSSMANN, 1909 (*ex* Loxonematidae KOKEN, 1889)]

Commonly high-spired, with numerous whorls, mostly anomphalous; deep to obsolescent labral sinus without slit or notch; inner shell layers not nacreous. *M.Ord.-U.Jur.*

Although the sinus in the Loxonematacea does not culminate in a slit or notch, as in the Murchisoniacea, it is thought to have served as an excurrent channel, at least in those genera in which it is deepest. Perhaps the anal tube lay between a pair of ctenidia, as has been postulated for the Murchisoniacea. With passage of time, however, the sinus tends to become shallower and its culmination is found to move toward the suture. This supports the inference that, if the right ctenidium was retained in more primitive forms, it had been lost by Devonian time, and the anus and other pallial organs had been displaced to the positions which they occupy in the Cerithiacea.

The Loxonematacea seem to have been closely related to the Murchisoniacea and probably were derived from them.

Family LOXONEMATIDAE Koken, 1889

[=Holopellidae KOKEN, 1897]

Mostly relatively large; labrum with median sinus, lower segment opisthocline; ornament dominantly collabral; protoconch seemingly of several whorls, unornamented. *M.Ord.-Miss.*

Loxonema PHILLIPS, 1841 [**Terebra? sinuosa* J. DEC.SOWERBY, 1839; SD KING, 1850] [=*Holopella* M'COY, 1851; *Rhabdostropha* DONALD, 1905]. Sinus deep; sutures moderately deep. *M.Ord.-Miss.*, cosmop.——FIG. 206,*4*. **L. sinuosum* (J.DEC. SOWERBY), M.Sil., Eng.; ×2.

Girvania LONGSTAFF, 1924 [**G. excavata*]. Small, extremely slender, high-spired and many-whorled; with shallow labral sinus; spiral threads and collabral undulations. *U.Ord.*, Eu.——FIG. 206,2. **G. excavata*, Scot.; ×4.

Spiroecus LONGSTAFF, 1924 [**S. girvanensis*]. Whorls rounded except for sloping ramp above low spiral cord occurring somewhat above midwhorl. *U.Ord.*, Eu.——FIG. 206,*6*. **S. girvanensis*, Scot.; ×4.

Stylonema PERNER, 1907 [**Loxonema (Stylonema) potens*; SD LONGSTAFF, 1909]. Very slender, high-spired, many-whorled; with shallow sinus, upper limb extending a little farther beyond aperture than lower; ornament numerous very fine collabral threads. *L.Sil.-L.Dev.*, Eu.——FIG. 206,*1*. **S. potens* (PERNER), U.Sil., Czech.; ×0.7.

Aulacostrepsis PERNER, 1907 [**A. simplex*]. Much like *Stylonema* but wider, with lower and wider whorls; minutely phaneromphalous, with umbilical opening surrounded by rounded ridge. *L.Dev.*, Eu.——FIG. 206,*3*. **A. simplex*, Czech.; ×1.3.

Katoptychia PERNER, 1907 [**K. alba;* SD COSSMANN, 1909] [=*Cataptychia* COSSMANN, 1909 (obj.)]. Whorls flat, with shallow sutures; outer lip

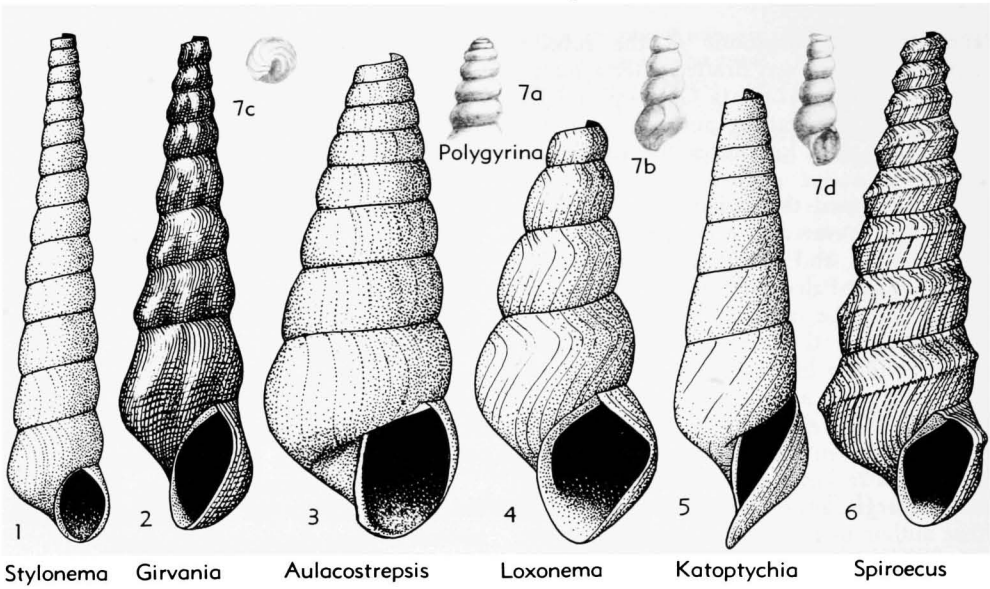

FIG. 206. Loxonematacea (Loxonematidae) (p. I311-I312).

strongly opisthocline until close to base, without sinus (unless the subangular juncture of outer and parietal lips may be interpreted as a sinus). *L.Dev.*, Eu.——FIG. 206,*5*. **K. alba*, Czech.; apertural view, ×2.7.

Polygyrina KOKEN, 1892 [**Turritella lommelii* MÜNSTER, 1841; SD COSSMANN, 1909]. Whorls many, strongly convex; protoconch obtuse, domelike; growth lines forming broad, symmetrical sinus on spire whorls, their complete curve parasigmoid. *L.Trias.-U.Trias.*, Eu.-Asia.——FIG. 206, *7*. **P. lommeli* (MÜNSTER), M.Trias-(Ladin.), S.Tyrol; *7a*, early whorls, ×3; *b-d*, later whorls, ×1 (64).

Family PALAEOZYGOPLEURIDAE Horny, 1955

Relatively small, labral sinus shallow or wanting; protoconch composed of one or (rarely) more smooth whorls; ornament collabral or wanting. *Dev.-L.Carb.*

Palaeozygopleura HORNY, 1955 [**Zygopleura alinae* PERNER, 1907] [=*Bojozyga, Palaeozyga* HORNY, 1955 (58, p.27)]. Small, high-spired, with labral sinus; whorls not shouldered, with shallow sutures or adpressed (58, p.27). *Dev.-L.Carb.*, Eu. ——FIG. 207,*1*. **P. alinae* (PERNER), L.Dev., Czech.; *1a*, apertural view, ×6; *1b*, early whorls ×14.

Devonozyga HORNY, 1955 [**D. perneri*]. Small, slightly pupiform, with flat-sided, shouldered whorls and no labral sinus (58, p.51). *M.Dev.*, Eu.——FIG. 207,*2*. **D. perneri*, Czech.; ×14.

Family PSEUDOZYGOPLEURIDAE Knight, 1930

[*nom. transl.* KNIGHT, BATTEN & YOCHELSON, herein (*ex* Pseudozygopleurinae KNIGHT, 1930] [=Palaeostylinae WENZ, 1938]

Gross characters variable but distinguished by nature of ornament and shape of protoconch; first 1 to 1.5 whorls of protoconch smooth, strong collabral ornament appearing on 2nd whorl and continuing to 4th where it gives way very abruptly to adult type of ornament (commonly present but lacking in some species); 1st ornamented whorl commonly slightly swollen, giving protoconch shape suggestive of coronet. *L.Carb.(Miss.)-M.Perm.*

The presence or absence of the pseudozygopleurid type of protoconch can be determined only on specimens in which this part of the shell is exceptionally well preserved, although the shape of the protoconch may be suggestive even if fine details are not discernible. If the protoconch of any genus is unknown its placement here is queried. The distinctive juvenile characters of the Pseudozygopleuridae are shown clearly by many Pennsylvanian and Permian shells but are not yet known in Mississippian genera that it seems impossible to exclude. HORNÝ's stimulating monograph on the Palaeozygopleuridae appeared after

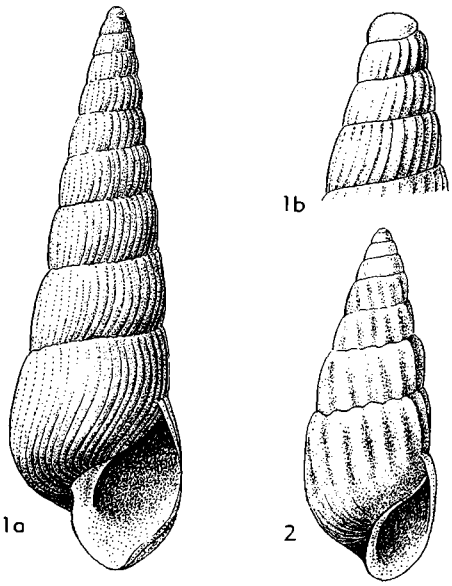

FIG. 207. Loxonematacea (Palaeozygopleuridae) (p. 1312).

the section on the Pseudozygopleuridae was completed. There proved to be considerable overlap in respect to genera for which protoconchs are unknown. With these it is impossible to decide definitely between two assignments or possibly others. The authors have concluded to leave their arrangement as it was but are conscious that some at least of the queried genera may prove to belong where HORNÝ placed them. Triassic genera very similar to the Pseudozygopleuridae are referred to the family Zygopleuridae because the protoconchs of well-preserved specimens are smooth.

?Tmetonema LONGSTAFF, 1912 [**T. subsulcatum*]. Small, with collabral threads crossing whorls which bear broad, slightly depressed band approximately at mid-height, slight sinus (shown by pattern of threads) occurring above band; threads prosocline close to upper suture but opisthocline crossing band and then gradually prosocline on base; protoconch unknown. [Description derived from LONGSTAFF's photographic illustration; this fails to accord with her diagnosis and line drawings, which do not agree among themselves.] *L.Carb.*, Eu.

?Knightella LONGSTAFF, 1933 [*pro Knightia* LONGSTAFF, 1933 (*non* JORDAN, 1907)] [**Knightia irregularis* LONGSTAFF, 1933]. Whorls rounded, sutures moderately deep; outer lip with very shallow sinus; ornament growth lines only. [Shape of protoconch suggests Pseudozygopleuridae but characteristic larval ornament not demonstrated.] *L.Carb.-U.Carb.*, Eu.——FIG. 208,*6*. **K. irregularis* (LONGSTAFF), L.Carb., Scot.; ×8.

?Microptychia LONGSTAFF, 1912 [**M. wrighti*]. Earlier adult whorls with moderately strong collabral threads outlining shallow sinus; beyond 1st 0.25 of spire threads become obsolete over middle of whorls but are accentuated at shallow sutures; protoconch unknown. *Miss.(L.Carb.)-Penn.(U. Carb.)*, N.Am.-Eu.——FIG. 208,*1*. *M. cerithiformis* (MEEK & WORTHEN), M.Penn., Ill.; ×2.7.

Helminthozyga KNIGHT, 1930 [**H. vermicula*]. Protoconch characteristic of subfamily, but coiling of later-formed shell quite variable, conical with wide umbilicus or completely disjunct and vermiform; with somewhat lamellar collabral ornament. *Miss.-Penn.*, N.Am.——FIG. 208,*11*. **H. vermicula*, M.Penn., Mo.; ×20.

?Eoptychia LONGSTAFF, 1933 [**Loxonema sulcatum* DEKONINCK, 1881]. Large, with relatively flat whorls and shallow sutures; numerous fine collabral threads; protoconch unknown. *L.Carb.-U. Carb.*, Eu.——FIG. 208,*13*. **E. sulcata* (DEKONINCK), L.Carb., Belg.; ×1.

Palaeostylus MANSUY, 1914 [**P. pupoides;* SD COSSMANN, 1918]. With collabral ornament or none. *Miss.-M.Perm.*, N.Am.-SE.Asia.

?P. (Stephanozyga) KNIGHT, 1930 [**Zygopleura nodosa* GIRTY, 1915] [=*Nodozyga* HORNÝ, 1955 (58, p. 24)]. Relatively large, with collabral ornament weak or missing on upper part of whorls but strong and nodelike below; with rather deep labral sinus; protoconch unknown. *Miss.-M.Perm.*, N.Am.-SE.Asia.——FIG. 208,*2*. **P. (S.) nodosus* (GIRTY), M.Penn., Mo.; ×1.3.

P. (Pseudozygopleura) KNIGHT, 1930 [**Loxonema semicostatum* MEEK, KNIGHT, 1930 (=*L. attenuata semicostata* MEEK, 1872)]. Collabral threads or cords on all whorls, or confined to earlier whorls, or absent entirely. *?Miss., Penn.-M.Perm.*, N.Am.——FIG. 208,*12*. **P. (P.) semicostatus* (MEEK), M.Penn., Mo.; ×10.

P. (Leptozyga) KNIGHT, 1930 [**Pseudozygopleura (Leptozyga) minuta*]. Very small, cyrtoconoid, with high spire but relatively few whorls. *Penn.*, N.Am.——FIG. 208,*4*. **P. (L.) minutus*, M. Penn., Mo.; ×20.

P. (Palaeostylus) [=*Pyrgozyga* KNIGHT, 1930]. Very high-spired, with many low broad whorls; collabral ornament orthocline or nearly so. *Penn.-M.Perm.*, N.Am.-SE.Asia.——FIG. 208,*7*. **P. (P.) pupoides*, L.Perm. Cambodia; ×4.

?Hemizyga GIRTY, 1915 [**H. elegans;* SD KNIGHT, 1930]. With both collabral and spiral ornament; labral sinus very shallow or absent. *Miss.-M.Perm.*, N.Am.

?H. (Hemizyga) [=*Strianematina* H.CHRONIC, 1952 (14, p.130)]. Collabral ornament of fine to coarse somewhat prosocline threads, spiral ornament mostly on base; protoconch unknown.

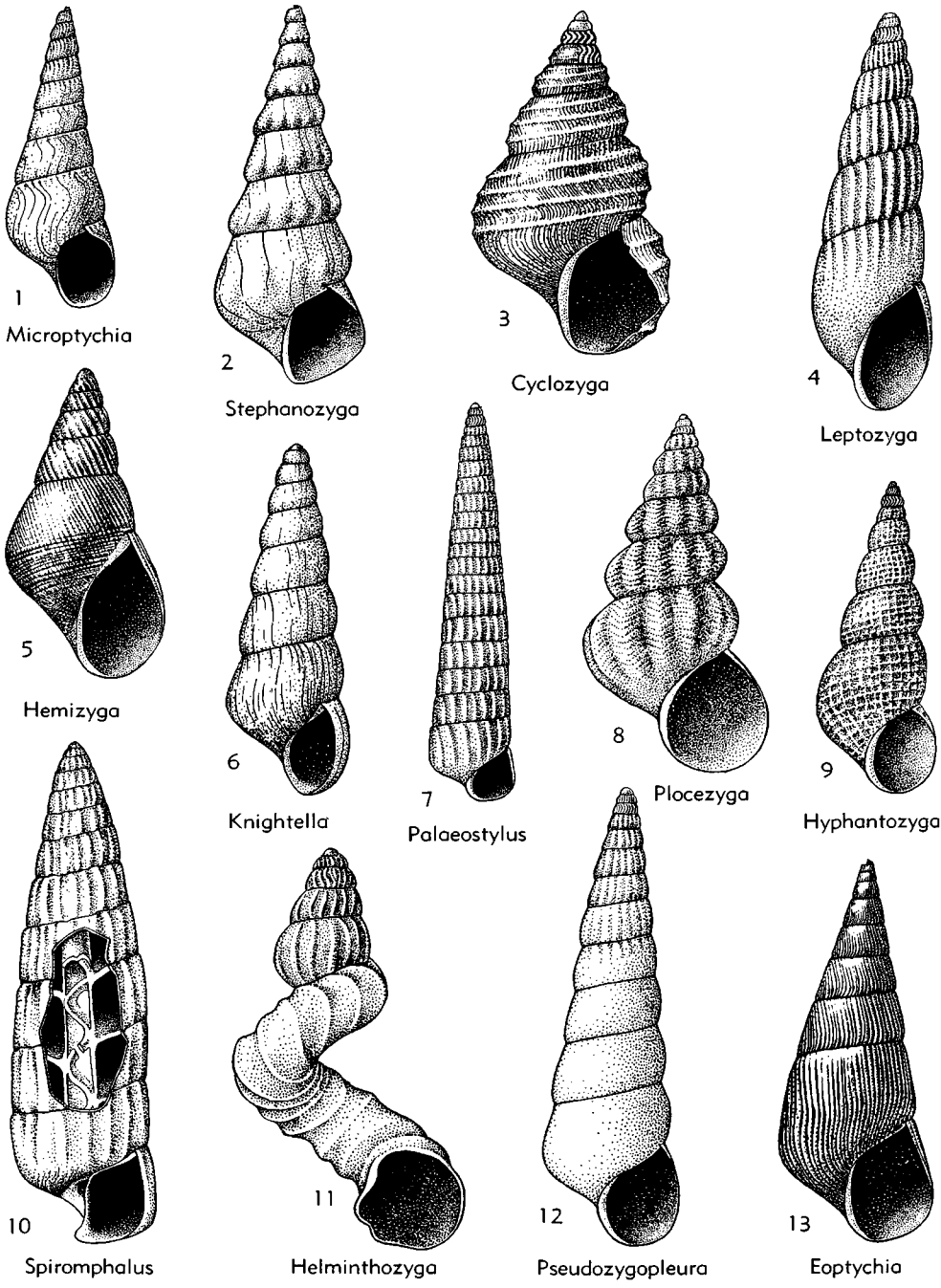

FIG. 208. Loxonematacea (Pseudozygopleuridae) (p. I313-I315).

Miss.-M.Perm., N.Am.——Fig. 208,*5*. **H. (H.) elegans*, M.Penn., Mo.; ×5.3.

H. (Hyphantozyga) Knight, 1930 [**H. (Hyphantozyga) gracilis*]. Spiral and collabral ornament of subequal sharp threads. *Penn.*, N.Am.——Fig. 208,*9*. **H. (P.) corona*, M.Penn., Mo.; ×10.

H. (Plocezyga) Knight, 1930. [**H. (Plocezyga) corona*]. Collabral ornament of strong cords or ribs, spiral ornament of fine threads or striae. *U.Carb.(Penn.)*, N.Am.——Fig. 208,*8*. **H. (P.) corona*, N.Penn., Mo.; ×10.

Cyclozyga Knight, 1930 [**C. mirabilis*; SD Knight, 1936]. Minute, with protoconch of subfamily, spiral threads on adult shell; shallow sinus low on whorl. *Penn.*, N.Am.——Fig. 208,*3*. **C. mirabilis*, M.Penn., Mo.; ×20.

?**Spiromphalus** Hayasaka, 1939 [**S. yabei*]. Much like *Palaeostylus* with deep and (for such a high-spired shell) wide umbilicus, within which is a spiral projecting flange; protoconch unknown (54, p.20). *Perm.*, NE.Asia.——Fig. 208,*10*. **S. yabei*, Japan; apertural view, with window showing spiral flange, ×4.5.

Family ZYGOPLEURIDAE Wenz, 1938

[*nom. transl.* Cox, herein (*ex* Zygopleurinae Wenz, 1938)]

Shell slender; protoconch smooth, of up to about 3 regularly increasing whorls; ornament narrow collabral riblets which have parasigmoid curve in most genera; subordinate spiral ornament in some genera. *Trias.-U.Jur.*

Zygopleura Koken, 1892 [**Cerithium meyeri* Klipstein, 1843 (=*Turritella hybrida* Münster, 1841, *non* Deshayes, 1832); SD Cossmann, 1909]. Whorls strongly convex; riblets well defined and with pronounced parasigmoid curve; no spiral ornament. *Trias.-U.Jur.(L.Kimm.)*, cosmop.——Fig. 209,*9*. **Z. meyeri* (Klipstein), M.Trias.(Ladin.), Italy; ×2.5 (178).

Katosira Koken, 1892 [**K. fragilis*]. Whorls flattened-convex; collabral riblets not extending on to base and with parasigmoid curve less pronounced than in *Zygopleura*; weak spiral threads on whorl side, stronger ones on base; apertural margin slightly reflected anteriorly to form ill-defined spout, possibly a rudimentary siphonal outlet. *U.Trias.(Carn.)-M.Jur.(Baj.)*, cosmop.——Fig. 209,*1*. **K. periniana* (d'Orbigny), M.Lias., Fr.; ×1 (111).

Kittliconcha Bonarelli, 1927 [**Zygopleura (Kittliconcha) cassiana, pro Loxonema walmstedti* Kittl (*partim*), 1894, *non Turritella walmstedti* Klipstein, 1843]. Broader and less acute than in most genera of family; whorls strongly convex; collabral riblets strong on spire whorls, where only their opisthocyrt upper part is exposed, obsolete on last whorl except for a varix; no spiral ornament. *M. Trias.-(Ladin.)*, Eu.-S.Am.——Fig. 209,*4*. **K. cassiana*, S.Tyrol.; *4a-c*, ×1 (64).

Anoptychia Koken, 1892 [**Melania supraplecta* Münster, 1841; SD Cossmann, 1909[1]]. Whorls flat to feebly convex; in some species a carina occupies periphery of last whorl and is just exposed on those of spire; collabral riblets on early whorls only; spiral threads weakly developed on sides, stronger on base. *M.Trias.(Ladin.)-M.Jur.(Baj.)*, cosmop.——Fig. 209,*7*. **A. supraplecta* (Münster), M.Trias.(Ladin.), S.Tyrol; ×3 (64).

Allocosmia Cossmann, 1897 [*pro Heterocosmia* Koken, 1896, *non* Ehrenberg, 1872] [**Holopella grandis* Hörnes, 1855]. Large, slightly coeloconoid, very acute at apex; whorls strongly convex, collabral riblets confined to very early ones, spiral threads more persistent; aperture (if appearance is not due to fracture) with spoutlike siphonal outlet. *M.Trias.-L.Jur.*, cosmop.——Fig. 209,*11*. **A. grandis* (Hörnes), U.Trias.(Nor.), Aus.; *11a,b*, ×1, ×0.5 (79).

Hypsipleura Koken, 1892 [**H. cathedralis*]. Slender, with high, almost flat whorls; early whorls with feebly sigmoid riblets, which later fade away progressively, partly or wholly, from their abapical end upward; spiral threads present in some. *M.Trias.(Ladin.)-L.Jur.(M.Lias.)*, Eu.-S.Am.——Fig. 209,*5*. **H. subnodosa* (Klipstein), M.Trias.(Ladin.), S.Tyrol; *5a-c*, ×1 (64).

Tyrsoecus Kittl, 1892 [**Tyrsoecus cassiani* Cox (*nom. nov.*) =**Turritella compressa* Münster, 1841 (*non* Münster, 1840); SD Cossmann, 1909] [=*Stephanocosmia* Cossmann, 1895 (*pro Coronaria* Koken, 1892, *non* Lowe, 1854)]. Whorls low, convex or with median angulation, bearing at mid-height row of blunt tubercles located in some species on axial riblets crossing the strongly parasigmoid growth lines; spiral threads present in some. *M.Trias.(Ladin.)-U.Jur.(Raurac.)*, cosmop.——Fig. 209,*12*. **T. subcompressus* Kittl, M.Trias.(Ladin.), S.Tyrol; *12a,b*, later whorls, ×1 (64).

Goniospira Cossmann, 1895 [*pro Goniogyra* Kittl, 1894 (*non* Agassiz, 1857)] [**Turritella armata* Münster, 1841]. Small; whorls high, steeply coiled, with sharply angular nodose periphery at mid-height; 2nd angulation, continuing suture, delimiting spirally striated part of base of last; growth lines strongly parasigmoid. *M.Trias.*, Eu.-?Asia.——Fig. 209,*3*. **G. armata* (Münster), S.Tyrol; *3a,b*, ×1, ×2 (64).

[1] Münster in 1841 described 2 different species (now included in *Anoptychia*) under the names *Melania supraplecta* and *Turritella supraplecta*. Koken, when founding *Anoptychia*, cited *Chemnitzia supraplecta* Münster as one of its species, and, as at that time only *Melania supraplecta* had been transferred to *Chemnitzia* (by d'Orbigny, 1850) it could be argued that this was the species intended. Cossmann, however, cited *Turritella supraplecta* as type species of *Anoptychia*, although in illustration of it he reproduced Kittl's figure of *Melania supraplecta*. Kittl had sunk *Turritella supraplecta* in the synonymy of *T. carinata* Münster (unfortunately a homonym of *T. carinata* Lea). *Melania supraplecta* is here cited as type species of *Anoptychia* (see also Haas, 1953, p. 122 [no. 50 in following reference list]).

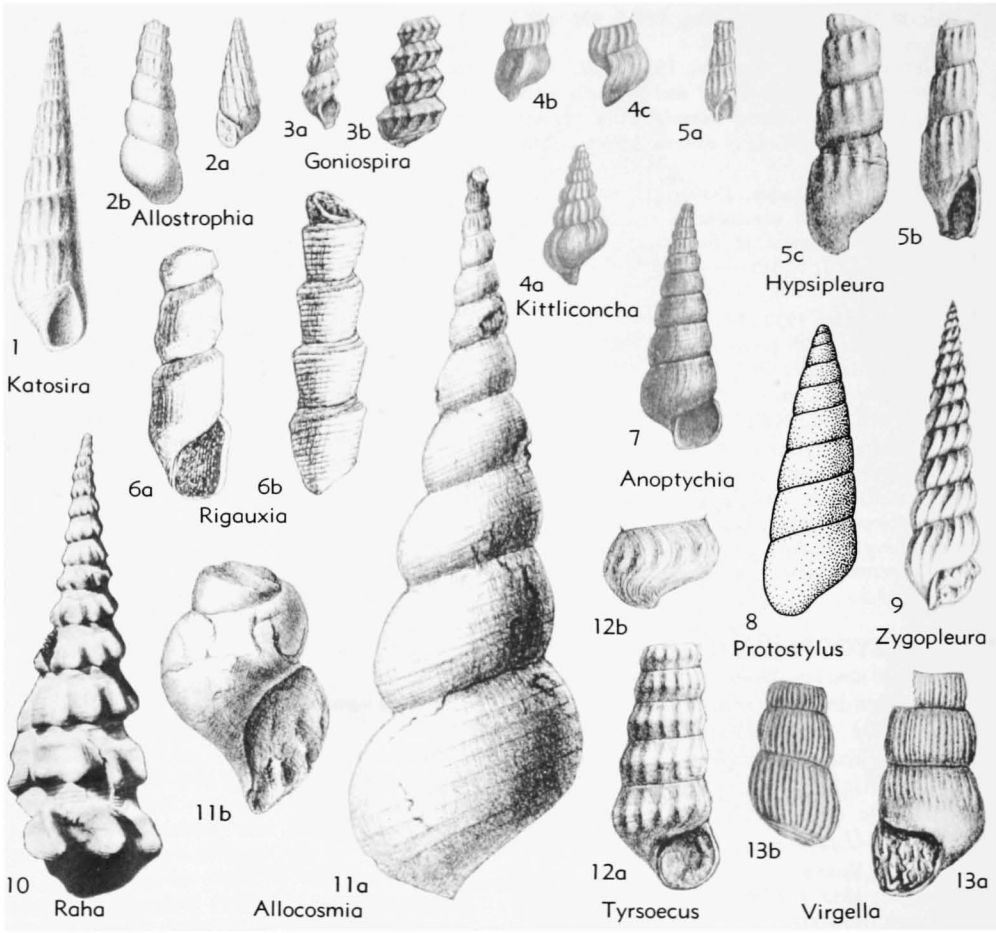

FIG. 209. Loxonematacea (Zygopleuridae, genus inquirendum) (p. *I*315-*I*316).

?Raha MARWICK, 1953 [**Coronaria spectabilis* TRECHMANN, 1918]. Large, coeloconoid; lower part of whorls with strong rounded ribs ending by suture in tubercles; spiral threads present, strongest on unribbed region; collabral lines almost straight. *U.Trias.(Carn.)*, N.Z.——FIG. 209,*10*. **R. spectabilis* (TRECHMANN); ×0.7 (204).

Allostrophia KITTL, 1894 [**Melania perversa* MÜNSTER, 1841]. Sinistral; whorls moderately convex; collabral riblets with strong sigmoid curve, and becoming obsolete on later whorls; no spiral ornament. *M.Trias.(Ladin.)-U.Trias.(Nor.)*, Eu.-S.Am.——FIG. 209,*2*. **A. perversa* (MÜNSTER), M.Trias.(Ladin.), S.Tyrol; *2a,b*, ×1 (10).

?Virgella DEGREGORIO, 1930 [**V. jucunda*]. Small, sinistral; early whorls unknown, later ones high, feebly convex, bearing close-spaced narrow collabral riblets parallel with axis, not sigmoid. *L.Jur.*, Sicily.——FIG. 209,*13*. **V. jucunda*; *13a,b*, ×3 (174).

Rigauxia COSSMANN, 1885 [**Chemnitzia canaliculata* RIGAUX & SAUVAGE, 1868; SD COSSMANN, 1909]. Very acute; whorls high, feebly concave to feebly convex, with narrow sutural ramp in some species; presence of narrow parasigmoid collabral riblets, low varices, and spiral threads variable. *L.Jur.-M.Jur.(Callov.)*, Fr.-Sinai.——FIG. 209,*6*. **R. canaliculata* (RIGAUX & SAUVAGE), M.Jur. (Bathon.), Fr.; *6a,b*, ×1, ×1.5 (17).

LOXONEMATACEA Genus inquirendum

Protostylus MANSUY, 1914 [**P. lantenoisi*; SD BATTEN, 1952 (4, p.355)]. Smooth, unornamented, with flat whorls and shallow sutures; labrum and protoconch unknown. *Perm.*, SE.Asia.——FIG. 209,*8*. **P. lantenoisi*, Yunnan; ×1.3.

Superfamily CERITHIACEA Fleming, 1822

[*nom. transl. et correct.* COSSMANN, 1906 (*ex* Cerithiadae FLEMING, 1822)]

Shell mostly high-spired, with many whorls, less commonly of other shapes; operculum spiral; penis absent. *L.Dev.-Rec.*

Family TURRITELLIDAE Woodward, 1851

[Family Turritellidae also erected in the same year independently by W. CLARK; =Acanthonematidae WENZ, 1938]

High-spired, with 8 to 20 or more whorls, spiral ornament commonly conspicuous; shallow labral sinus usually culminating at or above mid-whorl with upper limb extending farther adaperturally than lower; siphonal notch or canal wanting. *L.Dev.-Rec.*

Turritella LAMARCK, 1799 [**Turbo terebra* LINNÉ, 1758]. Moderate to large, slender; whorls convex, neanic primary spirals starting in the order abapical-medial-adapical; outer lip arcuate, lateral sinus shallow, oblique; no basal sinus. *Oligo.-Rec.*, SE.Asia-E.Indies-Japan; *Mio.*, S.Eu.-N.Afr.-trop. & subtrop. Am.

Acanthonema SHERZER & GRABAU, 1908 [**A. holopiforme* (=*Orthonema newberryi* MEEK, 1873); SD GRABAU & SHIMER, 1909]. With spiral row of spirally elongate pustules just below upper suture and in some shells 1 or 2 similar rows just above lower suture; minutely phaneromphalous. *L.Dev.*, N.Am.——FIG. 210,*1*. *A. newberryi* (MEEK), Ohio; ×2.

Orthonema MEEK & WORTHEN, 1862 [**Eunema? salteri* MEEK & WORTHEN, 1861]. Commonly with very slight subsutural shoulder, principal spiral thread or carina just below it coinciding roughly with culmination of labral sinus, then below this a pair of threads, angulations or carinae; anomphalous. *L.Carb.(Miss.)-M.Perm.*, N.Am.-Eu.——FIG. 210,*5*. **O. salteri* (MEEK & WORTHEN), M.Penn., Ill.; ×4.

Callispira NELSON, 1947 [**C. quinquecostata*]. Much like *Orthonema* but with 5 or 6 closely spaced spiral cords and labral sinus culminating on 2nd cord (105, p. 464). *Penn.*, N.Am.-NE.Asia. ——FIG. 210,*4*. **C. quinquecostata*, M.Penn., Tex.; ×2.

Family PROCERITHIIDAE Cossmann, 1905

[*nom. correct.* WENZ, 1938 (*pro* Procerithidae COSSMANN, 1905)]

Commonly high-spired; ornament of collabral and spiral elements, former commonly dominant but wanting in some genera; varices rarely present; apertural margin entire or with rudimentary siphonal outlet, at most a small sinus or break.

Procerithium COSSMANN, 1902 [**P. quinquegranosum*]. Small; intersecting collabral and spiral elements producing granulose ornament. *L.Jur.(Lias.)-U.Jur.(Portland)*, cosmop.

Spanionema WHIDBORNE, 1891 [**Loxonema scalaroides* WHIDBORNE, 1889]. Outer lip prosocline, with a few heavy irregularly spaced varices; no labral sinus; seemingly anomphalous. *M.Dev.*, Eu. ——FIG. 210,*2*. **S. scalaroides* (WHIDBORNE), Eng.; ×1.3.

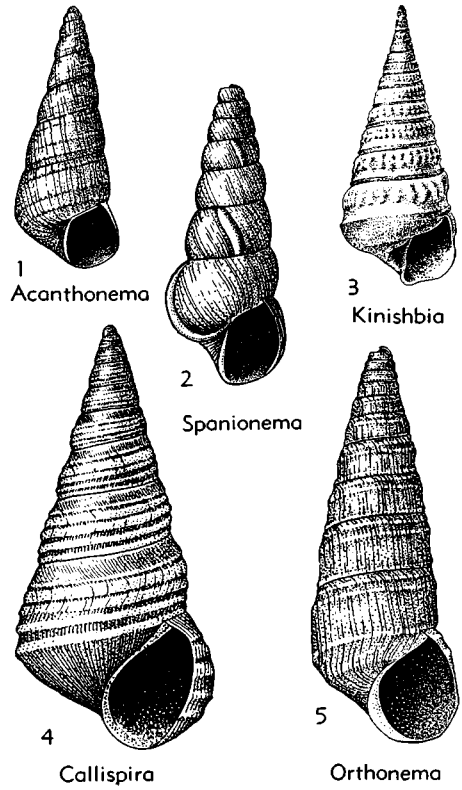

FIG. 210. Cerithiacea (Turritellidae, Procerithiidae) (p. *1317*).

Kinishbia WINTERS, 1956 [**K. nodosa*]. High-spired, with many whorls; sides slightly coeloconoidal, base rounded, narrowly phaneromphalous, with short inhalant canal; whorls somewhat inflated but with spiral groove above low peripheral carina; sutures shallow; ornament a row of nodes on shoulder, each composed of 2 or 3 smaller nodes arranged vertically; labrum seemingly orthocline (151, p.44). *M.Perm.*, N.Am. ——FIG. 210,*3*. **K. nodosa*, Ariz.; ×3.3 (151).

Superfamily CYCLOPHORACEA Gray, 1847

[*nom. transl.* KNIGHT, BATTEN & YOCHELSON, herein (*ex* Cyclophoridae GRAY, 1847)]

Prevailing conispiral but varying in shape; pedal ganglia ladder-like; pallial cavity commonly transformed into a lung, without ctenidium; operculum corneous, typically multispiral. Habitat fresh-water and terrestrial. *L.Carb.(Miss.)-Rec.*

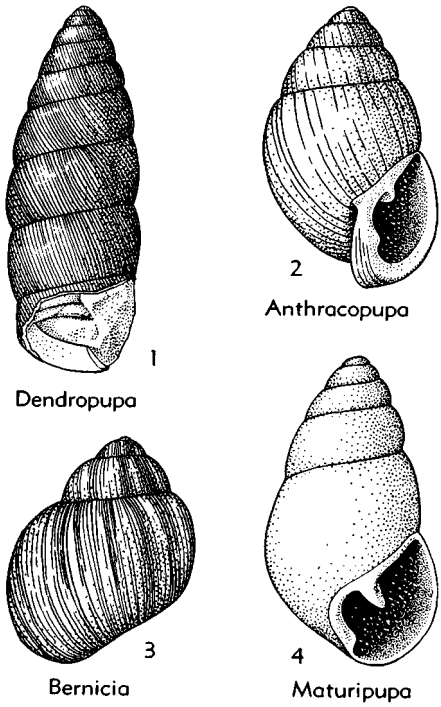

FIG. 211. Cyclophoracea (Cyclophoridae, Viviparidae) (p. I318-I319).

Family CYCLOPHORIDAE Gray, 1847

Apertural margins commonly somewhat thickened or reflexed, with or without apertural teeth or notches. *L.Carb.(Miss.)-Rec.*

Subfamily DENDROPUPINAE Wenz, 1938

Small, pupiform, with one or more lamellar teeth in aperture; whorls smooth or with numerous collabral threads; operculum unknown. *L.Carb.(Miss.)-L.Perm.*

Owing to certain errors in assignment of geologic age and in understanding of morphological features, genera included in this subfamily have been placed previously with pulmonate families, principally the Pupillidae. No compelling reason is now seen to recognize the occurrence of Pulmonata in the Paleozoic—indeed, it seems improbable that representatives of this group appeared so early. The Dendropupinae may be classed in the Cyclophoridae close to the Diplomatinae or actually incorporated in this subfamily, which contains several pupiform genera with toothed apertures and ornament consisting of numerous collabral threads. The occurrence of genera here included in the Dendropupinae indicates that they are not marine forms but evidence for assignment of a terrestrial or fresh-water habitat, or both, is inconclusive.

?Carbonispira YEN, 1949 [**C. scotica*]. Little known, based on poorly preserved specimen, described characters probably due to crushing and corrosion (152, p. 238). *L.Carb.*, Eu.

Dendropupa OWEN, 1861 [**Pupa vetusta* DAWSON, 1859] [=*Strophites* DAWSON, 1880 (*non* DESHAYES, 1832); *?Strophella* DAWSON, 1895]. Relatively large, cylindrical pupiform, with numerous fine collabral threads. [Aperture of type species poorly known; a specimen with broken whorls discloses what seem to be lamellar columellar teeth but their number and position are not clear. There is little to support DAWSON's drawing of the aperture.] *Miss.-Penn.*, N.Am.——FIG. 211,*1*. **D. vetusta* (DAWSON), Penn., Can.(N.Scot.); final whorl showing broken internal folds, ×6.7.

Maturipupa PILSBRY, 1926 [**Pupa vermilionensis* BRADLEY, 1872]. Without ornament; aperture with strong lamellar parietal tooth; columellar lip arcuate and truncate at notched base; labrum not thickened. [Eventually may be shown to represent juvenile stages of *Anthracopupa*.] *L.Carb.(Miss.)-U.Carb.(Penn.)*, N.Am.-Eu.——FIG. 211,*4*. **M. vermilionensis* (BRADLEY), M.Penn., Ill.; ×13.3.

Anthracopupa WHITFIELD, 1881 [**A. ohioensis*]. Ornament of faint collabral threads; spire and base both somewhat tapering; aperture with strong lamellar parietal tooth and columellar tooth, notch on inner side of upper end of labrum, which, like columellar lip, is considerably thickened at final growth stage. *L.Perm.*, N.Am.——FIG. 211,*2*. **A. ohioensis*, Ohio; ×13.3.

[The remaining subfamilies of the Cyclophoridae are post-Paleozoic, the majority being confined to Cenozoic deposits.]

Family VIVIPARIDAE Gray, 1847

Broadly turbiniform; anomphalous or minutely phaneromphalous; mostly unornamented but spiral cords or rows of pustules present on some shells. Living species inhabit fresh water and are viviparous. *?L.Carb., Jur.-Rec.*

Viviparus MONTFORT, 1810 [**V. fluviorum* (= *Helix vivipara* LINNÉ, 1758)] [=*Paludina* FÉRUSSAC, 1812]. Medium-sized, mostly with smooth, convex whorls, but some species with carinate or nodosely carinate whorls. *Jur.-Rec.*, cosmop. [A record from the Lower Carboniferous of England was based on an internal mold, perhaps of a marine shell, and needs confirmation before acceptance.]

?**Bernicia** Cox, 1927 [**B. praecursor*]. Small naticiform, but with deep sutures; apertural lips unknown but probably simple. *L.Carb.*, Eu.——FIG. 211,*3*. **B. praecursor*, Eng.; ×10.

Superfamily RISSOACEA Adams & Adams, 1854

[*nom. transl.* THIELE, 1929 (*ex* Rissoidae ADAMS & ADAMS, 1854)]

Shell mostly small, commonly turriculate or ovate, more rarely turbiniform to subdiscoidal, smooth or ornamented; mostly holostomatous, aperture circular or ovate. *Perm.-Rec.*

Family HYDROBIIDAE Stimpson, 1865

[*nom. transl.* FISCHER, 1885 (*ex* Hydrobiinae STIMPSON, 1865)]

Shell small or minute, smooth or with collabral threads or riblets, rarely spirally carinate. Operculum horny, spiral. [Mostly in fresh or brackish water.] *Perm.-Rec.*

Hydrobia HARTMANN, 1821 [**Cyclostoma acutum* DRAPARNAUD, 1805; SD GRAY, 1847] [=*Paludestrina* D'ORBIGNY, 1839 (obj.)]. Entire shell, or early whorls only, acute; whorls convex, smooth or with collabral threads; apertural margin uninterrupted, not thickened. *Perm.(Karroo)*, Rhodesia; *U.Jur.(Oxford.)-Rec.*, cosmop.

Superfamily SUBULITACEA Lindström, 1884

[*nom. transl.* WENZ, 1938 (*ex* Subulitidae LINDSTRÖM, 1884)]

Subulate, acicular to subglobular; commonly with anterior notch and columellar fold, although these are but weakly developed in some, also basically with parietal fold; inner shell layers not sharply differentiated, not nacreous. *M.Ord.-M.Perm.*

Inasmuch as the superfamily is extinct, anatomical features can be inferred only from characters of the shell. The total lack of a sinus or slit in the outer lip argues for advanced anatomical asymmetry. Surely only a single ctenidium, probably of ctenobranch type, was present. Likewise, all other primitively paired pallial organs must have been represented only by the topographically left-hand member. The anterior notch and columellar fold probably were associated with an inhalant siphon and the pallial currents presumably made their exit at the angle where the outer lip joins the preceding whorl. The derivation of the group is uncertain but it probably was close to the Loxonematacea.

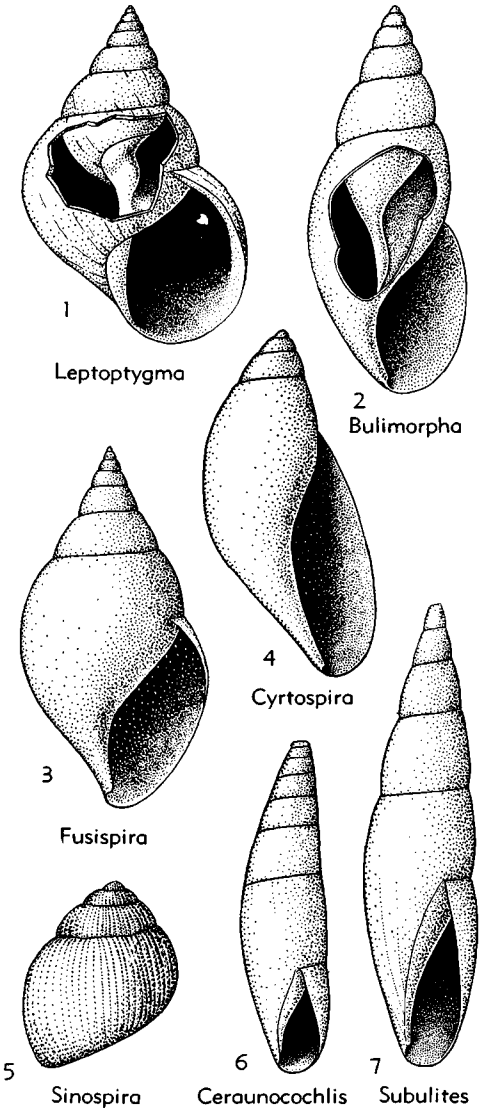

FIG. 212. Subulitacea (Subulitidae—Subulitinae) (p. *1320*).

Family SUBULITIDAE Lindström, 1884

[=Bullimorphidae, Fusispiridae S.A.MILLER, 1889]

Anterior notch present, with at least one columellar fold. *M.Ord.-M.Perm.*

Subfamily SUBULITINAE Lindström, 1884

[*nom. transl.* KNIGHT, BATTEN & YOCHELSON, herein (*ex* Subulitidae LINDSTRÖM, 1884)]

Parietal fold wanting. *M.Ord.-M.Perm.*

Subulites EMMONS, 1842 [**S. elongatus* (=*Macrocheilus subelongatus* D'ORBIGNY, 1850, *pro M.*

elongatus "HALL" =EMMONS, *non M. elongatus* PHILLIPS, 1841)]. Subulate to fusiform, spire high and straight or short and curved; whorls flat or gently arched, with shallow sutures; aperture narrowly elongate, with small but sharp anterior notch; labral inductura present; ornament lacking.

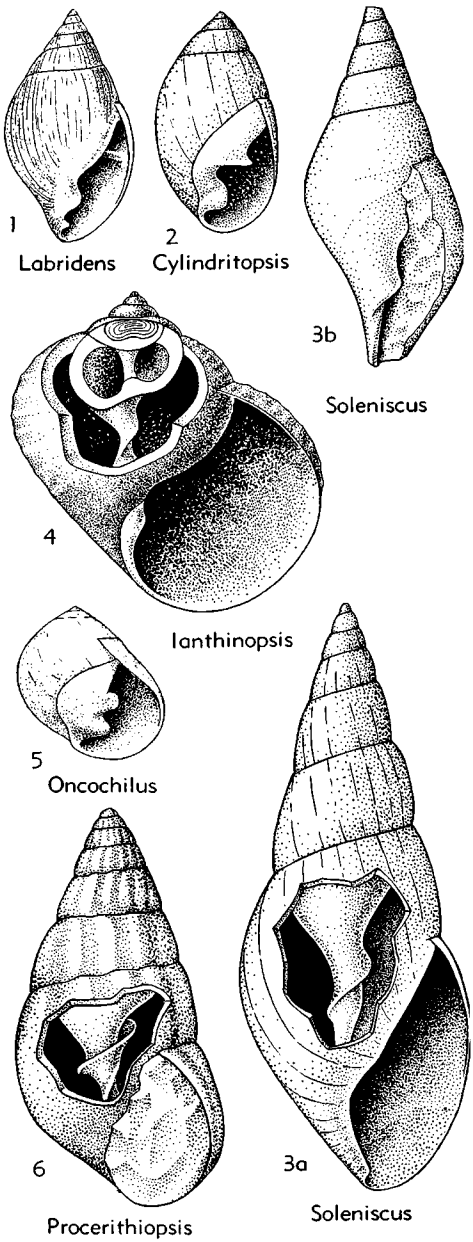

FIG. 213. Subulitacea (Subulitidae——Soleniscinae); Neritacea *(Oncochilus)* (p. *I*218, *I*320-*I*321).

[Subgenera are intergrading.] *M.Ord.-L.Dev.*, N. Am.-Eu.-NC.Asia.

S. (Subulites) [=*Polyphemopsis* PORTLOCK, 1843]. Spire straight, whorls high, last one occupying about half of total height; aperture acuminate above, widest below. *M.Ord.-U.Sil.*, N.Am.-Eu.-NC.Asia.——FIG. 212,*7*. **S. (S.) subelongatus* (D'ORBIGNY), M.Ord., N.Y.; ×1.3.

S. (Cyrtospira) ULRICH in ULRICH & SCOFIELD, 1897 [**C. tortilis*; SD COSSMANN, 1909]. Axis of shell curved, last whorl occupying much more than half of total shell height. *M.Ord.-U.Sil.*, N.Am.-Eu.——FIG. 212,*4*. **S. (C.) tortilis* (ULRICH), M.Ord., Tenn.; ×2.

S. (Fusispira) HALL, 1872 [**F. ventricosa*; SD S.A.MILLER, 1889]. Fusiform; aperture narrow, acuminate above and narrower below than in *S. (Subulites)*. *M.Ord.-L.Dev.*, N.Am.-Eu.-NE.Asia. ——FIG. 212,*3*. **S. (F.) ventricosus* (HALL), M.Ord., Wis.; ×0.7.

Bulimorpha WHITFIELD, 1882 [*pro Bulimella* HALL, 1858 (*non* PFEIFFER, 1854)] [**Bulimella bulimiformis* HALL, 1858]. Fusiform, with gently arched whorls, final whorl more than half of total height; well-developed siphonal fold seen in broken specimens. *Miss.*, N.Am.——FIG. 212,*2*. **B. bulimiformis* (HALL), M.Miss., Ind.; apertural view with window showing columellar features, ×4.

Leptoptygma KNIGHT, 1936 [**Auriptygma virgatum* KNIGHT, 1931]. Fusiform but with rounded base, sutures deep; labral inductura with low fold not covering parietal lip; siphonal channel below fold very wide and diffuse; ornament lacking or consisting of fine collabral threads. *Miss.(L.Carb.)-Penn.(U.Carb.)*, N.Am.-NE.Asia.——FIG. 212,*1*. **L. virgatum* (KNIGHT), M.Penn., Mo.; apertural view with window showing columellar features, ×4.

?Sinospira YIN, 1932 [**S. ornata*]. Naticiform, with protruding spire and moderately deep sutures; ornament of fine collabral threads; apertural features unknown. [May prove to be senior synonym of *Leptoptygma*.] *U.Carb.*, E.Asia.——FIG. 212,*5*. **S. ornata*, China; ×1.3 (153).

Ceraunocochlis KNIGHT, 1931 [**C. fulminula*]. Very small, subulate, whorls of spire, low, first whorl button-like; sutures very shallow; entire labrum covered by inductura, with small anterior notch; without ornament. *Miss.-Penn.*, N.Am. ——FIG. 212,*6*. **C. fulminula*, M.Penn., Mo.; ×10.

Subfamily SOLENISCINAE Wenz, 1938

[*nom. transl.* KNIGHT, BATTEN & YOCHELSON, herein (*ex* Soleniscidae WENZ, 1938)]

Parietal fold present, in some genera appearing as diffuse thickening on parietal inductura. *M.Dev.-M.Perm.*

Ianthinopsis MEEK & WORTHEN, 1866 [**Platyostoma? tumida* MEEK & WORTHEN, 1861] [= *Plectostylus* CONRAD, 1842 (*non* BECK, 1837);

Strobeus DEKONINCK, 1881; *Sphaerodoma* KEYES, 1889; *Strobaeus* COSSMANN, 1909 (*pro Strobeus* DEKONINCK, 1881, obj.)]. Form variable, globular with pointed apex to high-spired fusiform; without ornament but exceptionally with faint spiral ridges; strong columellar siphonal fold barely visible in unbroken apertures but well developed just within it, resorbed in all but last 1 or 2 whorls; an obscure parietal fold may appear as broadly arched thickening of parietal inductura; labrum thin but thickening as growth proceeds until outer shell wall is very massive and earlier whorls completely filled, with whorl partitions and columella much reduced by resorption. *M.Dev.-M.Perm.*, N.Am.-S.Am.-Eu.-NE.Asia-SE.Asia-NC.Asia. —— FIG. 213,*4*. **l. tumida* (MEEK & WORTHEN), U. Penn., Tex.; apertural view with window showing development and resorption of columellar fold and filling of earlier whorls, ×1.3.

Soleniscus MEEK & WORTHEN, 1861 [*pro Macrocheilus* PHILLIPS, 1841 (*non* KIRBY, 1838)] [**S. typicus*] [*Duncania* BAYLE, 1879; *Macrochilina* BAYLE, 1880 (*pro Duncania* BAYLE, 1879, *non* DEKONINCK, 1872); *Macrochilus* LINDSTRÖM, 1884]. Fusiform; with small siphonal notch visible externally; small siphonal canal present internally with more or less elevated parietal fold somewhat above it; ornament lacking. *Miss.(L. Carb.)-M.Perm.*, N.Am.-Eu.-NE.Asia-SE.Asia.—— FIG. 213,*3*. **S. typicus*, M.Penn., Ill.; *3a*, apertural view with window showing columella, ×1.3; *3b*, apertural view with broken lip exposing columella, ×2.7.

?Procerithiopsis MANSUY, 1914 [**P. ambigua*; SD COSSMANN, 1918]. Small, minutely phaneromphalous, with rather strong collabral ribs; seemingly with small siphonal notch and columellar folds much as in *Soleniscus*. *L.Perm.*, SE.Asia—— FIG. 213,*6*. **P. ambigua*, Cambodia; apertural view with window showing columellar folds, ×6.

Cylindritopsis GEMMELLARO, 1889 [**C. ovalis*; SD COSSMANN, 1909] [=*Ankorella* DELPEY, 1941 (29, p. 272)]. Ovoid, with shallow sutures and small spire; base produced anteriorly with deep siphonal notch and heavy siphonal fold, higher parietal fold in middle of parietal lip being set off by deep groove; parietal inductura well developed. *M.Perm.*, Eu.-Asia.——FIG. 213,*2*. **C. ovalis*, Sicily; ×2 (46).

Labridens YOCHELSON, 1956 [**L. shupei*]. Form much as in *Cylindritopsis* but with relatively higher spire; base produced anteriorly with small siphonal fold, a stronger fold above it low on parietal lip and still higher a very low obscure fold bordered by shallow groove; labium thin, with prominent sharp lira or internal fold approximately opposite 3rd low fold on parietal lip; surface without ornament (156, p. 45). [This is a unique Paleozoic genus in having a well-developed labral lira, which, with the parietal folds, suggests that the Jurassic and Cretaceous Nerineacea may have had their origin here.] *M.Perm.*, N.Am.——FIG. 213,*1*. **L. shupei*, Tex.; ×3.

Family MEEKOSPIRIDAE Knight, 1956

Without columellar fold and anterior notch; *?U.Sil., L.Carb.(Miss.)-M.Perm.*

?Auriptygma PERNER, 1903 [**A. fortior*; SD COSSMANN, 1909]. Very similar to *Leptoptygma* but columella thin and gently spiral about pseudumbilicus, without columellar fold. *U.Sil.*, Eu.—— FIG. 214,*3*. **A. fortior*, Czech.; ×1.3.

Meekospira ULRICH, in ULRICH & SCOFIELD, 1897 [**Eulima? peracuta* MEEK & WORTHEN, 1861] [= COSSMANN, 1920 (20, p. 83); *Cambodgita* STRAND, 1928]. Slender, sharply acuminate; columellar lip somewhat arcuate, reflexed, inductura not covering upper part of parietal lip. *L.Carb.(Miss.)-L.Perm.*, N.Am.-S.Am.-Eu.-SE.Asia.——FIG. 214,*2*. **M. peracuta* (MEEK & WORTHEN), M.Penn., Ill.; ×1.3.

Girtyspira KNIGHT, 1936 [**Bulimella canaliculata* HALL, 1858]. Small, fusiform, with relatively high final whorl which has narrow ramp or is adpressed, columellar lip arcuate. *L.Carb.(Miss.)-M.Perm.*, N.Am.-Eu.——FIG. 214,*1*. **G. canaliculata* (HALL), M.Miss., Ind.; ×6.7.

Subclass OPISTHOBRANCHIA Milne Edwards, 1848

[*nom. emend.* BRONN, 1862 (*pro* Opisthobranchiata, *nom. correct.* WOODWARD, 1851, also MORRIS & LYCETT, 1851 (*pro* 'opisthobranches' MILNE EDWARDS, 1848, invalid vernacular name)), *nom. auct. conserv.* proposed Cox, 1958 (ICZN pend.)]

Shell tending to be reduced or absent; if present, either aciculate (Pyramidellidae) or more commonly low-spired, involute or convolute, and commonly covered largely by expansions of the mantle or foot which cannot always be entirely withdrawn into it; columellar folds frequent; protoconch commonly heterostrophic, ornament absent

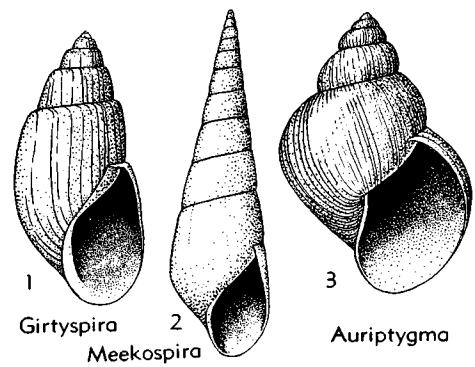

FIG. 214. Subuliticea (Meekospiridae) (p. 1321).

or if present commonly confined to spiral elements, operculum commonly absent in adult, tentacles ear-shaped or flattened; eyes sunken, mantle cavity becoming shallow, commonly rotated to face more or less to the right and finally lost with shell; gills in mantle cavity foliobranch, not filamentous, absent in some genera, replaced in others by pallial outgrowths; ciliated strips present on right side of mantle cavity to help exhalant current, tendency to concentrate all ganglia on dorsal side of esophagus with consequent elongation of pedal and parapedal commissures and shortening of visceral loop, leading to euthyneury (except Acteonidae and *Toledonia*); ventricle anterior to auricle (except Acteonidae, Pyramidellidae, Ringiculidae); hermaphrodite; penis invaginable (except Acteonidae), commonly armed; reproductive ducts tending to be sunk in haemocoele and to split into separate vas deferens, oviduct, and vagina; esophagus without glands, its opening into stomach adjoining that of intestine, with stomach tending to be reduced to a caecum; histology of digestive gland comparatively elaborate. Marine only, eggs hatch to free-swimming veligers showing torsion and operculum. *?Dev., Miss.-Rec.*

Order UNCERTAIN
Superfamily PYRAMIDELLACEA d'Orbigny, 1840

[*nom. transl.* Wenz, 1938 (*ex* Pyramidellidae d'Orbigny, 1840)]

Small, aciculate; with or without columellar fold, protoconch orthostrophic, heterostrophic, or deviated. *?Dev., Miss.-Rec.*

The work of Thorson (1946) and Fretter & Graham (1949) has demonstrated that the Pyramidellidae are opisthobranchs and that some (if not all) living species are highly specialized ectoparasites. The presence and size of the heterostrophic or deviated protoconch found in most species may be a measure of time spent as free-swimming larvae. Living species lack radulae. There is no evidence of parasitism or lack of a radula in the other families (Streptacididae, Mathildidae) that may be included because of form and protoconch. The reported radula of a living species assigned to the Mathildidae, as well as the assignment itself, should be reinvestigated.

Family STREPTACIDIDAE Knight, 1931

High-spired, with moderately deep labral sinus that culminates roundly high on whorl; protoconch with initial discoidal whorl that caps spire flatly or is deviated either simply or at top of a variably long segment of disjunct whorls. *?Dev., L.Carb. (Miss.)-M.Perm.*

The shell form in this family and particularly the labral sinus remind one strongly of the Loxonematacea, from which they probably were descended. The protoconch is very similar to that found in the Mathildidae to which they may be closely related.

Donaldina Knight, 1933 [**Aclisina grantonensis* Donald, 1898]. Ornament of spiral threads confined generally to lower part of whorl. *?Dev., L. Carb.(Miss..)-L.Perm.*, N.Am.-Eu.——Fig. 215,*3*. **D. grantonensis* (Donald), L.Carb., Scot.; *3a*, apertural view, ×10; *3b*, heterostrophic apex, ×25.

Platyconcha Longstaff, 1933 [**P. dunlopiana*]. Ornament of strong collabral costae. *L.Carb.-U. Carb.*, Eu.——Fig. 215,*2*. **P. dunlopiana*, L.Carb., Scot.; apertural view showing flat apex, ×9.

Streptacis Meek, 1872 [**S. whitfieldi*]. Very slender, ornamented only with growth lines. *U. Carb.(Penn.)-M.Perm.*, N.Am.-Eu.——Fig. 215,*1*. **S. whitfieldi*, M.Penn., Ill.; apertural view showing heterostrophic apex, ×10.

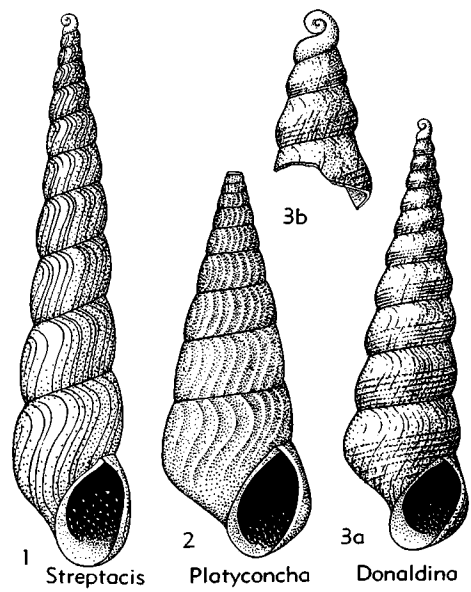

Fig. 215. Pyramidellacea (Streptacididae) (p. *I*322).

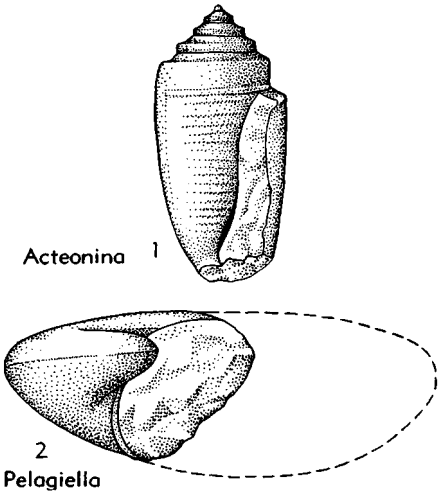

FIG. 216. Acteonacea (Acteonidae); Pelagiellacea (Pelagiellidae) (p. 1323).

Order PLEUROCOELA Thiele, 1925

Commonly with dextral shell and mantle cavity but both tending to become obsolete; shell commonly involute, nearly so, or convolute. *Miss.-Rec.*

Superfamily ACTEONACEA d'Orbigny, 1842

[*nom. transl.* WENZ, 1938 (*ex* Acteonidae D'ORBIGNY, 1842)] [=Cephalaspidea FISCHER, 1883]

Shell commonly external but in many forms enclosed by mantle. *Miss.-Rec.*

Family ACTEONIDAE d'Orbigny, 1842

Shell spiral, external, commonly with spiral ornament, columella commonly with 1 or 2 folds; with corneous operculum and cephalic shield, soft parts completely retractable into shell; streptoneurous; auricle in front of ventricle. *L.Carb.-Rec.*

Acteonina D'ORBIGNY, 1850 [**Chemnitzia carbonaria* DEKONINCK, 1843; SD MEEK, 1863] [= *Actaeonina* FISCHER, 1883 (obj.)]. Small, cylindrical, with high narrow aperture and very short gradate spire; protoconch seemingly a single deviated whorl, partly immersed; with collar-like structure above suture; probably a fold low on columella; fine spiral striae. *L.Carb.*, Eu.——FIG. 216,*1*. **A. carbonaria* (DEKONINCK), Belg.; ×4.

?GASTROPODA INCERTAE SEDIS

The genus *Pelagiella* is classed tentatively as belonging to the Gastropoda because shell form suggests this assignment, but it is not possible to reach conclusions about its relationships within the class. If *Pelagiella* is a gastropod, its remoteness from others is indicated by such features as the presence of fine spiral striae inside the shell, gerontic thickening inside the aperture, filling of apex by solid shell matter, variable position of apertural sinuses, and common occurrence of dextral and sinistral individuals in a single species. Each of these characters is found in some very much later gastropods but few of them appear in Paleozoic forms. Comprehensive studies based on large collections have never been made.

Superfamily PELAGIELLACEA Knight, 1956

Shell comprising 0.5 to 3 whorls, rather flattened on top and arched below or rotelliform above and umbilicate below, with sharply rounded periphery; initial whorl (protoconch) wider than thick, with faintly bulbous beginning; shell relatively thick and may be filled completely near apex so as to produce short blunt curved steinkerns; with one or more labral sinuses (indicated by growth lines) that vary in shape, depth and position in different species; with numerous very fine spiral grooves inside of shell in some species; external ornament wanting or consisting of fine spiral and collabral markings. *Cam.*

This little-known assemblage is difficult to study and to place systematically. Some authors (WENZ, 1938; KNIGHT, 1952) have doubted that they are gastropods.

Family PELAGIELLIDAE Knight, 1956

With characters of superfamily. *Cam.*

Pelagiella MATTHEW, 1895 [**Cyrtolites atlantoides* MATTHEW, 1894] [=*Parapelagiella, Proeccyliopterus, Protoscaevogyra* KOBAYASHI, 1939 (77, pp. 286-287); *Semicircularia* LOCHMAN, in LOCHMAN & DUNCAN, 1944 (91, p.44)]. Dextral or sinistral, with broad blunt apex and rapidly expanding helicocone; shallow sinus culminating at periphery or with one or more sinuses above or below periphery; interior marginal thickening of gerontic shell indicated by steinkerns. [*Parapelagiella* was proposed for forms without the supposed constricted apertural margin of *Pelagiella*, but this is a gerontic feature of *Pelagiella* itself, though seen rarely; *Proeccyliopterus* was proposed for forms with a ridge on the upper shell surface and *Protoscaevo-*

gyra for sinistral forms. In so-called *Proeccyliopterus* sinuses above and below the periphery generate ridges, and there are both dextral and sinistral individuals in the type species. *Semicircularia* is based on steinkerns of a sinistral form, the supposed short blunt uncoiled spire denoting apical filling of the shell. All these forms are considered to be congeneric with *Pelagiella.*] *Cam.*, N.Am.-NE.Asia. —— FIG. 216,*2*. **P. atlantoides* (MATTHEW), L.Cam., N.B.; ×4.

GENERIC NAMES ASSIGNED TO PALEOZOIC FOSSILS IMPROPERLY REGARDED AS GASTROPODA AND MONOPLACOPHORA

Anticalyptraea QUINSTEDT, 1867 [=*Autodetus* LINDSTRÖM, 1884] (worm).

Archaeonassa FENTON & FENTON, 1937 (trail).

Barella HEDSTRÖM, 1930 (hyolithid operculum).

Charruia RUSCONI, 1955 (problematical organism).

Chuaria WALCOTT, 1899 (carbon scale).

Coleolus HALL, 1879 [*pro Coleoprion* HALL, 1876 (*non* SANDBERGER, 1847)] (hyolithid).

Conchopeltis WALCOTT, 1879 (scyphozoan).

Conularia MILLER (1818) in SOWERBY, 1821 (Scyphozoan).

Halophiala KOKEN, 1925 (?pelecypod).

Harttites HOWELL & KNIGHT, 1936 [*pro Harttia* WALCOTT, 1884 (*non* STEINDACHNER, 1877)] (not a mollusk).

Hercynella KAYSER, 1878 [*pro Pilidium* KAYSER, 1878 (*non* MÜLLER, 1846; *nec* FORBES, 1849; *nec* MIDDENDORFF, 1851); *Pilidion* PERNER, 1911 (*non* WAGLER, 1830)] (pelecypod).

Hyolithellus BILLINGS, 1871 (hyolithid) and *Discinella* HALL, 1871 (its operculum).

Hyolithes EICHWALD, 1840 (hyolithid).

Matthevia WALCOTT, 1885 (possibly extinct class of unknown affinities).

Mobergella HEDSTRÖM, 1923 (hyolithid operculum).

Paoshanella YIN, 1937 (problematical organism).

Polyopea CLARK, 1925 (hyolithid).

Rectogloma VAN TUYL & BERCKHEIMER, 1914 (coprolite).

Salterella BILLINGS, 1865 (hyolithid).

Scenellopsis RESSER, 1938 (probably not a mollusk).

Stenotheca SALTER, 1872 (crustacean).

Stenothecoides RESSER, 1938 (?crustacean).

Tentaculites SCHLOTHEIM, 1820 (?worm).

Watsonella GRABAU, 1900 (conchostracan).

REFERENCES

Archiac, Adolphe d' & Verneuil, E. P. de

(1) 1842, *On the fossils of the older deposits in the Rhenish Provinces:* Geol. Soc. London, Trans., v. 6, p. 303-410.

Baker, H. B.

(2) 1922, *Notes on the radula of the Helicinidae:* Acad. Nat. Sci. Philadelphia, Proc., v. 74, p. 29-68, pl. 3-7.

(3) 1923, *Notes on the radula of the Neritidae:* Same, v. 75, p. 117-178, pl. 9-16.

Batten, R. L.

(4) 1952, *The type species of the gastropod genus Protostylus:* Washington Acad. Sci., Jour., v. 42, p. 355.

(5) 1956, *Some new pleurotomarian gastropods from the Permian of west Texas:* Same, v. 46, no. 2, p. 42-44.

Böhm, Johannes

(6) 1895, *Die Gastropoden des Marmolatakalkes:* Palaeontographica, v. 42, p. 211-308, pl. 9-15 (Stuttgart).

Boucot, A. J.

(7) 1956, *Gyrospira, a new genus of bellerophontid (Gastropoda) from Bolivia:* Washington Acad. Sci., Jour., v. 46, no. 2, p. 46-47, fig. 1-5.

Bowsher, A. L.

(8) 1955, *Origin and adaptation of platyceratid gastropods:* Univ. Kansas Paleont. Contr. Mollusca, Art. 5, p. 1-11, pl. 1-2, fig. 1.

Bridge, Josiah, & Cloud, P. E., Jr.

(9) 1947, *New gastropods and trilobites critical in the correlation of Lower Ordovician rocks:* Am. Jour. Sci., v. 245, p. 545-559, pl. 1-2 (New Haven).

Broili, Ferdinand

(10) 1907, *Die Fauna der Pachycardientuffe der Seiser Alp. Scaphopoden und Gastropoden:* Palaeontographica, v. 54, p. 69-138, pl. 6-11 (Stuttgart).

Brösamlen, Richard

(11) 1909, *Beitrag zur Kenntnis der Gastropoden des schwäbischen Jura:* Same, v. 56, p. 177-322, pl. 17-22.

Campbell, K. S. W.

(12) 1953, *The fauna of the Permo-Carboniferous Ingelara Beds of Queensland:* Univ. Queensland Papers, Dept. Geol., v. 4, no. 3, p. 3-43, pl. 1-7 (Brisbane).

Chronic, B. J.

(13) 1949, *Invertebrate paleontology (excepting fusulinids and corals):* in Newell, N. D., Chronic, B. J., & Roberts, T. G., Upper Paleozoic of Peru, p. 46-173, pl. 5-35, Columbia Univ. (New York).

Chronic, Halka

(14) 1952, *Molluscan fauna from the Permian*

Kaibab Formation, Walnut Canyon, Arizona: Geol. Soc. America, Bull., v. 63, p. 95-166, pl. 1-10 (New York).

Clarke, J. M.

(15) 1904, *Naples fauna in western New York:* New York State Museum, Mem. 5, pt. 2, 454 p., 20 pl. (Albany).

Cobbold, E. S.

(16) 1921, *The Cambrian horizons of Comley, and their Brachiopoda, Pteropoda, Gasteropoda:* Geol. Soc. London, Quart. Jour., v. 76, pt. 4, p. 325-386, pl. 21-24.

Cossmann, Maurice

(17) 1885, *Contribution à l'étude de la faune de l'étage bathonien en France. (Gastropodes):* Soc. géol. France, Mém., sér. 3, v. 3, p. 1-374 pl. 1-18 (Paris).

(18) 1895-1925, *Essais de paléoconchologie comparée:* livr. 1-13 (1, 1895; 2, 1896; 3, 1899; 4, 1901; 5, 1903; 6, 1904; 7, 1906; 8, 1909; 9, 1912; 10, 1916 ("1915"); 11, 1918; 12, 1921; 13, 1925 (Paris).

(19) 1913, *Contributions à la paléontologie française des terrains jurassiques. III. Cerithiacea et Loxonematacea:* Soc. géol. France, Paléont., Mém., no. 46, 263 p., 18 pl. (Paris).

(20) 1920, *Rectifications de nomenclature:* in Revue critique de Paléozoologie et Paléophytologie, v. 24, p. 81-83 (Paris).

Cox, L. R.

(21) 1949, *Moluscos del Triasico Superior del Peru:* Inst. geol. Peru, Bol. 12, 50 p., 2 pl.

———, & Arkell, W. J.

(22) 1948-50, *A survey of the Mollusca of the British Great Oolite Series:* Palaeontogr. Soc. Mon., xiii+105 p., revised explanations of 15+38 pl. (London).

Cresswell, A. W.

(23) 1893, *Notes on the Lilydale limestone: Royal* Soc. Victoria, Proc., new ser., v. 5, p. 38-44, pl. 8-9 (Melbourne).

Crofts, D. R.

(24) 1955, *Muscle morphogenesis in primitive gastropods and its relation to torsion:* Zool. Soc. London, Proc., v. 125, pt. 3-4, p. 711-750.

Cullison, J. S.

(25) 1944, *The stratigraphy of some Lower Ordovician formations of the Ozark Uplift:* Univ. Missouri, School of Mines and Metallurgy, Bull. tech. ser., v. 15, p. 1-112, pl. 1-35 (Rolla).

Dahmer, Georg

(26) 1925, *Die Fauna der Sphärosideritschiefer de Lahnmulde. Zugleich ein Beitrag zur Kenntnis unterdevonischer Gastropoden:* Preuss. geol. Landesanstalt, Jahrb., v. 46, p. 34-67, pl. 3-4 (Berlin).

Dawson, J. W.

(27) 1880, *Revision of the land snails of the Paleozoic Era, with descriptions of new species:* Am. Jour. Sci., ser. 3, v. 20, p. 403-415 (New Haven).

Delpey, Geneviève

(28) 1941, *Gastéropodes marins. Paléontologie-stratigraphie:* Soc. géol. France, Mém., new ser., v. 43, no. 1, p. 5-114, pl. 1-27 (Paris).

(29) 1941, *Les gastéropodes permiens du Cambodge:* Jour. Conchyliologie, v. 84, p. 255-278 (Paris).

Diener, Carl & Kutassy, Endré

(30) 1926-40, *Glossophora triadica:* Fossilium Catalogus 1, Animalia, pars 34 & 81, 477 p. (Berlin).

Dietz, Bugen

(31) 1911, *Ein Beitrag zur Kenntnis der deutschen Zechsteinschnecken:* Kön. preuss, geol. Landesanstalt, Jahrb., v. 30 (for 1909), p. 444-506, pl. 13-15 (Berlin).

Donald, Jane

(32) 1889, *Descriptions of new species of Carboniferous gastropods:* Geol. Soc. London, Quart. Jour., v. 45, p. 619-625, pl. 20.

(33) 1892, *Notes on some new and little known species of Carboniferous Murchisonia:* Same, v. 48, p. 562-575, pl. 16-17.

(34) 1898, *Observations on the genus Aclisina De Koninck, with descriptions of British species and of some other Carboniferous Gastropoda:* Same, v. 54, p. 45-72, pl. 3-5.

(35) 1905, *On some Gasteropoda from the Silurian rocks of Llangadock (Caermarthenshire):* Same, v. 61, p. 567-577, pl. 37 (part).

Dubar, Gonzague

(36) 1948, *Études paléontologiques sur le Lias du Maroc. La faune domérienne du Jebel Bou-Dahar, près de Béni-Tajjite:* Service géol. Maroc, Notes et Mémoires, no. 68, 248 p., 30 pl. (Rabat).

Eichwald, Eduard d'

(37) 1860, *Lethaea rossica ou paléontologie de la Russie, décrite et figurée:* v. 1, 681 p., 59 pl. (St. Petersburg).

Etheridge, Robert, Jr.

(38) 1917, *Descriptions of some Queensland Palaeozoic and Mesozoic fossils. 3. A remarkable univalve from the Devonian limestone of the Burdekin River, Queensland:* Queensl. Dept. Mines, Geol. Survey Queensl., Pub. no. 260, p. 13-16, pl. 3, fig. 1-2 (Brisbane).

(39) 1921, *Palaeontologia Novae Cambriae Meridionalis - Occasional descriptions of New South Wales fossils, No. 8:* Geol. Survey New South Wales, Records, v. 10, pt. 1, p. 1-11, pl. 1-7 (Sydney).

Eudes-Deslongchamps, J. A.

(40) 1842, *Mémoire sur les patelles, ombrelles,*

calyptrées, fissurelles, émarginules et dentales fossiles des terrains secondaires du Calvados: Soc. linn. Normandie, Mém., v. 7, p. 111-130, pl. 7, 8, 11 (Caen).

(41) 1849, *Mémoire sur les pleurotomaires des terrains secondaires du Calvados:* Same, v. 8, p. 1-151, pl. 1-18.

Finlay, H. J.

(42) 1926, *A further commentary on New Zealand molluscan systematics:* N.Z. Inst., Trans., v. 57, p. 320-485 (Wellington).

Fleming, C. A.

(43) 1952, *Notes on the genus Haliotis (Mollusca):* Same, v. 80, p. 229-232, pl. 50.

Frech, Fritz

(44) 1894, *Ueber das Devon des Ostalpen. 3. Die Fauna des Unterdevonischen Riffkalkes:* Deutsch. geol. Gesell., Zeitschr., v. 46, p. 446-479, pl. 34 (Berlin).

Fretter, Vera & Graham, Alastair

(45) 1949, *The structure and mode of life of the Pyramidellidae, parasitic opisthobranchs:* Marine Biol. Assoc. United Kingdom, Jour., v. 28, p. 493-532 (Plymouth).

Gemmellaro, G. G.

(46) 1889, *La fauna dei calcari con Fusulina della valle del Fiume Sosio nella Provincia di Palermo. Nautiloidea & Gastropoda:* Giornale di Scienze Naturali ed economiche, v. 20, p. 37-138, pl. 11-19 (Palermo).

Girty, G. H.

(47) 1939, *Certain pleurotomariid gastropods from the Carboniferous of New Mexico:* Washington Acad. Sci., Jour., v. 29, p. 21-36, fig. 1-27.

Grabau, A. W.

(48) 1936, *Early Permian fossils of China, Part 2, Fauna of the Maping Limestone of Kwangsi and Kweichow:* Paleont. Sinica, ser. B, v. 8, fasc. 4, p. 1-441, pl. 1-31 (Peiping).

Greco, Benedetto

(49) 1937-38, *La fauna permiano del Sosio conservata nei musei di Firenze e di Padova, Parte Secunda, Gastropoda, Lamellibranchiata:* Paleont. Italica, v. 37 (new ser., v. 7), p. 57-114, pl. 3, 4 (Pisa).

Haas, Otto

(50) 1953, *Mesozoic invertebrate faunas of Peru:* Am. Mus. Nat. History, Bull., v. 101, p. 3-328, pl. 1-18 (New York).

Haber, G.

(51) 1932, *Gastropoda, Amphineura et Scaphopoda jurassica:* Fossilium Catalogus, 1, Animalia, pars 53, 400 p. (Berlin).

Hall, James

(52) 1879, *Containing descriptions of the Gastropoda, Pteropoda, and Cephalopoda of the Upper Helderberg, Hamilton, Portage, and Chemung groups:* Nat. History New York, Paleontology, v. 5, pt. 2, 113 p. (Albany).

———, & Whitfield, R. P.

(53) 1872, *Notice of two new species of fossil shells from the Potsdam sandstone of New York:* New York State Cab. Nat. History, Ann. Rept. 23, p. 241-242, pl. 11 (Albany).

Hayasaka, Ichiro

(54) 1939, *Spiromphalus, a new gastropod genus from the Permian of Japan:* Fac. Sci. Agric., Taihoku Imperial Univ., Mem., v. 22, p. 19-23, pl. 3 (Sendai).

Heller, R. L.

(55) 1956 ("1954"), *Stratigraphy and paleontology of the Roubidoux Formation of Missouri:* Missouri Bur. Geol. Survey & Water Resources, ser. 2, v. 35, 118 p., 19 pl. (Rolla). [Heller's publication did not appear in 1954 as shown on title page; it was delivered to the Missouri State Geologist on December 20, 1955, but distribution was not begun until January, 1956 - J. B. Knight.]

Holzapfel, Eduard

(56) 1887-88, *Die Mollusken der Aachener Kreide (Einleitung, Cephalopoda, Glossophora):* Palaeontographica, v. 34, p. 29-180, pl. 4-21 (Stuttgart).

Horný, Radvan

(57) 1953, *Několik nových gastropodu ze středočeského siluru [New gastropods from Silurian of central Bohemia]:* Sborník Uštředního ústavu geologického oddíl paleontologický [Service géologique de Tchecoslovaquie, Sec. de paléontologie], v. 20, p. 189-195 (Czech), 196-205 (Russ.), 206-211 (Eng.), pl. 22-24 (Praha).

(58) 1955, *Palaeozygopleuridae, nov. fam. (Gastropoda), ze středočeského devonu [from Devonian of central Bohemia]:* Same, v. 21, p. 17-74 (Czech), 75-118 (Russ.), 119-143 (Eng.), pl. 2-11.

Hudleston, W. H.

(59) 1887-96, *A monograph of the British Jurassic Gasteropoda. Part 1. The Inferior Oolite Gasteropoda:* Palaeontogr. Soc. Mon., 509 p., 44 pl. (London).

Huene, Freidrich von

(60) 1900, *Über Aulacomerella, ein neues Brachiopodengeschlecht:* Kais. russ. mineral. Gesell. zu St. Petersburg, Verhandl., ser. 2, v. 38, no. 1, p. 209-237, pl. 4.

Ikebe, Nobuo

(61) 1942, *Trochid Mollusca. Calliostoma of Japan, fossil and Recent:* Jan. Jour. Geol. Geogr., v. 18, p. 249-282, pl. 26-28 (Tokyo).

Jahn, J. J.

(62) 1894, *Neue Thierreste aus dem böhmischen Silur:* Kais. -kön. geol. Reichsanstalt, Jahrb., v. 44, p. 381-388, pl. 7 (Wien).

Kayser, F. H. E.

(63) 1889, *Über einige neue oder wenige gekannte Versteinerungen des rheinischen Devon:* Deutsch. geol. Gesell., Zeitschr., v. 41, p. 288-296, pl. 13-14 (Berlin).

Kittl, Ernst

(64) 1891-94, *Die Gastropoden der Schichten von St. Cassian der südalpinen Trias:* Kais. -kön. naturh. Hofmus., Ann., v. 6, p. 166-277, pl. 1-12 (Wien).

(65) 1894, *Die triadischen Gastropoden der Marmolata und verwandter Fundstellen in den weissen Riffkalken Südtirols:* Kais. -kön. geol. Reichsanstalt, Jahrb., v. 44, p. 99-182, pl. 1-6 (Wien).

(66) 1899, *Die Gastropoden der Esinokalke nebst einer revision der Gastropoden der Marmolatakalke:* Kais. -kön. naturh. Hofmus., Ann., v. 14, p. 1-237, pl. 1-8 (Wien).

Knight, J. B.

(67) 1930-34, *The gastropods of the St. Louis, Missouri, Pennsylvanian outlier:* Jour. Paleont., v. 4 (1930), Suppl. 1, The Pseudogopleurinae, p. 1-88, pl. 1-5, fig. 1-4; v. 5 (1931), *Streptacis* and *Aclisina,* p. 1-15, pl. 1-2, fig. 1; v. 5 (1931), The Subulitidae; p. 177-229, pl. 21-27, fig. 1-3; v. 6 (1932), The Pseudomelaniidae, p. 189-202, pl. 27-28; v. 7 (1933), The Trochoturbinidae, p. 30-58, pl. 8-12; v. 7 (1933), The Neritidae, p. 359-392, pl. 40-46; v. 8 (1934), The Euomphalidae and Platyceratidae, p. 139-166, pl. 20-26; v. 8 (1934), The Turritellidae, p. 433-447, pl. 56-57 (Menasha, Wis.).

(68) 1940, *Gastropods of the Whitehorse Sandstone:* in Newell, N.D., Invertebrate Fauna of the Whitehorse Sandstone, Geol. Soc. America, Bull., v. 51, p. 302-315, pl. 4-9 (New York).

(69) 1941, *Paleozoic gastropod genotypes:* Same, Spec. Paper 32, 510 p., 96 pl., 32 fig.

(70) 1942, *Four new genera of Paleozoic Gastropoda:* Jour. Paleont., v. 16, p. 487-488 (Tulsa).

(71) 1945, *Some new genera of the Bellerophontacea:* Same, v. 19, p. 333-340, pl. 49.

(72) 1945, *Some new genera of Paleozoic Gastropoda:* Same, v. 19, p. 573-587, pl. 79-80.

(73) 1947, *Some new Cambrian bellerophont gastropods:* Smithson, Misc. Coll., v. 106, no. 17, p. 1-11, pl. 1-2 (Washington).

(74) 1947, *Bellerophont muscle scars:* Jour. Paleont., v. 21, p. 264-267, pl. 42 (Tulsa).

(75) 1948, *Further new Cambrian bellerophont gastropods:* Smithson, Misc. Coll., v. 111, no. 3, p. 1-6, pl. 1 (Washington).

(76) 1952, *Primitive fossil gastropods and their bearing on gastropod classification:* Same, v. 117, no. 13 (Pub. 4092), 56 p., 2 pl.

Kobayashi, Teiichi

(77) 1939, *Restudy of Lorenz's Raphistoma broggeri from Shantung with a note on Pelagiella:* Jubilee Pub. in Commemoration of Professor H. Yabe's 60th Birthday, p. 283-288 (Tokyo).

(78) 1955, *The Ordovician fossils from the McKay group in British Columbia, western Canada, with a note on the early Ordovician palaeogeography:* Fac. Sci., Univ. Tokyo, Jour., sec. 2, v. 9, pt. 3, p. 355-492, pl. 1-9.

Koken, Ernst

(79) 1897, *Die Gastropoden der Trias um Hallstadt:* Kais. -kön. geol. Reichsanst., Abhandl., v. 17, no. 4, 112 p., 23 pl. (Wien).

(80) 1925, *Die Gastropoden des baltischen Untersilurs:* Acad. Sci. Russie Mém. (J. Perner, ed.), Classe physico-mathématique, ser. 8, v. 37, no. 1, p. 1-326, pl. 1-41 (Leningrad).

Koninck, L. G. de

(81) 1842-44, *Description des animaux fossiles qui se trouvent dans le terrain carbonifère de Belgique:* 651 p., 54 pl. (Liége).

(82) 1881, *Faune du calcaire carbonifère de la Belgique, 3e partie, Gastéropodes:* Mus. roy. Histoire nat. Belgique, Ann., sér. paléont., v. 6, p. 1-170, pl. 1-24 (Bruxelles).

(83) 1883, *Faune du calcaire carbonifère de la Belgique, 4e partie, Gastéropodes (suite et fin):* Same, v. 8, p. 1-240, pl. 22-54.

Kutassy, Endré

(84) 1937, *Triadische Faunen aus dem Bihar-Gebirge:* Geologica Hungarica, ser. palaeont., v. 13, p. 1-18, pl. 1, 3 (Budapest).

Lamont, Archie

(85) 1946, *Some Ashgillian and Llandovery gastropods from the Girvan District, Scotland:* Quarry Managers' Jour., v. 29, p. 635-644, pl. 1-3 (London).

———, & Gilbert, D. L. F.

(86) 1945, *Upper Llandovery Brachiopoda from Coneygore Coppice and Old Storridge Common, near Alfrick, Worcestershire:* Annals & Mag. Nat. History, ser. 11, v. 12, p. 641-682, pl. 1-5 (London).

La Rocque, Aurèle

(87) 1949, *New uncoiled gastropods from the Middle Devonian of Michigan and Manitoba:* Contr. Museum Paleont., Univ. Michigan, v. 7, no. 7, p. 113-122, 1 pl. (Ann Arbor).

Laube, G. C.

(88) 1868, *Die Gastropoden des braunen Jura von Balin:* K. Akad. Wiss., Denkschr., v. 28, pt. 2, p. 1-28, pl. 1-3 (Wien).

(89) 1869-70, *Die Fauna der Schichten von St. Cassian. Abt. III-IV, Gastropoden:* Same, Band 28, Abt. 2, p. 29-94, pl. 21-28; Band 30, Abt. 2, p. 1-48, pl. 29-35.

Lindström, Gustaf
(90) 1884, *On the Silurian Gastropoda and Pteropoda of Gotland:* Kongl. Svenska Vetenskaps-Akad., Handl., v. 19, no. 6, p. 1-250, pl. 1-21 (Stockholm).

Lochman, Christina & Duncan, Donald
(91) 1944, *Early Upper Cambrian faunas of central Montana:* Geol. Soc. America, Spec. Paper 54, 181 p., pl. 1-19, fig. 1-2 (New York).

Longstaff, J. D.
(92) 1912, *Some new lower Carboniferous Gastropoda:* Geol. Soc. London, Quart. Jour., v. 68, p. 295-309, pl. 27-30.
(93) 1933, *A revision of the British Carboniferous Loxonematidae with descriptions of new forms:* Same, v. 89, p. 87-124, pl. 1-12.

Loriol, Perceval de
(94) 1874, *Monographie paléontologique et géologique des étages supérieurs de la formation jurassique des environs de Boulogne-sur-Mer - Description des fossiles (Pt. 1):* Soc. Phys. Hist. nat. Genève, Mém., v. 23, p. 261-407, pl. 1-10.
(95) 1886-88, *Études sur les mollusques des couches coralligènes de Valfin (Jura):* Soc. paléont. suisse, Mém., v. 13-15, 369 p., 37 pl.
(96) 1889-93, *Études sur les mollusques des couches coralligènes inférieurs du Jura bernois:* Same, v. 16-19, 419 p., 37 pl.

Mansuy, Henri
(97) 1912, *Étude géologique du Yunnan oriental, 2e partie, Paléontologie:* Service géol. Indo-Chine, Mém., v. 1, fasc. 2, 146 p., 25 pl. (Hanoi-Haiphong).
(98) 1914, *Nouvelle contribution à la paléontologie du Yunnan:* Same, v. 3, fasc. 2, 190 p., 10 pl.

Meek, F. B.
(99) 1873, *Descriptions of invertebrate fossils from the Silurian and Devonian Systems:* Ohio Geol. Survey, v. 1, pt. 2, Paleontology, p. 1-243, pl. 1-23 (Columbus).

———, & Worthen, A. H.
(100) 1866, *Descriptions of invertebrates from the Carboniferous System:* Illinois Geol. Survey, v. 2, Paleontology, p. 143-410, pl. 14-32 (Springfield).

Miller, A. K., Downs, H. R., & Youngquist, W.
(101) 1949, *Some Mississippian cephalopods from central and southern United States:* Jour. Paleont., v. 23, p. 600-612, pl. 97-100 (Tulsa).

Moore, R. C.
(102) 1941, *Upper Pennsylvanian gastropods from Kansas:* State Geol. Survey of Kansas, Bull. 38, pt. 4, p. 121-163, pl. 1-3 (Lawrence).

———, Lalicker, C. G., & Fischer, A. G.
(103) 1952, *Invertebrate fossils:* 766 p., McGraw-Hill (New York).

Morris, John & Lycett, John
(104) 1851, *A monograph of the Mollusca from the Great Oolite. Part 1, Univalves:* Palaeontogr. Soc. Mon., 130 p., 15 pl. (London).

Nelson, L. A.
(105) 1947, *Two new genera of Paleozoic Gastropoda:* Jour. Paleont., v. 21, p. 460-465, pl. 65 (Tulsa).

Newell, N. D.
(106) 1935, *Some Mid-Pennsylvanian invertebrates from Kansas and Oklahoma: II. Stromatoporoidea, Anthozoa, and Gastropoda:* Same, v. 9, p. 341-355, pl. 33-36.

Norwood, J. G. & Pratten, H.
(107) 1855, *Notice of fossils from the Carboniferous series of the western states, belonging to the genera Spirifer, Bellerophon, Pleurotomaria, Macrocheilus, Natica, and Loxonema, with descriptions of eight new characteristic species:* Acad. Nat. Sci. Philadelphia, Jour., ser. 2, v. 3, p. 71-78, pl. 9.

Oehlert, D. P.
(108) 1888, *Descriptions de quelques espèces dévoniennes du département de la Mayenne:* Soc. d'Études sci. d'Angers, Bull., 1887, p. 65-120, pl. 6-10.

Öpik, A. A.
(109) 1953, *Lower Silurian fossils from the "Illaenus band," Heathcote, Victoria:* Geol. Survey Victoria, Mem., no. 19, 42 p., 13 pl. (Melbourne).

Orbigny, Alcide d'
(110) 1842-43, *Paléontologie française, terrains crétacés:* v. 2, 456 p., atlas, pl. 149-236 *bis* (Paris).
(111) 1850-60, *Paléontologie française, terrains jurassiques:* v. 2, 621 p., atlas, pl. 235-428 (Paris).

Perez-Farfante, Isabel
(112) 1943, *The genera Fissurella, Lucapina and Lucapinella in the Western Atlantic:* Johnsonia, v. 1, no. 10, p. 1-20, pl. 1-5 (Cambridge, Mass.).
(113) 1943, *The genus Diodora in the Western Atlantic:* Same, v. 1, no. 11, p. 1-20, pl. 1-6.

Perner, Jaroslav
(114) 1903, *Patellidae et Bellerophontidae:* in Barrande, Joachim, Système silurien du centre de la Bohême, v. 4, Gastéropodes, tome 1, texte p. 1-164, pl. 1-89 (Praha).
(115) 1907, [No title]: Same, tome 2, text, pl. 90-175.
(116) 1911, [No title]: Same, tome 3, text, pl. 176-247.

Picard, Edmund
(117) 1904, *Beitrag zur Kenntniss der Glossophoren der mitteldeutschen Trias.:* Kön. preuss. geol. Landesanst., Jahrb., v. 22, p. 445-540, pl. 9-14 (Berlin).

Pilsbry, H. A.
(118) 1934, *Notes on the gastropod genus Liotia and its allies:* Acad. Nat. Sci. Philadelphia, Proc., v. 85, p. 375-381, pl. 13.

Pitcher, B. L.
(119) 1939, *The upper Valentian gastropod fauna of Shropshire:* Ann. & Mag. Nat. History, ser. 11, v. 4, p. 82-132, pl. 1-4 (London).

Powell, A. W. B.
(120) 1937, *The shellfish of New Zealand:* 100 p., 18 pl. (Auckland, N.Z.).
(121) 1951, *Antarctic and Subantarctic Mollusca: Pelecypoda and Gastropoda:* Discovery Reports, v. 26, p. 47-196, pl. 5-10 (Cambridge).

Quenstedt, F. A.
(122) 1881-84, *Petrefaktenkunde Deutschlands:* v. 7, Gastropoden, 867 p., atlas, pl. 186-218.

Reed, F. R. Cowper
(122a) 1920-21, *A monograph of the British Ordovician and Silurian Bellerophontacea:* Palaeontograph. Soc. Mon., p. 1-48, pl. 1-8, 1920; p. 49-92, pl. 9-13, 1921 (London).

Roemer, C. F. von
(123) 1876, *Lethaea geognostica oder Beschreibung und Abbildung der für die Gebirgs-Formationen bezeichnendsten Versteinerungen, 1 Theil, Lethaea palaeozoica:* 323 p., 61 pl. (Stuttgart).

Roemer, F. A.
(124) 1850-66, *Beiträge zur geologischen Kenntnis des nordwestlichen Harzgebirges:* Palaeontographica, v. 3, p. i-viii, 1-67, pl. 1-10 (1850); v. 3, p. 69-111, pl. 11-15 (1852); v. 5, p. 1-44, pl. 1-8 (1855); v. 9, p. 1-46, pl. 1-12 (1860); v. 13, p. 201-235, pl. 33-35 (1866) (Cassel).

Rusconi, Carlos
(125) 1952, *Fosiles cambricos del Cerro Aspero, Mendoza:* Mus. Historia Nat. Mendoza, Revista, v. 6, no. 1-4, p. 63-122, pl. 1-6.
(126) 1954, *Fosiles Cambricos y Ordovicos de San Isidro:* Bol. Paleont., no. 30, 4 p. (Buenos Aires).

Saito, Kazuo
(127) 1936, *Older Cambrian Brachiopoda, Gastropoda, etc., from northwestern Korea:* Fac. Sci. Imperial Univ. Tokyo, Jour., sec. 2, v. 4, p. 345-367, pl. 1-3.

Salter, J. W.
(128) 1859, *Figures and descriptions of Canadian organic remains:* Geol. Survey Canada, decade 1, p. 1-46, pl. 1-10 (Montreal).

Sandberger, Guido & Sandberger, Fridolin
(129) 1850-55, *Die Versteinerungen rheinischen Schichtensystems in Nassau:* Atlas, pl. 1-39 (Wiesbaden).

Sieberer, Karl
(130) 1907, *Die Pleurotomarien des schwäbischen Jura:* Palaeontographica, Band 54, p. 1-68, pl. 1-5 (Stuttgart).

Simroth, Heinrich
(131) 1906, *Mollusca:* in BRONN, H. G., Klassen und Ordnungen des Tier-Reichs, ed. 2, v. 3, Lief. 85-89, pl. 59-62.

Spitz, Albrecht
(132) 1907, *Die Gastropoden des Karnischen Unterdevon: Beiträge zur Paläontologie und Geologie Österreich-Ungarns und des Orients:* Geologischen und paläontologischen Inst. Universität Wien, Mitteil., v. 20, p. 115-190, pl. 11-16.

Spriestersbach, Julius
(133) 1942, *Lenneschiefer (Stratigraphie, Facies, und Fauna):* Reichsamts für Bodenforschung, Abhandl., Neue Folge, Heft 203, 219 p., 11 pl., 19 fig. (Berlin).

Stache, Guido
(134) 1877, *Beiträge zur Fauna der Bellerophonkalks Südtirols, Nr. 1, Cephalopoden und Gastropoden:* Kais. -kön. geol. Reichsanstalt, Jahrb., v. 27, p. 271-318, pl. 5-7 (Wien).

Stoyanow, Alexander
(135) 1948, *Molluscan faunule from Devonian Island Mesa Beds, Arizona:* Jour. Paleont., v. 22, p. 783-791, pl. 120-121 (Tulsa).

Talent, J. A. & Philip, G. M.
(136) 1956, *Siluro-Devonian Mollusca from Marble Creek, Thompson River, Victoria:* Roy. Soc. Victoria, Proc., v. 68, p. 57-71, pl. 6-7 (Melbourne).

Tasch, Paul
(137) 1953, *Causes and paleoecological significance of dwarfed fossil marine invertebrates:* Jour. Paleont., v. 27, no. 3, p. 356-444, pl. 49 (Tulsa).

Thiele, Johannes
(138) 1924, *Revision des Systems der Trochacea:* Zool. Mus. Berlin, Mitteil., v. 11, p. 47-74, 1 pl.
(139) 1929-31, *Handbuch der systematischen Weichtierkunde:* Band 1, 778 p. (Jena).

Thomas, E. G.
(140) 1940, *Revision of the Scottish Carboniferous Pleurotomariidae:* Geol. Soc. Glasgow, Trans., v. 20, p. 30-72, pl. 2-4.

Thorson, Gunnar
(141) 1946, *Reproduction and larval development of Danish marine bottom invertebrates, with special reference to the planktonic larvae in the Sound (Øresund):* Kommissionen for

Danmarks Fiskeriog Havundersøg., Meddel., ser. Plankton., v. 4, 523 p. (Købnhavn).

Ulrich, E. O. & Scofield, W. H.

(142) 1897, *The Lower Silurian Gastropoda of Minnesota:* Minnesota Geol. Survey, v. 3, pt. 2, p. 813-1081, pl. 61-82 (Minneapolis).

Vologdin, A. G.

(143) 1955, *Cambrian Solenopora and mollusks of the northern Tyan-Shan:* Akad. Nauk SSSR, Doklady, v. 105, no. 2, p. 354-356 [all Russ.] (Moskva).

Vostakova, V. A.

(144) 1955, *Ordovician gastropods of the Leningrad and Baltic Sea region:* Leningrad Universitet Nauchnoissledovate'skii Institut-Zemnoi Cory Paleontologischeskaia Laboratoriia, Voprosy Paleontologii, v. 2, p. 82-123, pl. 1-8 [all Russ.] (Moskva).

Waagen, W. H.

(145) 1880, *Productus Limestone fossils:* Geol. Survey India, Mem., Palaeont. Indica, ser. 13, Salt Range fossils, pt. 2, v. 1, p. 73-183, pl. 7-16 (Calcutta).

Wanner, C.

(146) 1942, *Neue Beiträge zur Gastropodenfauna des Perm von Timor:* in Geol. Exped. Univ. Amsterdam to Lesser Sunda Islands in the southeastern part of the Netherlands East Indies, 1937, under leadership of H. A. Brouwer, p. 133-208, pl. 1-3 (Amsterdam).

Wenz, Wilhelm

(147) 1938-44, *Gastropoda. Allgemeiner Teil und Prosobranchia:* in O. H. SCHINDEWOLF, ed., Handbuch der Paläozoologie, Band 6, 1639 p.; Teil 1, p. 1-240, 1938; Teil 2, p. 241-480, 1938; Teil 3, p. 481-720, 1939; Teil 4, p. 721-960, 1940; Teil 5, p. 961-1200, 1941; Teil 6, p. 1201-1506, 1943; Teil 7, p. 1507-1639, 1944 (Berlin).

(148) 1940, *Ursprung und frühe Stammesgeschichte der Gastropoden:* Arch. Molluskenkunde, v. 72, p. 1-10 (Frankfurt a. -M).

Whidborne, G. F.

(149) 1891, *A monograph of the Devonian fauna of the south of England. The fauna of the limestones of Lummaton, Wolborough, Chircombe Bridge, and Chudleigh. Gastropoda:* Palaeont. Soc. Mon., p. 156-250, pl. 16-24 (London).

Wilson, A. E.

(150) 1951, *Gastropoda and Conularida [Conulariida] of the Ottawa Formation of the Ottawa-St. Lawrence Lowland:* Geol. Survey Canada, Bull. 17, 149 p., 19 pl. (Ottawa).

Winters, S. S.

(151) 1956, *New Permian gastropod genera from eastern Arizona:* Washington Acad. Sci., Jour., v. 46, no. 2, p. 44-45.

Yen, T.

(152) 1949, *Review of Palaeozoic nonmarine gastropods and a description of a new genus from the Carboniferous rocks of Scotland:* Malacol. Soc. London, Proc., v. 27, p. 235-240, pl. 12A.

Yin, T. H.

(153) 1932, *Gastropoda of the Penchi and Taiyuan Series of North China:* Palaeont. Sinica, Ser. B, v. 11, fasc. 2, p. 1-53, pl. 1-3 (Peiping).

Yochelson, E. L.

(154) 1956, *Permian Gastropoda of the southwestern United States: I. Euomphalacea, Trochonematacea, Pseudophoracea, Anomphalacea, Craspedostomatacea, Platyceratacea:* Am. Mus. Nat. History, Bull., v. 110, pt. 3, p. 173-276, pl. 9-24 (New York).

(155) 1953, *Jedria, a new subgenus of Naticopsis:* Washington Acad. Sci., Jour., v. 43, no. 3, p. 65.

(156) 1956, *Labridens, a new Permian gastropod:* Same, v. 46, no. 2, p. 45-46, fig. 1.

Zittel, K. A. von

(157) 1873, *Die Gastropoden der Stramberger Schichten:* Palaeontographica, Supp. 2, p. 193-373, atlas, pl. 40-52 (Cassel).

SOURCES OF ILLUSTRATIONS

(Supplementary to works cited in the preceding list of references)

(158) **Abbott, R. T.**
(159) **Adams, Henry**
(160) **Ammon, Ludwig von**
(161) **Bartsch, Paul**
(162) **Bayle, Emile & Coquand, Henri**
(163) **Beets, C.**
(164) **Böhm, Johannes**
(165) **Buvignier, Amand**
(166) **Cantraine, F. J.**
(167) **Chavan, André**
(168) **Chenu, J. C.**
(169) **Clark, B. L. & Durham, J. W.**
(170) **Cossmann, Maurice**
(171) **Cossmann, Maurice & Pissarro, G.**
(172) **Dall, W. H.**
(173) **Dautzenberg, Philippe & Fischer, Paul**
(174) **De Gregorio, Antoine**
(175) **Dell, R. K.**
(176) **Delpey, Geneviève**
(177) **Deshayes, G. P.**
(178) **Di-Stefano, Giovanni**
(179) **Dunker, Wilhelm**
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(182) **Eudes-Deslongchamps, Eugène**
(183) **Finlay, H. J. & Marwick, John**

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(194) **Jekelius, Enrich**
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(196) **Koken, Ernst**
(197) **Kolesnikov, V.**
(198) **Kuroda, Tokubei & Habe, Tadashige**
(199) **———, & Hirase, Shintaro**
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(204) **Marwick, John**
(205) **Moore, Charles**
(206) **Müller, Georg**
(207) **Munier-Chalmas, Ernest**
(208) **Oppenheim, Paul**
(209) **Palmer, K. v. W.**
(210) **Pethö, Julius**
(211) **Philippi, R. A.**
(212) **Picard, Edmund**
(213) **Pilsbry, H. A.**
(214) **———, & McGinty, T. L.**
(215) **Raincourt, Marquis de & Munier-Chalmas, Ernest**
(216) **Reeve, L. A.**
(217) **Rehder, H. A.**
(218) **Rolle, F.**
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(221) **Stewart, R. B.**
(222) **Stoliczka, Ferdinand**
(223) **Strong, A. M.**
(224) **Terquem, Olry**
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(226) **Wade, Bruce**
(227) **Watson, R. B.**
(228) **White, C. A.**
(229) **Wilckens, Otto**
(230) **Williamson, M. B.**
(231) **Wood, S. V.**
(232) **Woodward, Henry**
(233) **Zittel, K. A. von**

ADDENDUM

Since the manuscript was prepared the following generic names proposed for Paleozoic gastropods have come to the attention of KNIGHT, BATTEN and YOCHELSON. The suggested systematic placement of these genera is given below, but in order not to delay publication of the *Treatise* volume, no illustrations or diagnoses are given.

Acevina RUSCONI, 1952 [**?Helcionella (Acevina) cuyunchensis*] ?Archaeogastropoda, incertate sedis. *M.Cam.*, S.Am.(Arg.).

Cycloscena FLETCHER, 1958 [**C. anomphala*] Anomphalacea, possibly Anomphalidae. *Perm.*, Austral.

Elkoceras LINTZ & LOHR, 1958 [**E. volborthi*] Euomphalacea, Euomphalidae, a junior synonym of *Straparollus (Phanerotinus). L.Miss.*, USA (Nev.).

Hampilina KOBAYASHI, 1958 [**H. goniospira*] Helcionellacea, Helcionellidae. *Cam.*, NE.Asia (Korea).

Lacunospira BATTEN, 1958 [**L. alta*] Pleurotomariacea, Eotomariidae. *Perm.*, USA(Tex.).

Lamellopspira BATTEN, 1958 [**L. conica*] Pleurotomariacea, doubtfully Phymatopleuridae. *Perm.*, USA(Tex.).

Mourlonopsis FLETCHER, 1958 [**Pleurotomaria strzeleckiana* MORRIS, 1845] Pleurotomariacea, Eotomariidae. *Perm.*, Austral.

Planikeenia FLETCHER, 1958 [**P. minor*] Pleuromariacea, Sinuopeidae, a junior synonym of *Keenia. Perm.*, Austral.

Pleurocinctosa FLETCHER, 1958 [**Pleurotomaria trifilata* DANA, 1947] Pleurotomariacea, Eotomariidae, a junior synonym of *Peruvispira. Perm.*, Austral.

Rhabdocantha FLETCHER, 1958 [**Pileopsis alta* DANA, 1849] Platyceratacea, Platyceratidae, a junior synonym of *Platyceras (Orthomychia). Perm.*, Austral.

Randomia MATTHEW, 1899 [**R. aurorae*] Possibly Monoplacophora or Helcionellacea. *M.Cam.*, Newfoundland.

Strotostoma FLETCHER, 1958 [**S. rylstonensis*] Possibly Platyceratacea, possibly Platyceratidae. *Perm.*, Austral.

Walnichollsia FLETCHER, 1958 [**Pleurotomaria subcancellata* MORRIS, 1845] Pleurotomariacea, not assigned to family. *Perm.*, Austral.

REFERENCES

Batten, R. L., 1958, *Permian Gastropoda of the Southwestern United States: 2. Pleurotomariacea: Portlockiellidae, Phymatopleuridae, and Eotomariidae:* Am. Mus. Nat. Hist., Bull., v. 114, art. 2, p. 153-246, pl. 32-42.

Fletcher, H. O., 1958, *The Permian gastropods of New South Wales:* Australian Mus. Records, v. 24, no. 10, p. 115-164, pl. 7-21.

Kobayashii, Teichii, 1958, *On some Cambrian gastropods from Korea:* Japanese Jour. Geol. Geog., v. 29, no. 3, p. 111-118, pl. 8.

Lintz, Joseph, Jr. & Lohr, L. S., 1958, *Two new invertebrates from the Mississippian of Nevada:* Jour. Paleont., v. 32, p. 977-980, pl. 128.

Matthew, G. F., 1899, *Preliminary notice of the Etcheminian fauna of Newfoundland:* Nat. Hist. Soc. New Brunswick, Bull., v. 4, art. 18, p. 189-197, pls. 1-3.

Rusconi, Carlos, 1952, *Varias especies de trilobitas del Cambrico de Canota:* Mus. Hist. Nat. Mendoza, Revista, v. 6, p. 5-17, pl. 1.