species of *Putrella* may properly be included in a broad understanding of *Fusulina*. However, it may possibly be somewhat like some of the forms that have been referred to *Quasifusulina* CHEN, 1934.

Quasifusulinoides RAUZER-CHERNOUSOVA & ROZOVSKAYA in RAUZER-CHERNOUSOVA & FURSENKO, 1959, *1509, p. 210 [**Pseudotriticites fusiformis* ROZOVSKAYA, 1952, *1592A, p. 29; OD] [=*Quasifusulinoides* RAUZER-CHERNOUSOVA & ROZOVSKAYA in A. D. MIKLUKHO-MAKLAY, RAUZER-CHERNOUSOVA & ROZOVSKAYA, 1958, *1275, p. 17 *(nom. nud.)*]. An enlargement of the wall structure illustrated by RAUZER-CHERNOUSOVA & FURSENKO (1959, *1509, pl. 7, fig 15B), shows it to be rather typical of the Fusulininae group of forms that occur from the upper part of the Myachkovo Horizon to the bottom of the Upper Carboniferous, southern Urals, Russian Platform. No axial fillings are visible in the axial section (*loc. cit.*, pl. 7, fig. 15A) and the septa are intensely fluted. The details by which this genus differs from *Quasifusulina* CHEN, 1934, are not understood by me.

Russiella A. D. MIKLUKHO-MAKLAY, 1957, *1267, p. 98 [**R. pulchra*; OD]. The illustrations of *R. pulchra* show a highly elongate shell with intensely fluted septa and rather massive axial fillings. The holotype has about 5 volutions. The minute size of the shell and rather indistinct details of its internal structure suggest that it may be related to *Minojapanella* FUJIMOTO & KANUMA, 1953. *Russiella* originally was placed in the "Boultoniinae." *U.Perm.*, USSR (Crimea).

Sichotenella TUMANSKAYA, 1953, *1955, p. 22 [**S. sutschanica*; OD]. Shells of *Sichotenella* are small, discoidal forms with an angular periphery. The last part of the shell, according to the author, becomes straightened out or uncoiled, the uncoiled part of the last volution being greater in volume than the entire coiled stages. Originally referred to the Fusulininae. *U.Perm.*, USSR (Yuzhno-Ussuriy region).

Sphaeroschwagerina A. D. MIKLUKHO-MAKLAY, 1959, *1271, p. 157 ["**Schwagerina princeps* (EHRENBERG)" SCHELLWIEN, 1898, *1644, p. 258 (*non Borelis princeps* EHRENBERG, 1842, *669A, p. 274) (=*Schwagerina sphaerica* SHCHERBOVICH var. *karnica* SHCHERBOVICH in RAUZER-CHERNOUSOVA & SHCHERBOVICH, 1949, *1509B, p. 102); OD] [=*Sphaeroschwagerina* A. D. MIKLUKHO-MAKLAY, 1956, *1265, p. 1154 (*nom. nud.*, type designated but no generic description) (obj.)]. An outline sketch of a typical specimen of *Sphaeroschwagerina* 1959, *1271, p. 159, suggests relationship to *Robustoschwagerina tumida* (LIKHAREV), 1939. Originally placed in the Schwagerinidae. *L.Perm.(U.Karachatyr Horizon P_1^{κ})*.

NOMINA NUDA (FUSULINACEANS)

Armeniella A. D. MIKLUKHO-MAKLAY, 1953 (*1263, p. 20).

Carina A. D. MIKLUKHO-MAKLAY, 1953 (*1263, p. 18).

Eozawainella A. D. MIKLUKHO-MAKLAY, 1953 (*1263, p. 18).

Orientella A. D. MIKLUKHO-MAKLAY, 1953 (*1263, p. 21).

Pseudoyabeina TUMANSKAYA, 1955 (cited in A. D. MIKLUKHO-MAKLAY, 1958, *1268, p. 6,10).

NOMEN INQUIRENDUM (FUSULINACEANS)

Eoparastaffella VDOVENKO, 1954 [*fide* RAUZER-CHERNOUSOVA & FURSENKO, 1959, *1509, p. 207, a synonym of *Pseudoendothyra* MIKHAYLOV, 1939].

Suborder MILIOLINA Delage & Hérouard, 1896

[*nom. correct.* LOEBLICH & TAPPAN, 1961, p. 219 (*pro* suborder Miliolidae DELAGE & HÉROUARD, 1896, p. 117)]——[In synonymic citations superscript numbers indicate taxonomic rank assigned by authors (¹order, ²suborder, ³group, ⁴division, ⁵subclass); dagger(†) indicates *partim*]——[=²Monosomatia† EHRENBERG, 1839; table opp. p. 120; =Monothalamia† SCHULTZE, 1854, p. 52; =Foraminifera Monomera† REUSS, 1862, p. 362; =⁴Monothalamia† MARRIOTT, 1878, p. 30; =¹Monothalamia† HAECKEL, 1894, p. 164]——[=¹Agathistègues D'ORBIGNY in DE LA SAGRA, 1839, p. xxxix, 153 *(nom. neg.)*; =¹Entomostègues D'ORBIGNY in DE LA SAGRA, 1839, p. xxxix, 113 *(nom. neg.)*; =¹Cyclostègues† D'ORBIGNY, 1851, p. 192 *(nom. neg.)*; =³Helicoidea SCHULTZE, 1854, p. 53; =Nautiloidea† REUSS, 1860, p. 151]——[=²Imperforata CARPENTER, 1861, p. 469; =³Imperforata CLAUS, 1872, p. 108; =⁵Imperforata† LANKESTER, 1885, p. 845; =¹Imperforida DELAGE & HÉROUARD, 1896, p. 107; =²Imperforina† CALKINS, 1901, p. 106]——[=Foraminifera Polymera† REUSS, 1862, p. 365; =¹Polystegia† HAECKEL, 1894, p. 164; =²Biloculinidea† SIGAL in PIVETEAU, 1952, p. 157; =Pluriloculinidea† SIGAL in PIVETEAU, 1952, p. 160]——[=Porcellanea CARPENTER, 1879, p. 375, 376; =¹Flexostylidia† CALKINS, 1926, p. 355; =¹Flexostili (Imperforata) SILVESTRI, 1937, p. 77]——[=¹Miliolidea LANKESTER, 1885, p. 846; =¹Miliolidaceae HARTOG in HARMER & SHIPLEY, 1906, p. 59; =¹Miliolida CALKINS, 1909, p. 39]——[¹Hellenoidea† WEDEKIND, 1937, p. 79; =Cornuspiroidea WEDEKIND, 1937, p. 87; =²Cristellariacea† WEDEKIND, 1937, p. 93; =²Orbitolitacea WEDEKIND, 1937, p. 120; =²Cornuspiridea JIROVEC, 1953, p. 335]

Test calcareous, porcelaneous, commonly with pseudochitinous lining, may also include some adventitious material in wall, imperforate in post-embryonic stages. *Carb.-Rec.*

Superfamily MILIOLACEA Ehrenberg, 1839

[*nom. correct.* LOEBLICH & TAPPAN, 1961, p. 289 (*pro* superfamily Miliolidea GLAESSNER, 1945, p. 116, and Miliolicae EASTON, 1960, p. 65, 76)]——[In synonymic citations superscript numbers indicate taxonomic rank assigned by authors (¹tribu, ²superfamily, ³family group); dagger(†) indicates *partim*]——[=¹Milleporita† LATREILLE, 1825, p. 166; =¹Orthoceratа† LATREILLE, 1825, p. 162; =¹Polycyclica† LATREILLE, 1825, p. 164]——[=²Orthoklinostegia† EIMER & FICKERT, 1899, p. 185; =³Archi-Monothalamidia† RHUMBLER in KÜKENTHAL & KRUMBACH, 1923, p. 85; =³Flexostylidia† RHUMBLER in KÜKENTHAL & KRUMBACH, 1923, p. 87; =²Alveolinidea VOLOSHINOVA in RAUZER-CHERNOUSOVA & FURSENKO, 1959, p. 244]

Wall porcelaneous, commonly with pseudochitinous inner lining, and may have adventitious material on exterior, imperfor-

ate at least in postembryonic stages; proloculus with spiral passage followed by numerous chambers which may be planispirally coiled or arranged in definite planes; aperture terminal, single or cribrate and may be variously modified. *Carb.-Rec.*

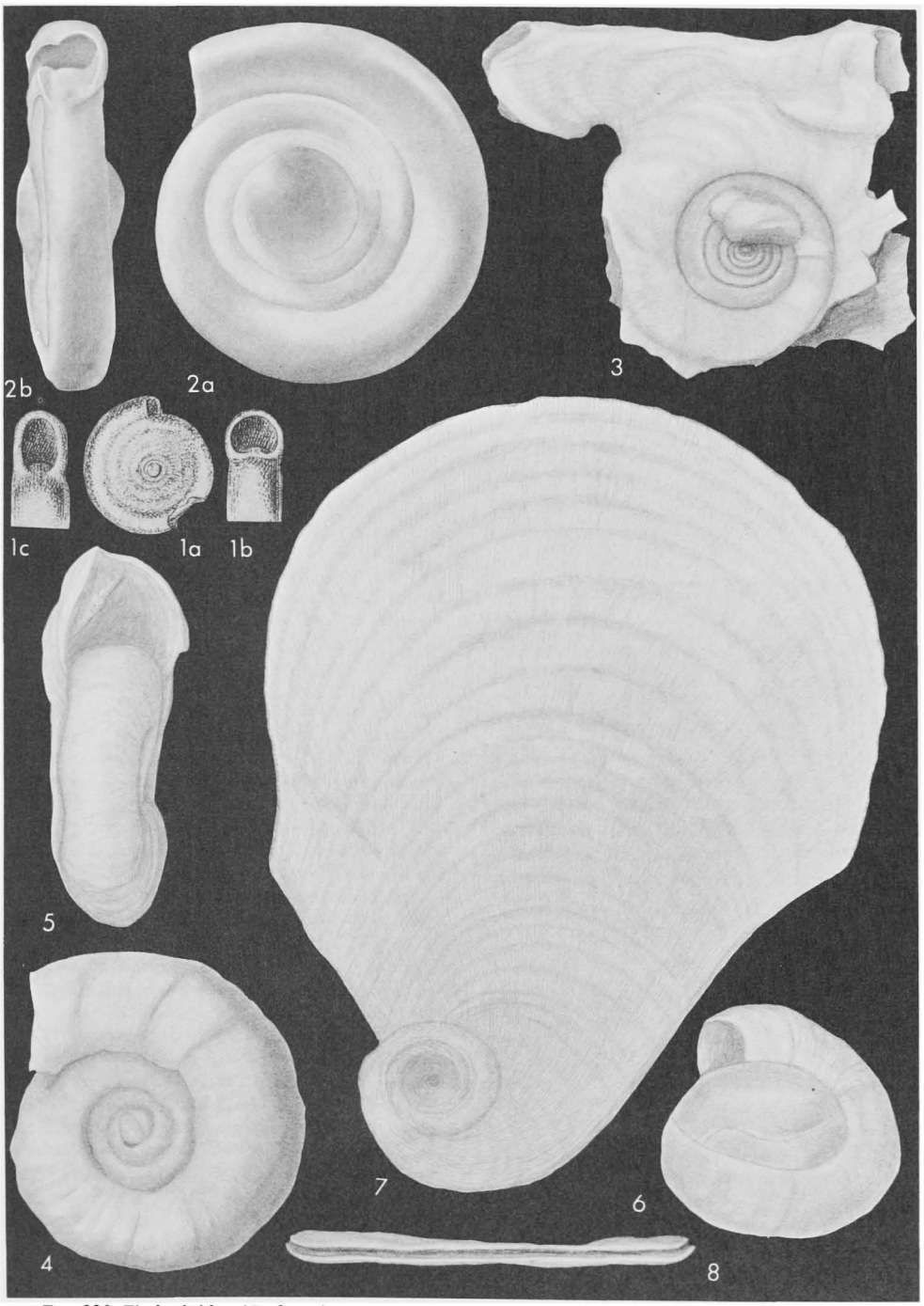


FIG. 329. Fischerinidae (Cyclogyrinae; *1,2, Cyclogyra; 3, Cornuspirella; 4-6, Gordiospira; 7,8, Cornuspiroides*) (p. C438-C439).

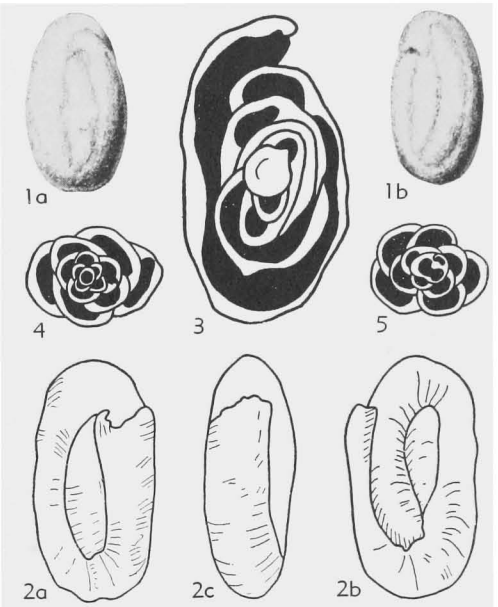


FIG. 330. Fischerinidae (Cyclogyrinae; *1-5, Agathammina*) (p. C438).

Family FISCHERINIDAE Millett, 1898

[*nom. transl.* CUSHMAN, 1927, p. 40 (*ex* subfamily Fischerininae MILLETT, 1898, p. 611)]——[All names referred to are of family rank]——[=Cornuspirida SCHULTZE, 1854, p. 52; =Cornuspiridae REUSS, 1860, p. 177; =Cornuspiridea REUSS, 1862, p. 364, 394; =Cornuspirideae GÜMBEL, 1870, p. 26; =Cornuspirida HAECKEL, 1894, p. 185]

Test free or attached, proloculus followed by undivided tubular or spreading second chamber; wall calcareous, porcelaneous; aperture terminal, rounded or slitlike. [As redefined herein the Fischerinidae includes the subfamilies Cyclogyrinae, Fischerininae, and Calcivertellinae and differs from the Nubeculariidae in lacking development of separate chambers after the early cyclogyrine development.] *Carb.-Rec.*

Subfamily CYCLOGYRINAE Loeblich & Tappan, 1961

[Cyclogyrinae LOEBLICH & TAPPAN, 1961, p. 290 (*nom. subst. pro* subfamily Cornuspirinae RHUMBLER, 1904, p. 284)]——[=Arcornuspirinia RHUMBLER, 1913, p. 387 (*nom. van.*); =Cornuspiritininae CUSHMAN, 1919, p. 633 (*nom. van.*)]

Proloculus followed by undivided second chamber; generally tubular and coiled, but adult variable; free or attached. *Carb.-Rec.*

Cyclogyra WOOD, 1842, *2077, p. 458 [**C. multiplex*; OD (M)] [=*Cornuspira* SCHULTZE, 1854, *1695, p. 40 (type, *Orbis foliaceus* PHILIPPI, 1844, *1452A, p. 147); SD CUSHMAN, 1917, *404f, p. 24; *Arcornuspirum* RHUMBLER, 1913, *1572b, p. 387 (*nom. van.*); *Conicocornuspira* MARIE in DELEAU & MARIE, 1961, *580A, p. 74 (type, *C. conica* MARIE, 1961)]. Test free, discoidal, consisting of globular proloculus and long undivided planispirally wound tubular second chamber, partly or wholly evolute; wall calcareous, imperforate, porcelaneous; aperture at the open end of the tube. *Carb.-Rec.*, cosmop.——FIG. 329,*1*. **C. multiplex*, Plio., Eng.; *1a*, side view of holotype, ×5.5; *1b,c*, apert. views, enlarged (*2077).——FIG. 329,*2*. *C. planorbis* (SCHULTZE), Rec., Gulf Mex.; *2a,b*, side and apert. views of hypotype, ×224 (*2117).

[The synonymy of *Cornuspira* with *Cyclogyra* was noted by LOEBLICH & TAPPAN (1961, *1177, p. 290), and had been indicated questionably by GALLOWAY (1933, *762, p. 109). *Orbis foliaceus* PHILIPPI, 1844, was designated by CUSHMAN, 1917 as type-species of *Cornuspira*, but in 1927, CUSHMAN (*433, p. 188) changed the type designation to *Cornuspira planorbis* SCHULTZE, 1854, stating that the previous designation was in error, as *C. foliacea* was not one of the names used by SCHULTZE. However, as SCHULTZE, 1854, p. 41 (footnote) definitely included *Orbis foliaceus* in the genus, the original designation of CUSHMAN must stand. The two species are not conspecific.]

Agathammina NEUMAYR, 1887, *1354, p. 171 [**Serpula pusilla* GEINITZ in GEINITZ & GUTBIER, 1848, *776, p. 6; SD CUSHMAN, 1927, *433, p. 188]. Test ovate; globular proloculus followed by enrolled, nonseptate tubular second chamber, which coils in quinqueloculine manner; wall calcareous, imperforate with growth lines on surface but no internal subdivisions; aperture simple, terminal, may have thickened rim. [Commonly placed in the Miliolidae because of its quinqueloculine appearance, *Agathammina* has been shown to be nonseptate and is here transferred to the *Cyclogyrinae*. Agglutinated species placed herein by various authors should be reallocated, in the Ammodiscidae.] *Carb.-Perm., ?Trias., ?Jur.*, C.Eu.——FIG. 330,*1-5*. **A. pusilla* (GEINITZ), U.Carb.(Namur.), Czech.; *1a,b*, opposite sides, ×117 (*1985); *2a-c*, opposite sides and edge view showing nonseptate character, ×25; *3*, long. sec. of megalospheric form, ×55; *4,5*, transv. secs. of microspheric and megalospheric forms, ×25 (*2070).

Cornuspirella CUSHMAN, 1928, *436, p. 4 [**Cornuspira diflusa* HERON-ALLEN & EARLAND, 1913, *908, p. 272; OD]. Early portion as in *Cyclogyra*, planispiral and evolute, later rectilinear, spreading and branching in various directions but in plane of original coiling; aperture elongate, narrow, at ends of flattened branches. *Rec.*, N.Atl.——FIG. 329,*3*. **C. diffusa* (HERON-ALLEN & EARLAND); lectotype (BMNH-ZF3578) from Goldseeker Station 41A, Haul 8265 at lat. 56°48′N., long. 1°19′E., at 94 m., showing branches in 2 directions and broken areas where other branches had formerly occurred, ×48 (*2117).

Cornuspiroides CUSHMAN, 1928, *436, p. 3 [**Cornuspira striolata* BRADY in TIZARD & MURRAY, 1882, *1936, p. 713; OD]. Test free, large, flabelliform, early portion planispiral with coils increasing very gradually in diameter, later portion

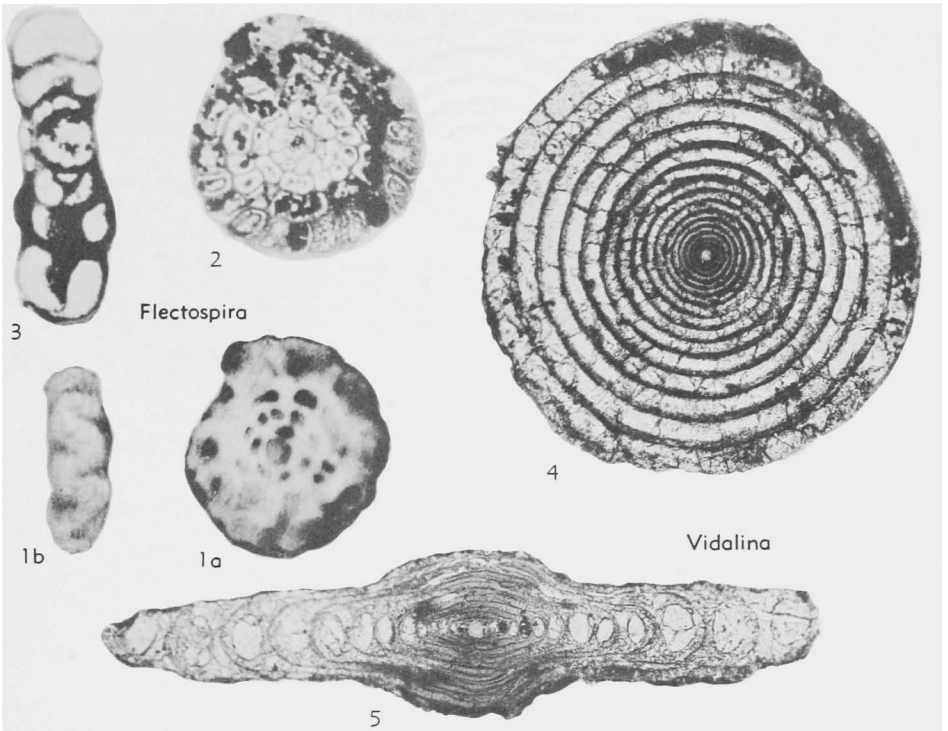


FIG. 331. Fischerinidae (Cyclogyrinae; *1-3, Flectospira; 4,5, Vidalina*) (p. C439-C441).

of coil increasing very rapidly in height and spreading out into an uncoiled, flattened and flabelliform portion, nonseptate but with distinct transverse growth lines and in type-species with fine vertical striae on surface; wall calcareous, milky white, imperforate; aperture narrow elongate slit at open end of expanded, flattened test. [*Cornuspiroides* differs from *Cyclogyra* in its later uncoiled, flabelliform development and from *Cornuspirella* CUSHMAN in being unbranched in the later portion.] *Rec.*, Atl.——FIG. 329,*7,8*. **C. striolata* (BRADY); *7*, side view of hypotype, ×5; *8*, apert. view of hypotype, ×5.5 (*2117).

Flectospira CRESPIN & BELFORD, 1957, *395, p. 76 [**F. prima*; OD]. Test discoidal, similar to *Meandrospira* in development but evolutely coiled, so that earlier whorls of zigzagging tubular second chamber are visible; aperture large, rounded, at open end of tube. *L.Perm.(Artinsk.)*, W. Australia.——FIG. 331,*1-3*. **F. prima; 1a,b*, side, edge views of holotype; *2*, equat. sec.; *3*, axial sec.; all ×77 (*395).

Gordiospira HERON-ALLEN & EARLAND, 1932, *914d, p. 254 [**G. fragilis*; OD (M)]. Test free, consisting of proloculus and long undivided second chamber, early portion coiling about proloculus in varying planes, becoming planispiral and partially involute in later portion; wall calcareous, imperforate, with numerous transverse wrinkles; aperture comprising broad arch at open end of tube. *Rec.*, Antarctic-Arctic.——FIG. 329, *4-6*. **G. fragilis*, S. Georgia Is.; *4*, large microspheric paratype, ×64; *5*, edge view (*914d, pl. 6, fig. 13), redrawn, showing crushing of test in the apertural region simulating a triangular aperture, ×64; *6*, small megalospheric paratype showing early irregular coiling and arched aperture, ×146 (*2117).

[*Gordiospira* differs from *Hemigordius* SCHUBERT in possessing a thin, delicate test wall and in lacking lateral secondary thickening. It differs from *Cyclogyra* in the glomospiroid early coiling. CUSHMAN (1948, *486, p. 193) stated that the aperture is "somewhat triangular." This was shown by the original figures and also by the edge view of the figure herein given of the same specimen, but it is due to the broken, slightly collapsed wall, which gives a pseudotriangular appearance. On uncrushed specimens the aperture is merely a broadly arched opening. The original specimens figured in side view are broken in the British Museum slides. Those here illustrated are from the same slide, however (BMNH-ZF3284).]

Hemigordiopsis REICHEL, 1945, *1516, p. 528 [**H. renzi*; OD]. Test globular, consisting of globular proloculus followed by nonseptate second chamber, coiling streptospiral in early portion and later planispiral, involute, so that only final whorl is

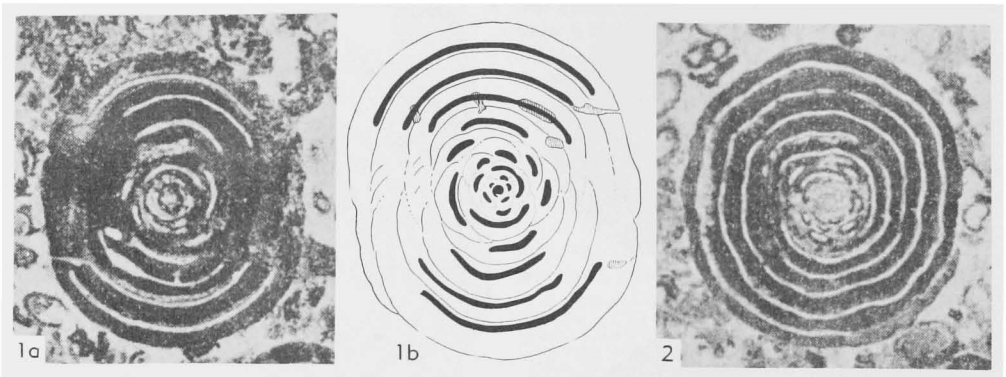


FIG. 332. Fischerinidae (Cyclogyrinae; *1,2, Hemigordiopsis*) (p. C439-C440).

visible externally; wall calcareous, porcelaneous, thick, chamber cavity much reduced. [*Hemigordiopsis* is similar to *Vidalina* and *Hemigordius* in its involute, later planispiral development, but differs from *Vidalina* in early streptospiral coiling, and differs from *Vidalina* and *Hemigordius* in its globular test resulting from very broad and low chambers.] *Perm.*, E.Medit.(Cyprus).——FIG. 332,*1,2*. **H. renzi*; *1a*, axial sec. of holotype (wall appears dark and chamber cavity light); *1b*, holotype, diagrammatic to show early streptospiral development and later planispiral coiling, ×20; *2*, equat. sec. of paratype showing nonseptate tube, ×20 (*1516).

Hemigordius SCHUBERT, 1908, *1686, p. 381 [**Cornuspira schlumbergeri* HOWCHIN, 1895, *967, p. 195] [=*Hemigordiella* MARIE in DELEAU & MARIE, 1961, *580A, p. 75 (type, *Hemigordius calcarea* CUSHMAN & WATERS, 1928, *535, p. 44); *Ondogordius* MARIE in DELEAU & MARIE, 1961, *580A, p. 78 (type, *O. campanula* MARIE, 1961); *Neoangulodiscus* KRISTAN-TOLLMANN, 1962, *1059A, p. 230 (type, *N. leischneri*)]. Test similar to *Gordiospira*, with early whorls glomospiroid, later planispiral, but whorls involute, resulting in umbonal thickening. *Carb.-L.Jur.(Lias.)*, Australia-N.Am.-Eu.-USSR.——FIG. 333,*1*. **H. schlumbergeri* (HOWCHIN), Carb., Australia; *1a-c*, opposite sides and edge of topotype, ×62 (*2117).

Meandrospira LOEBLICH & TAPPAN, 1946, *1154, p. 248 [**M. washitensis*; OD] [=*Streblospira* CRESPIN & BELFORD, 1957, *395, p. 74 (type, *S. meandrina*)]. Test free, small, composed of proloculus followed by tubular second chamber, which spirals streptospirally and involutely about proloculus in short zigzag bends, so that side view shows numerous loops reaching toward umbilicus, loops being formed by tubular chamber swinging back upon itself and only those of final whorl visible externally; wall calcareous, imperforate; aperture simple, terminal. *L.Perm. (Artinsk.)-Rec.*, N.Am.-Eu.-N.Afr.-Australia.——FIG. 333,*3*. **M. washitensis*, L.Cret.(Alb.), USA (Tex.); *3a-c*, holotype, opposite sides and edge views, ×211 (*2117).——FIG. 333,*4-6*. *M. meandrina* (CRESPIN & BELFORD). U.Perm., Australia; *4a-c*, opposite sides and edge views of holotype (in glycerine), ×53; *5*, equat. sec., ×90; *6*, axial sec., ×95 (*395).

[*Meandrospira* differs from *Calcitornella* and *Calcivertella*, both of which have a zigzag tubular second chamber, in being free living and enrolled, rather than attached to a flat substratum. *Streblospira* (L.Perm.) is a synonym and *Glomospira glomerata* HÖGLUND (Rec., Sweden) also belongs to *Meandrospira*.]

Orthovertella CUSHMAN & WATERS, 1928, *535, p. 45 [**O. protea*; OD]. Proloculus followed by undivided tubular second chamber, streptospirally coiled in early portion, later becoming uncoiled; aperture at open end of tube. [REYTLINGER (1950, *1560, p. 22) regarded *Orthovertella* as a synonym of *Lituotuba*, but *Orthovertella* has a porcelaneous rather than agglutinated wall.] *Penn.-Perm.*, N. Am.——FIG. 333,*2*. **O. protea*, Penn., USA (Tex.); *2a,b*, side, edge views of holotype, ×122 (*2117).

Rectocornuspira WARTHIN, 1930, *2040, p. 15 [**R. lituiformis*; OD]. Test differing from *Orthovertella* in being completely planispiral, rather than streptospiral in early stage, later portion uncoiled; wall porcelaneous; aperture rounded at open end of tube. *Penn.*, N.Am.——FIG. 333,*7*. **R. lituiformis*, USA(Okla.); *7a,b*, side, edge views, ×63 (*2117).

Vidalina SCHLUMBERGER, 1900, *1660, p. 459, 460 [**V. hispanica*; OD (M)] [=*Arvidaloum* RHUMBLER, 1913, *1572b, p. 388 (obj.) *(nom. van.)*]. Test large, to 1.5 mm. in diam., with proloculus followed by planispirally enrolled, involute, nonseptate, tubular second chamber, involute whorls resulting in umbonal thickening; wall calcareous, imperforate; aperture at open end of tube. *U.Cret.*, Eu.——FIG. 331,*4,5*; 333, *8,9*. **V. hispanica*, Santon., Spain; 331,*4*, equat.

sec., ×45; 331,*5*, axial sec., ×85 (*1660); 333, *8a,b*, side, edge views of large paratype, ×23 (*2117); 333,*9a,b*, side, edge views of small hypotype, ×55 (*2117).

Subfamily FISCHERININAE Millett, 1899

[Fischerininae Millett, 1899, p. 611]

Few tubular chambers to whorl, planispiral or in conical spire; aperture at open end of final chamber. *Jur.-Rec.*

Fischerina Terquem, 1878, *1889, p. 80 (*non* Stuckenberg, 1904) [**F. rhodiensis*; OD (M)] [=*Planispirina* Seguenza, 1880, *1713, p. 310 (type, *P. communis*); *Trisegmentina* Wiesner, 1920, *2061, p. 18 (type, *T. compressa* Wiesner, 1931, *2063, p. 70, =*Hauerina compressa* Sidebottom, 1904, *non H. compressa* d'Orbigny, 1846, =*T. sidebottomi* Cushman, 1933)]. Test free, globular proloculus followed by enrolled nonseptate tubular chamber of nearly full coil in

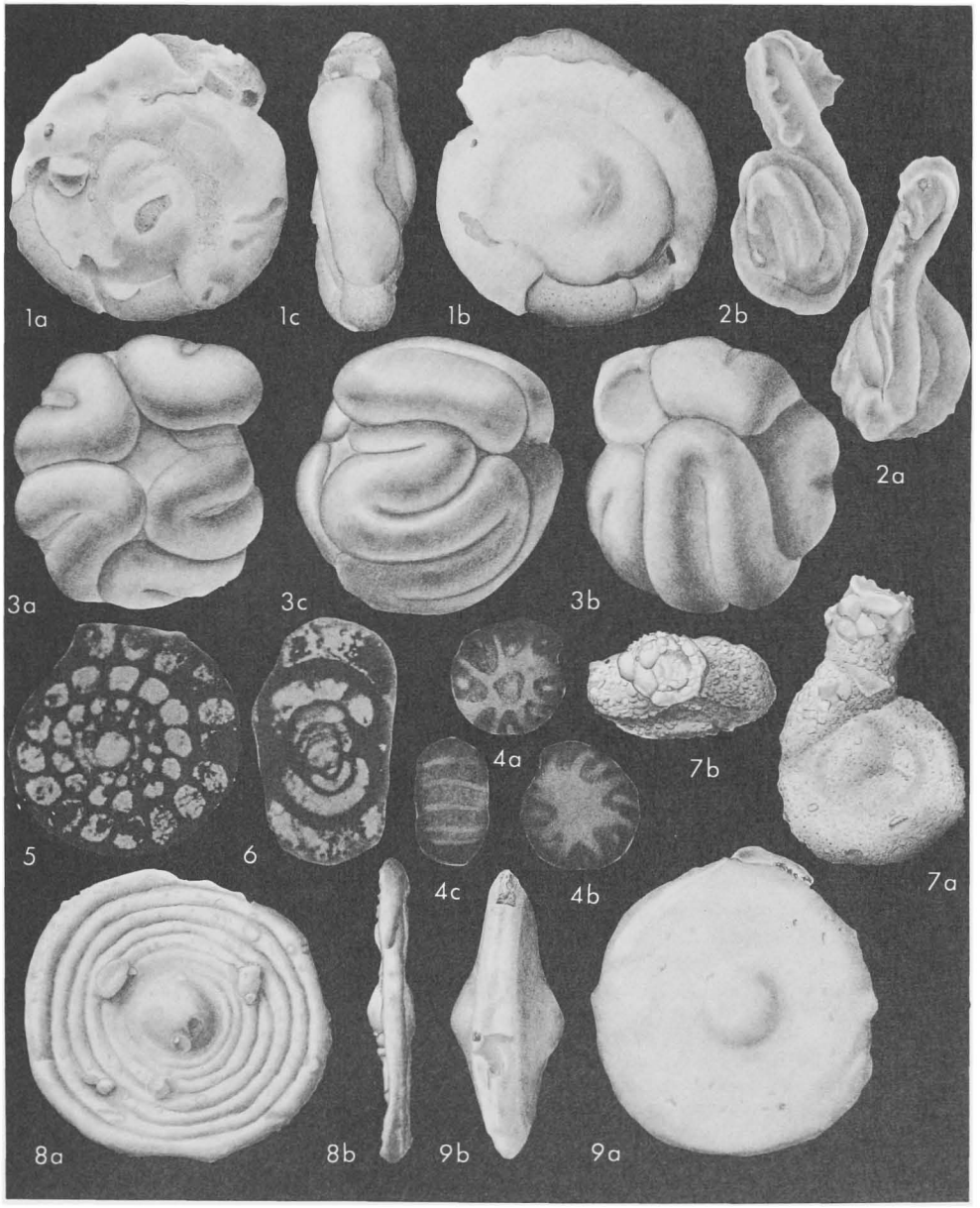


Fig. 333. Fischerinidae (Cyclogyrinae; *1, Hemigordius; 2, Orthovertella; 3-6, Meandrospira; 7, Rectocornuspira; 8,9, Vidalina*) (p. C440-C441).

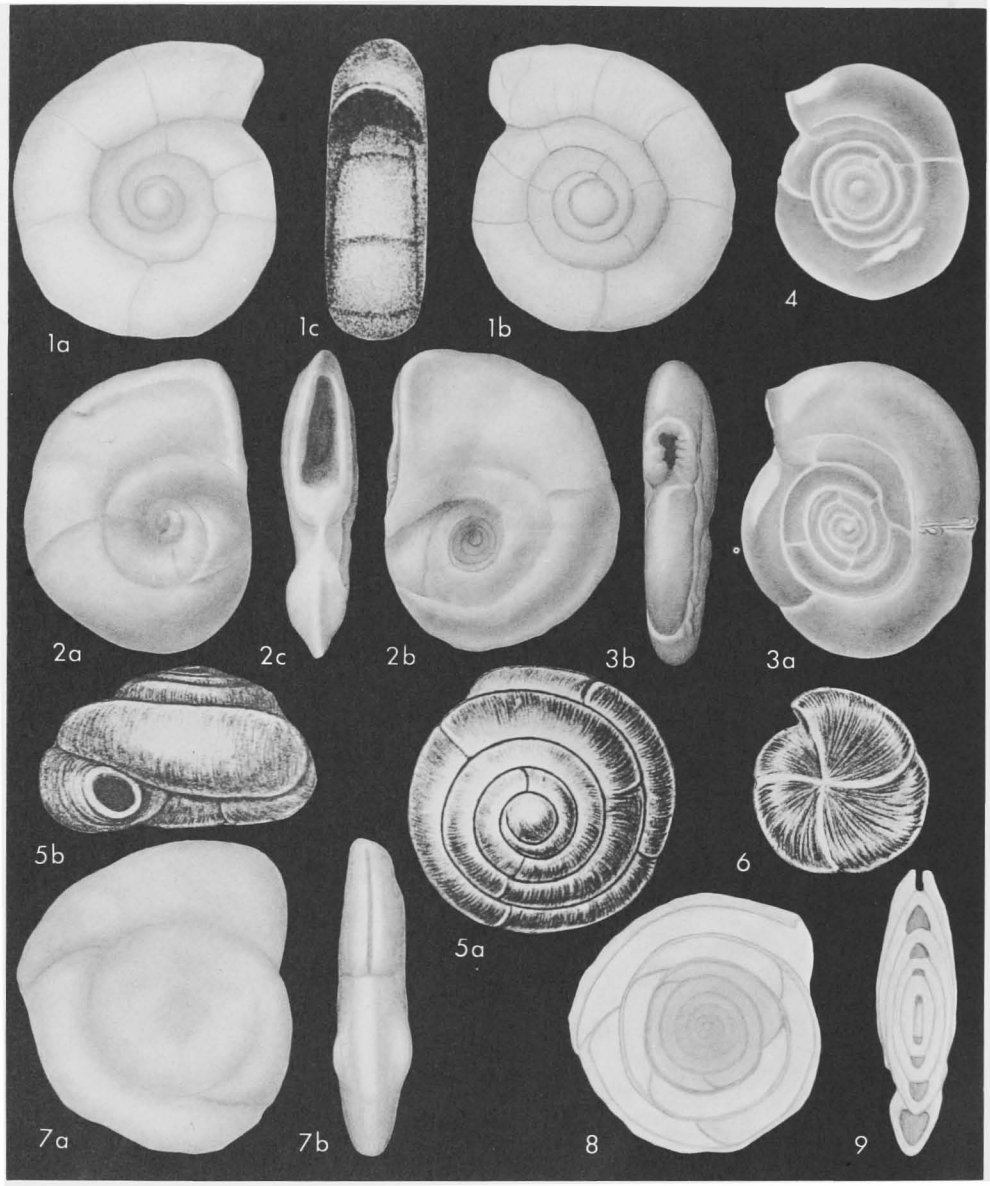


FIG. 334. Fischerinidae (Fischerininae; *1-4, Fischerina; 5,6, Fischerinella; 7-9, Planispirinella*) (p. *C*441-*C*443).

length, later chambers continuing about proloculus in planispiral coil; wall calcareous, thin, imperforate; aperture at open end of tube. *?Paleoc., Oligo.-Rec.*, cosmop.——FIG. 334,*1*. **F. rhodiensis*, Rec., Medit.; *1a,b*, opposite sides of holotype, ×79 (*2117); *1c*, edge view, ×79 (*1889).——FIG. 334,*2*. *F. communis* (SEGUENZA), Pleist., USA (Calif.); *2a-c*, opposite sides and edge views, ×115 (*2117).——FIG. 334,*3,4*. *F. compressa* (WIESNER), Rec., Medit.; *3a,b*, side, edge views of microspheric topotype; *4*, side view of megalospheric topotype; all ×111 (*2117).

[Although *Fischerina* is commonly described as trochospiral, with involute umbilical side, the holotype of the type-species, preserved in the Museum National d'Histoire Naturelle, Paris, is completely planispiral. *Fischerina* is therefore similar to *Cyclogyra*, but septate. *Trisegmentina* WIESNER was previously shown to be a junior synonym of *Planispirina* by LOEBLICH & TAPPAN (1955, *1166, p. 15), but with the redefinition of *Fischerina* TERQUEM to conform to the type-species, both *Trisegmentina* and *Planispirina* become synonyms of *Fischerina*. The original type of *Fischerina* was from the Pliocene, Isle of Rhodes, that of *Planispirina communis* from the Pliocene (Astian) of Sici-

ly, and that of *Trisegmentina compressa* WIESNER from Recent of the Mediterranean. The nomenclature of this last species is discussed by LOEBLICH & TAPPAN (1955, *1166, p. 16). *P. communis* differs only in having somewhat more rapidly enlarging chambers and thus a higher arched opening, but the relative proportions are regarded as of specific importance only.]

Fischerinella LOEBLICH & TAPPAN, 1962, *1185, p. 108 [**Fischerina helix* HERON-ALLEN & EARLAND, 1915, *910b, p. 591; OD]. Test similar to *Fischerina* but with trochospiral coiling and involute umbilical side. *Rec.*, E.Afr.(Kerimba Arch.).——FIG. 334,*5,6*. **F. helix* (HERON-ALLEN & EARLAND); *5a,b*, spiral and edge views of large specimen; *6*, umbilical view of smaller form, all ×49 (*910b).

Nautiloculina MOHLER, 1938, *1297, p. 18 [**N. oolithica*; OD]. Test free, planispirally enrolled, with numerous chambers in each whorl, completely involute and bilaterally symmetrical; wall calcareous, imperforate; aperture crescentic equatorial interiomarginal slit. [*Nautiloculina* differs from *Planispirinella* in its robust rather than flattened form and basal slitlike aperture, instead of a high vertical slit in the apertural face.] *Jur.*, Eu.(Switz.).——FIG. 335,*1-3*. **N. oolithica*, Raurac. *(1,2)*, Sequan. *(3)*; *1*, equat. sec., ×75; *2*, equat. sec., central portion enlarged to show planispiral development, ×230; *3*, axial secs., ×75 (*1297).

Planispirinella WIESNER, 1931, *2063, p. 69 [**Hauerina exigua* BRADY, 1879, *196b, p. 267; OD]. Test free, discoidal, planispiral and involute; proloculus followed by low, broad spiraling chambers, about 3 to whorl; sutures obscure, internal septa very thin and oblique; wall calcareous, imperforate, porcelaneous, composed of successive laminae developed with addition of each chamber, laminae each covering entire test, obscuring early chamber divisions externally; aperture high, elongate, subtriangular or slitlike opening extending up face of final chamber. *Tert.-Rec.*, Pac.O.——FIG. 334,*7-9*. **P. exigua* (BRADY), Rec., *Challenger* Station 187-A, off Booby Island at 8 fathoms; *7a,b*, side, apert. views of lectotype, here designated and redrawn (BMNH-ZF3616 ex ZF2107); *8*, equat. sec. (BMNH-ZF2110); *9*, axial sec. (BMNH-ZF2108), ×79 (*2117).

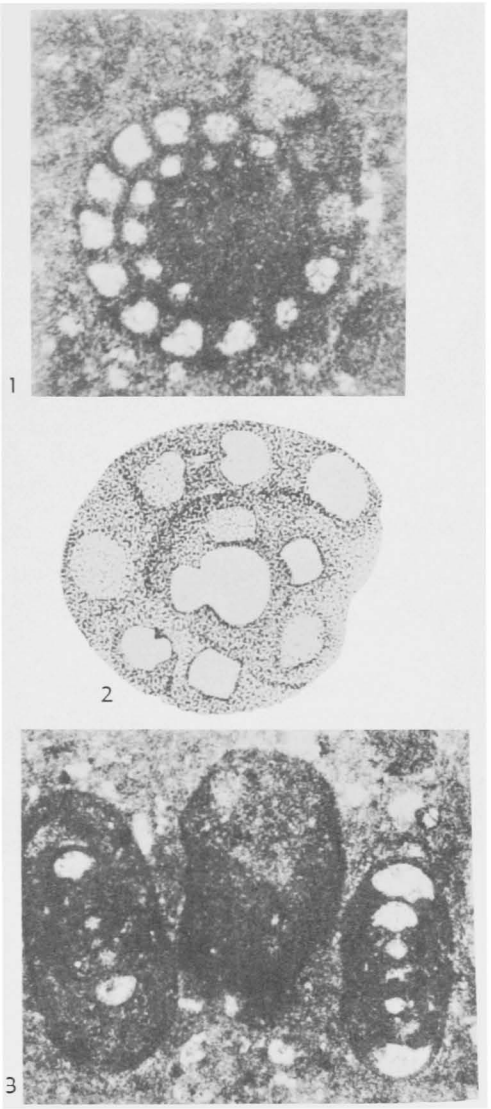


FIG. 335. Fischerinidae (Eischerininae; *1-3, Nautiloculina*) (p. C443).

Subfamily CALCIVERTELLINAE Loeblich & Tappan, n. subfam.

Test attached, proloculus followed by nonseptate tubular second chamber. *Penn.-Jur.*

Calcivertella CUSHMAN & WATERS, 1928, *535, p. 48 [**C. adherens*; OD]. Test attached, with proloculus partially encircled by nonseptate tubular second chamber, which then has rectilinear development in closely appressed zigzag across attachment, and finally tends to spread; wall calcareous, porcelaneous; aperture at open end of tube. [*Calcivertella* differs from *Plummerinella* in having a rectilinear, rather than enrolled, zigzag development of chamber.] *Penn.-Perm.*, N.Am. ——FIG. 336,*1*. **C. adherens*, Penn., USA(Tex.); holotype, ×47 (*2117).

Calcitornella CUSHMAN & WATERS, 1928, *535, p. 45 [**C. elongata*; OD] [=*Apterrinella* CUSHMAN & WATERS, 1928, *536, p. 64 (type, *Tolypammina grahamensis* HARLTON, 1928, *880, p. 305)]. Test attached, proloculus followed by nonseptate enrolled portion, later uncoiling and winding irregularly across attachment; wall calcareous, porcelaneous; aperture terminal. [The attached side of the holotype of *Calcitornella elongata* shows irregularly spaced transverse thickenings which give the appearance of septa in the early portion,

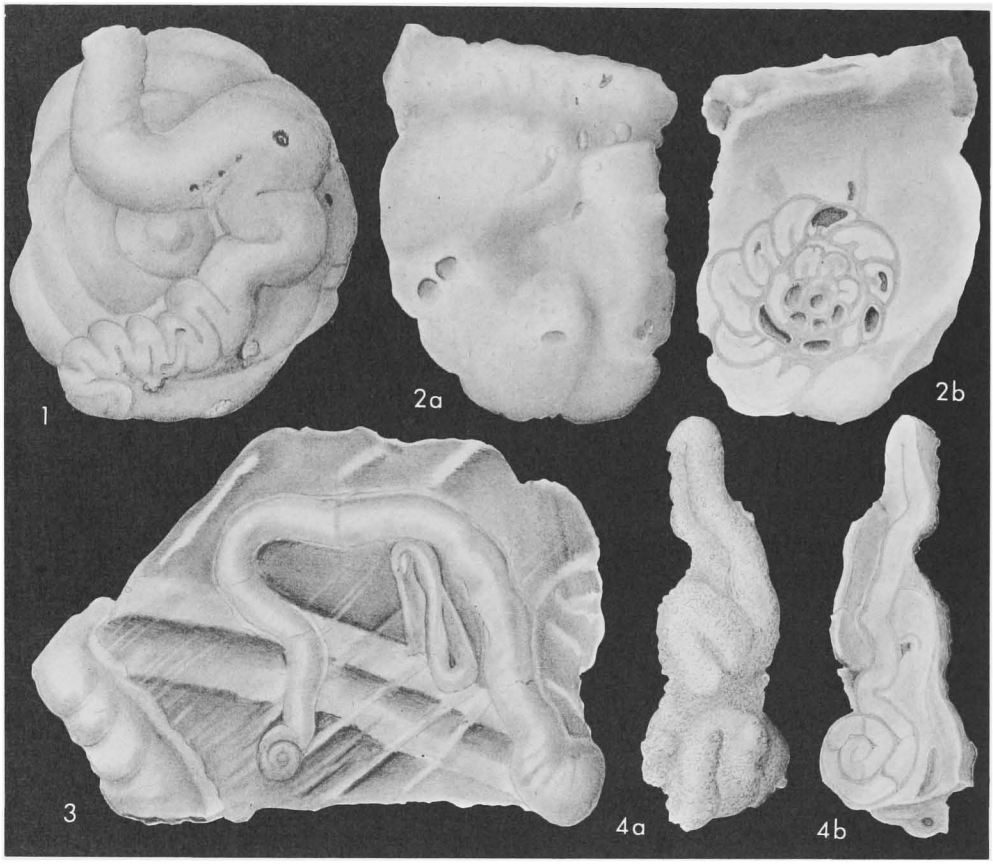


FIG. 336. Fischerinidae (Calcivertellinae; *1, Calcivertella; 2, Plummerinella; 3,4, Calcitornella*) (p. C443-C444).

but apparently are only thickenings of the attached wall and not true septa. The later portion is definitely nonseptate. *Apterrinella* is here regarded as a synonym of *Calcitornella*, as the two are similar in all respects. The actual form of the test depends largely on the area of the attachment and both type-species grow back upon themselves to some extent.] *Penn.-Jur.*, N.Am.-Eu.——FIG. 336,*3*. *C. grahamensis* (HARLTON), Penn., USA(Tex.); holotype, ×35 (*2117).——FIG. 336,*4*. **C. elongata*, Penn., USA(Tex.); *4a,b*, free and attached sides of holotype, ×53 (*2117).

Carixia MACFADYEN, 1941, *1200, p. 27 [**C. langi*; OD]. Test attached, consisting of unsegmented tubes radiating from central point and anastomosing over surface of substratum; wall calcareous, imperforate, with attachment of calcareous cement; apertures formed by simple open ends of tubes. *Jur.*, G.Brit.(Eng.).——FIG. 337,*1*. **C. langi*, Lias., hypotype, ×80 (*2117).

Planiinvoluta LEISCHNER, 1961, *1128, p. 11 [**P. carinata*; OD]. Test flattened, discoidal, probably originally attached; with globular proloculus and nonseptate planispirally enrolled second chamber, evolute on one side, involute on opposite side, which as a result is centrally inflated. [Described from thin sections, the genus is not completely known. As the flattened side suggests an attached condition, the genus is here placed in the Calcivertellinae.] *U.Trias.(Rhaet.)*, Eu.(Aus.).——FIG. 337,*3-5*. **P. carinata; 3*, axial sec. of holotype; *4,5*, equat. secs., ×100 (*1128).

Plummerinella CUSHMAN & WATERS, 1928, *535, p. 49 [**P. complexa*; OD]. Test attached, development otherwise similar to *Meandrospira* in early stage, with tubular nonseptate second chamber enrolled about proloculus in zigzag pattern, later spreading and tending to uncoil; wall calcareous, porcelaneous; aperture at open end of tube. *Penn.*, N.Am.——FIG. 336,*2*. **P. complexa*, USA(Tex.); *2a,b*, opposite sides of holotype, ×73 (*2117).

Family SQUAMULINIDAE Reuss, 1862

[*nom. correct.* LOEBLICH & TAPPAN, herein (*pro* family Squamulinidea REUSS, 1862, p. 364, and Squamulinida HAECKEL, 1894, p. 190)]

Test single-chambered, attached. *Rec.*

Squamulina SCHULTZE, 1854, *1695, p. 56 [**S.*

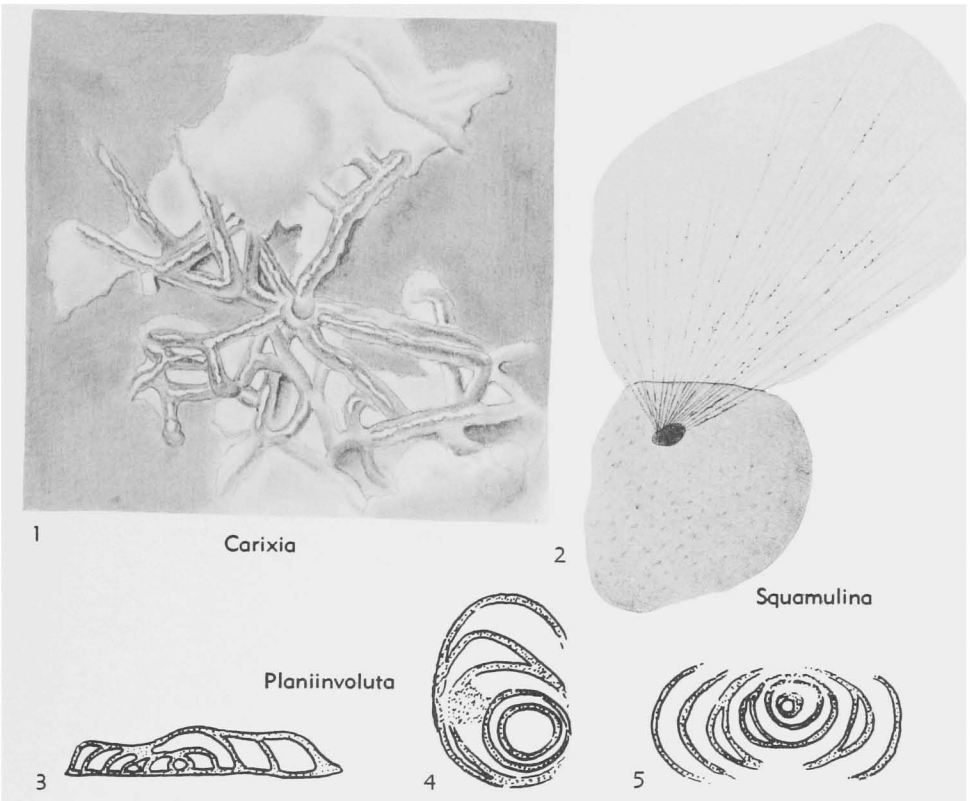


FIG. 337. Fischerinidae (Calcivertellinae; *1, Carixia; 3-5, Planiinvoluta*); Squamulinidae; *2, Squamulina* (p.C444-C445).

laevis; OD(M)] [=*Arsquamulum* RHUMBLER, 1913, *1572b, p. 346 (obj.) *(nom. van.)*]. Test attached, consisting of single inflated chamber with calcareous imperforate wall; aperture rounded on upper surface. *Rec.*, Eu.(Baltic Sea).——FIG. 337,2. **S. laevis*; ×72 (*1695).

Family NUBECULARIIDAE Jones, 1875

[*nom. correct.* AVNIMELECH & REISS in AVNIMELECH, PARNESS & REISS, 1954, p. 838 (*pro* family Nubecularida JONES in GRIFFITH & HENFREY, 1875, p. 319, and Nubeculariidae LISTER in LANKESTER, 1903, p. 143)]——[All names referred to are of family rank]——[=Inequilateralidae D'ORBIGNY in DE LA SAGRA, 1839, p. 26 *(nom. nud.)*; =Inaequilateralidae D'ORBIGNY, 1846, p. 73 *(nom. nud.)*; =Ovulinetta HAECKEL, 1894, p. 164 *(nom. nud.)*]——[=Nubecularina LANKESTER, 1885, p. 846; =Nubecularinae DELAGE & HÉROUARD, 1896, p. 122]——[=Opthalmidiidae CUSHMAN, 1927, p. 36; *(nom. imperf.)*; =Ophthalmidiidae CUSHMAN, 1928, p. 159; =Ophtalmidiidae LE CALVEZ, 1935, p. 96 *(nom. van.)*; =Ophthalmididae DOGEL, 1951, p. 464 *(nom. van.)*; =Vertebralinidae POKORNÝ, 1958, p. 251; =Calcitubida HAECKEL, 1894, p. 185]

Test free or attached, planispiral or irregularly coiled, at least in early stages, later spreading or branched; aperture simple, rounded or slitlike or more rarely cribrate. *M.Carb.-Rec.*

Subfamily NUBECULARIINAE Jones, 1875

[*nom. correct.* CHAPMAN, 1901, p. 169 (*pro* subfamily Nubecularinae BRADY, 1884, p. 61, *nom. transl. ex* family Nubecularida JONES, 1875)] [=Nubeculinellinae AVNIMELECH & REISS in AVNIMELECH, PARNESS & REISS, 1954, p. 838]

Test attached, early stage coiled, later may be irregular. *Jur.-Rec.*

Nubecularia DEFRANCE, 1825, *579f, p. 210 [**N. lucifuga*; OD (M)]. Test attached, early portion in cornuspirine coil, later stage chambered, may continue coiling or become linear but varies considerably in shape according to substratum, terminal portion may grow away from substratum as tubular projection; wall calcareous, imperforate, commonly incorporates small grains of sand; aperture elongate slit at attachment when specimen is attached, but becoming rounded with lateral toothlike infoldings of walls when growing free. *Jur.-Rec.*, cosmop.——FIG. 338,*1-3*. **N. lucifuga*, M.Eoc.(Lutet.), Fr.; *1*, specimen showing attached side; *2*, specimen with free-growing final portion and infolded apertural margin; *3*, top view of specimen showing restricted aperture, ×25 (*2117).

[GALLOWAY (1933, *762, p. 116) stated that the genus does not have a lower wall. However, specimens of the type-species show a complete lower wall, others show various

stages between this and an absence of a lower wall, so that it seems that this character may be due to nature of the substratum. Apparently, infolding of the apertural wall has not been previously noted for this species, although it is shown on approximately half of the specimens from the Lutetian at Grignon, France. The original illustrations of DEFRANCE were at very low magnification and did not show this feature. Most other references to the species have been to Recent specimens, which probably belong to a distinct species, as some show much closer coiling, with more numerous chambers, and others are coarsely agglutinated. The original types were from the *Calcaire coquillier grossier* (Lutetian) at *la falunière de Hauteville, Dept. de la Manche,* France.]

Calcituba VON ROBOZ, 1884, *1580, p. 420 [**C. polymorpha*; OD]. Test attached to algae, con-

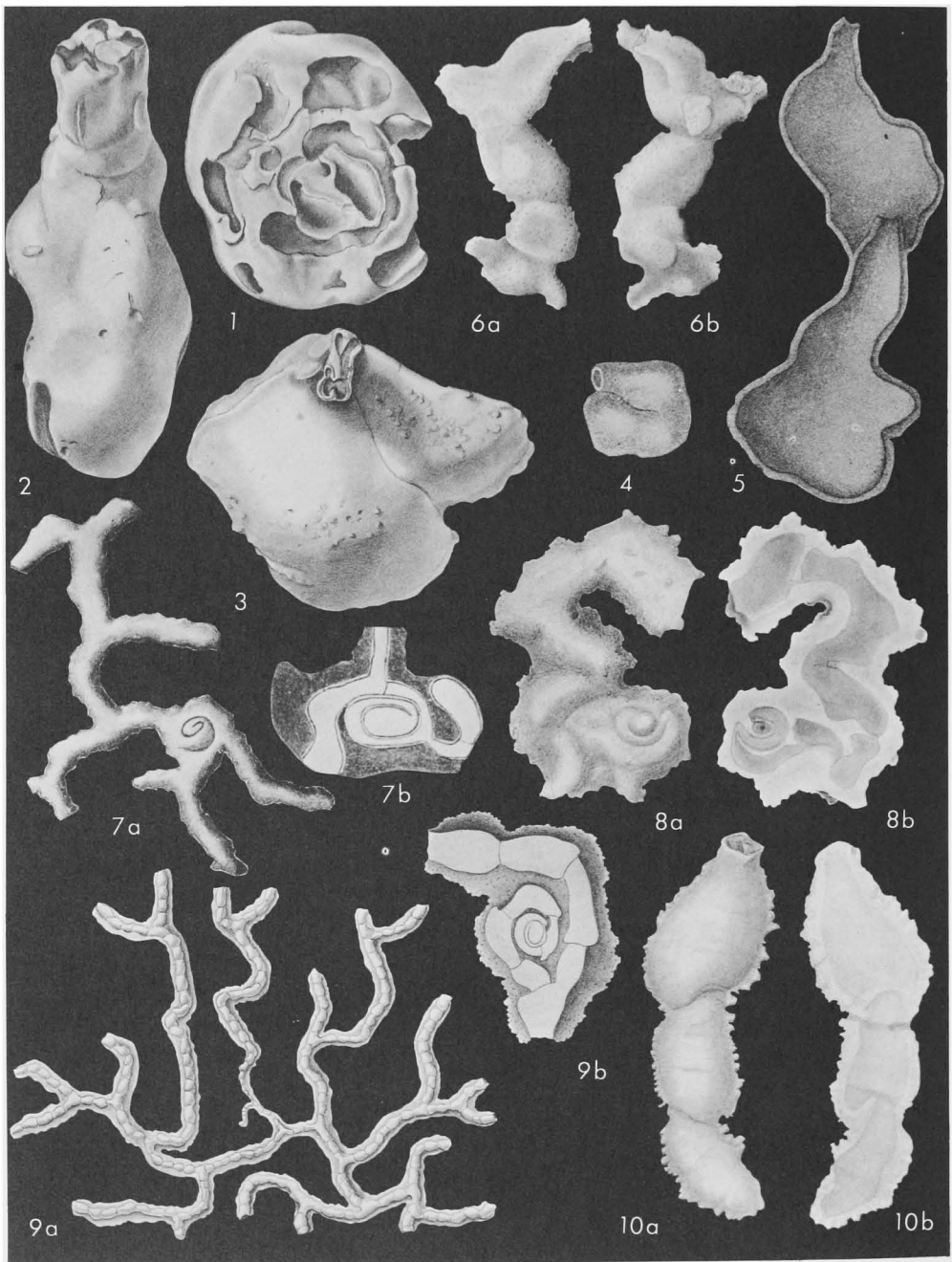


FIG. 338. Nubeculariidae (Nubeculariinae; *1-3, Nubecularia; 4-6, Calcituba; 7-9, Cornuspiramia; 10, Webbina*) (p. C445-C448).

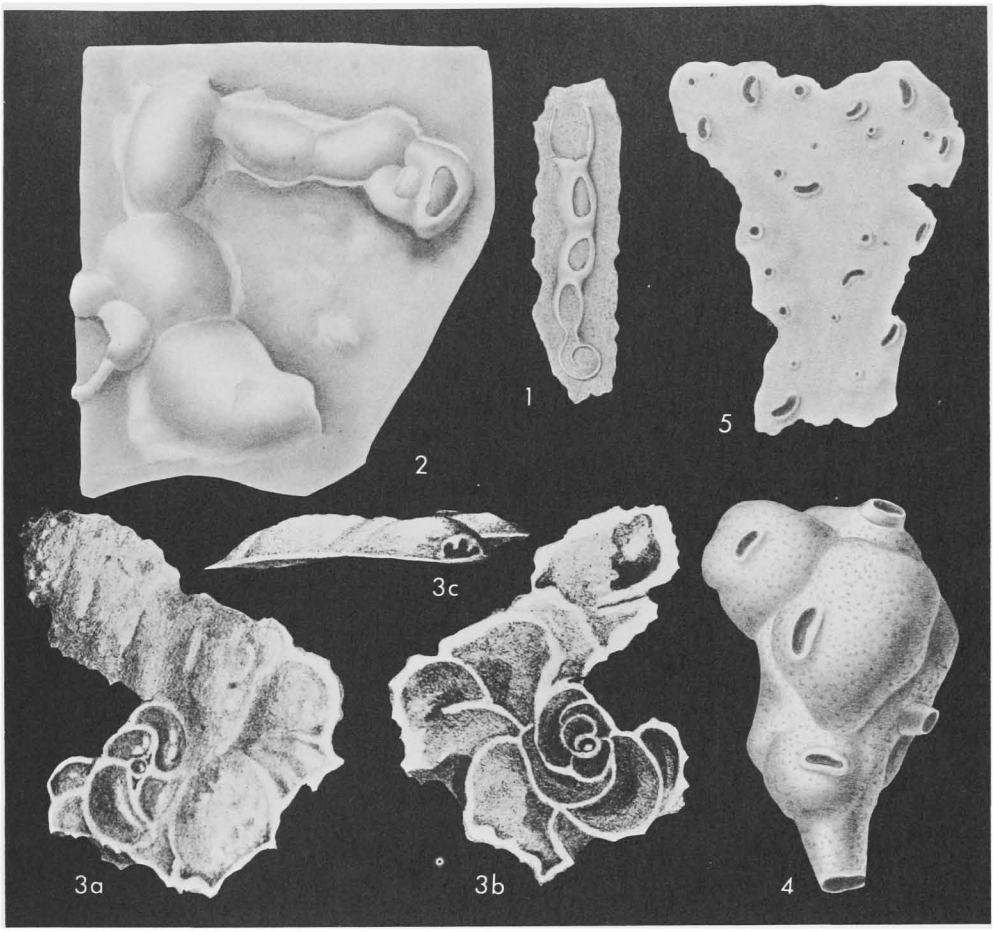


FIG. 339. Nubeculariidae (Nubeculariinae; *1,2, Nubeculinella; 3, Nubeculopsis; 4,5, Sinzowella*) (p. C447-C448).

sisting of irregular elongate chambers, uniserial or branching; wall calcareous, porcelaneous; aperture rounded, terminal, on one or more chambers. *Rec.,* Adriatic Sea-Gulf Mex.——FIG. 338, *4-6.* **C. polymorpha,* Adriatic *(4,5),* Gulf Mex. *(6)*; *4,* young form showing spiral appearance, ×50; *5,* optical sec. of 2-chambered form, ×150 (*1580); *6a,b,* opposite sides of larger specimen, ×56 (*2117).

Cornuspiramia CUSHMAN, 1928, *436, p. 4 [**Nubecularia antillarum* CUSHMAN, 1922, *416, p. 58; OD] [=*Rhizonubecula* J. LE CALVEZ, 1935, *1102, p. 96 (type, *R. adherens*)]. Test attached, proloculus followed by enrolled tubular second chamber of nearly 1 complete volution in length, and later subpyriform chambers in irregularly rectilinear series, later dichotomously branching over substrate. [*Cornuspiramia* was originally described as a nonchambered, tubular, attached form, as the chambers are difficult to distinguish externally on attached specimens. On specimens which have broken free of attachment the chamber development can be seen.] *Rec.,* Gulf Mex.-Carib.-Medit.——FIG. 338,*7,8.* **C. antillarum* (CUSHMAN), Gulf Mex. *(7),* Carib. *(8)*; *7a,b,* ext. and attached side, enlarged (*436); *8a,b,* dorsal and attached surfaces showing chamber development, ×73 (*2117).——FIG. 338,*9.* *C. adherens* (J. LE CALVEZ), Medit.; *9a,* entire specimen, ×7; *9b,* early portion enlarged to show chamber development, ×50 (*1102).

Nubeculinella CUSHMAN, 1930, *446, p. 133 [**N. bigoti*; OD]. Test attached, consisting of proloculus followed by second chamber coiling around first, varying from half coil to one and one-half coils in length, forms with smaller proloculus followed by longer and more enrolled second chamber, later chambers elongate-ovate to irregular in outline, uniserially arranged but winding somewhat upon shell fragments to which they attach; wall calcareous, imperforate, milky white; aperture semi-circular opening against substratum. [Differs from *Nubecularia* in its more regular chamber development, with early coil followed by un-

coiled portion.] *U.Jur.*, Eu.——FIG. 339,*1,2*. **N. bigoti*, Oxford., Fr.; *1*, holotype (*446); *2*, paratype, ×65 (*2117).

Nubeculopsis COLLINS, 1958, *375, p. 375 [**N. queenslandica*; OD]. Test attached, similar to *Nubeculinella* but early portion with arcuate chambers forming early coil, instead of nonseptate tube coiling around proloculus, later chambers tending to uncoil; aperture terminal arch against attachment, with infolded teeth, similar to those in *Nubeculina*. *Rec.*, Australia.——FIG. 339,*3*. **N. queenslandica*; *3a*, upper surface of holotype; *3b*, surface of attachment; *3c*, top view showing apert. teeth; all ×66 (*375).

Sinzowella CUSHMAN, 1933, *458, p. 33 [**Nubecularia novorossica* var. *deformis* KARRER & SINZOW, 1877, *1024, p. 283; OD]. Test to 10 mm. in length, attached, early stage planispiral as in *Cyclogyra*, later with globular chambers forming irregular mass; wall calcareous, porcelaneous, thick; elongate reniform aperture with bordering lip on each of globular chambers. *Mio.*, Eu.——FIG. 339,*4,5*. **S. deformis* (KARRER & SINZOW), Sarmat., Rumania; *4*, ext. showing globular chambers and apertures; *5*, long. sec. showing thick walls, enlarged (*1024).

Webbina D'ORBIGNY in DE LA SAGRA, 1839, *1611, p. 26 [**W. rugosa* D'ORBIGNY in BARKER-WEBB & BERTHELOT, 1839, *86, p. 126; SD (SM)] [=*Webbum* RHUMBLER, 1913, *1572b, p. 444 (type, *Webbina rugosa* D'ORBIGNY, SD LOEBLICH & TAPPAN, herein); *Arwebbum* RHUMBLER, 1913, *1572b, p. 445 *(nom. van.)*]. Test attached by entire lower surface, chambers few in number, inflated, surface marked by faint transverse "growth lines," margins of chambers bordered by fimbriate "keel"; wall thin, calcareous, appearing milky white and imperforate, surface smooth except for transverse wrinkles; aperture terminal, with bordering lip. *Rec.*, Atl.-Timor Sea.——FIG. 338,*10*. **W. rugosa*, Atl.; *10a,b*, holotype, showing convex chambers on free side and opposite side flattened against attachment, ×58 (*2117).

[Although commonly placed with the perforate calcareous genera, in the Cibicidinae (*762, p. 296; *486, p. 339; *1509, p. 287), the holotype, in the Museum National d'Histoire Naturelle, Paris, has a porcelaneous and imperforate wall, the "rugose" appearance being due merely to surface wrinkles. The genus was redefined by LOEBLICH & TAPPAN (*1166, p. 23) and is here transferred to the Nubeculariinae. Specimens of *Webbina* recently have been obtained from the Sahul Shelf, northern Australia, at a depth of 72 fathoms.]

Subfamily OPHTHALMIDIINAE Wiesner, 1920

[Ophthalmidiinae WIESNER, 1920, p. 17]——[All names of subfamily rank]——[=Trisegmentininae WIESNER, 1920, p. 17, 18; =Miliolidae holostreptae EIMER & FICKERT, 1899, p. 688 *(nom. nud.)*; =Opthalmidiinae CUSHMAN, 1927, p. 37 *(nom. van.)*; =Planispirinellinae WIESNER, 1931, p. 58, 60, 69, 110]

Test free, proloculus and undivided planispirally coiled chamber followed by irregular later chambers. *M.Carb.-Rec.*

Ophthalmidium KÜBLER & ZWINGLI, 1870, *1061, p. 46 [*pro Oculina* KÜBLER & ZWINGLI, 1866, *1060, p. 11 (*non* LAMARCK, 1816)] [**Oculina liasica* KÜBLER & ZWINGLI, 1866, *1060, p. 11; OD] [=*Spiropthalmidium* CUSHMAN, 1927, *431, p. 37 *(nom. imperf.)* (type, *Spiroloculina acutimargo* BRADY, 1884, *200, p. 154); *Spirophthalmidium* GALLOWAY, 1933, *762, p. 112 *(nom. correct.*, obj.)]. Test free, ovate to fusiform in outline, flattened, consisting of globular proloculus followed by spirally wound second chamber of one-half to complete whorl in length, later chambers one-half coil in length and regularly added, chambers may taper slightly from early portion to oral end, and may be loosely coiled with flattened plate between whorls; wall calcareous, imperforate, porcelaneous; aperture rounded to ovate, at end of final chamber. *U. Trias.-Rec.*, cosmop.——FIG. 340,*1*. **O. liasica* (KÜBLER & ZWINGLI), U.Lias., Eu.(Switz.); holotype (small megalospheric specimen), ×14 (*2071).——FIG. 340,*2*. *O. acutimargo* (BRADY), Rec., S.Atl.O.; *2a,b*, side and top views of topotype, ×48 (*2117).

Cornuloculina BURBACH, 1886, *253b, p. 497 [**Hauerina inconstans* BRADY, 1879, *196b, p. 268; SD LOEBLICH & TAPPAN, herein] [=*Hauerinella* SCHUBERT, 1921, *1694, p. 162 (obj.)]. Test free, planispirally coiled and evolute, globular proloculus followed by planispirally wound tubular second chamber of up to 3 whorls, followed by chambers of approximately one-half coil in length, or slightly less, resulting in 2.5 to 3 chambers to whorl in later stages, chambers somewhat loosely coiled, those of adjacent whorls being separated by thin plate; wall calcareous, imperforate; aperture at open end of final chamber. [*Cornuloculina* is separated from *Ophthalmidium* in the less regular coiling with more than 2 chambers in each whorl.] *Jur.-Rec.*, S.Atl.O.-S. Pac.O.-Eu.——FIG. 340,*3-7*. **C. inconstans* (BRADY), off Brazil *(3-6)*, S.Pac. *(7)*; *3-5*, topotypes, showing various stages of development from early planispiral tubular chamber to 2 or more chambers to whorl, ×31 (*2117); *6*, microspheric topotype in transmitted light, ×30; *7*, megalospheric hypotype in transmitted light, ×50 (*2074).

Edentostomina COLLINS, 1958, *375, p. 370 [**Miliolina cultrata* BRADY, 1879, *196c, p. 45; OD]. Test compressed, ovate, apparently planispiral, with chambers one-half coil in length; wall porcelaneous, surface smooth, longitudinally striate or pitted; aperture terminal, commonly somewhat produced, with thickened rim, without apertural teeth, but may be ovate, slitlike, or cruciform. *Rec.*, Indo-Pac.O.——FIG. 341,*1*. **E. cultrata* (BRADY), Malay Arch.; *1a-c*, opposite sides and apert. view showing planispiral development, ×40 (*1284a).——FIG. 341,*2*. *E. milletti* (CUSHMAN); specimen mounted in balsam and viewed in transmitted light to show chamber arrangement, exterior suture lines omitted, ×40 (*1284a).

[The original description stated in part, "Test triloculine or biloculine . . . last two chambers added at approximately 180°, . . . aperture oval with a thickened rim and no tooth." In addition to the type-species, *Miliolina durrandii* MILLETT, *Miliolina rupertiana* BRADY, and *Biloculina milletti* CUSHMAN were transferred to *Edentostomina*.

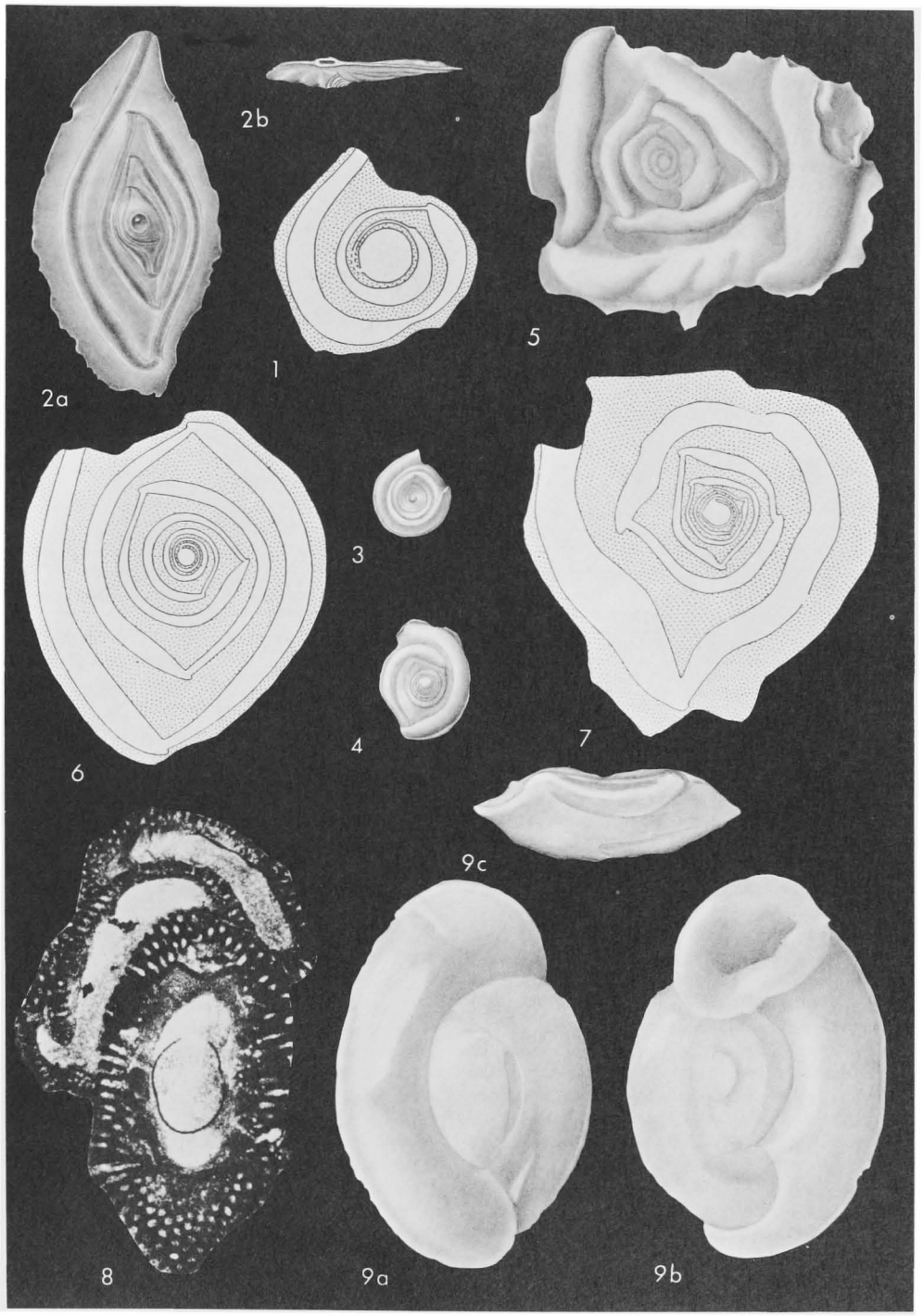


FIG. 340. Nubeculariidae (Ophthalmidiinae; *1,2, Ophthalmidium; 3-7, Cornuloculina; 8, Pseudovermiporella; 9, Wiesnerella*) (p. C448, C450-C452).

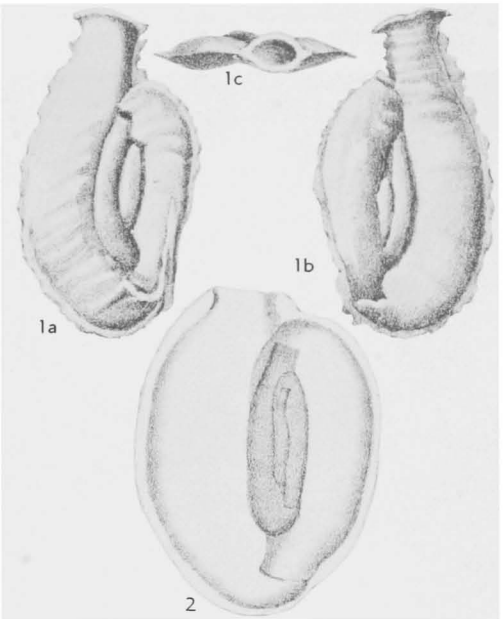


FIG. 341. Nubeculariidae (Ophthalmidiinae; *1,2, Edentostomina*) (p. C448-C450).

None of these species shows a typical triloculine development or is typically miliolid, since in most species the same number of chambers is visible on both sides (4 on each side in *E. durrandii,* and in MILLETT's specimens of *E. cultrata* whereas BRADY figured one side only of 2 different specimens, and 2 on each side in *E. milletti*). Only in *Miliolina rupertiana* does a suggestion of asymmetry appear, although no figures have been published showing both sides of a single specimen. The views of *E. milletti* in transmitted light given by MILLETT (Fig. 341,2) also appear to show a planispiral development. For this reason, and because of the absence of an apertural tooth, *Edentostomina* is here transferred to the Ophthalmidiinae.]

Eosigmoilina GANELINA in KIPARISOVA, *et al.,* 1956, *1040, p. 17 [**E. explicata*; OD]. Test compressed-ovate, globular proloculus followed by nonseptate tubular second chamber in glomospirine coil, later portion with 2 chambers to whorl and development as in *Sigmoilina,* with plane of coiling gradually changing to form sigmoid curve as seen in transverse section; septa very thin; wall calcareous, imperforate, thin, aperture simple rounded opening at end of final chamber. [Originally placed in the Miliolidae, this genus is here transferred to the Ophthalmidiinae, family Nubeculariidae, because of its nonseptate enrolled second chamber and later milioline development, and the simple apertural opening.] *M.Carb.,* USSR(Dnieper-Donets Basin)-Eu.(Czech.).——FIG. 342,*1,2*. **E. explicata,* USSR; *1a-c,* opposite sides and edge views of paratype, ×100; *2,* long. sec. showing change in axis of coiling, ×150 (*1040).

Galeanella KRISTAN, 1958, *1058, p. 114 [*pro Galea* KRISTAN, 1957, *1057, p. 291 (*non* MEUSCHEN, 1787; *nec* MEYEN, 1833; *nec* MOERCH, 1852)] [**Galea tollmanni* KRISTAN, 1957, *1057, p. 291; OD]. Test consisting of globular proloculus and enrolled close-coiled later chambers, which taper distally as in *Ophthalmidium,* whorls or chambers scarcely perceptible from exterior; wall calcareous, porcelaneous and thick, leaving only small chamber cavities, may form thickened rim or keel of test; in thin section few large pore canals seen to pierce thickened wall; aperture rounded opening with radial grooves radiating from it across depressed apertural face. *U.Trias.(Rhaet.),* Eu.(Aus.).——FIG. 342,*6-8*. **G. tollmanni* (KRISTAN); *6a-d,* opposite sides and opposite edge views of holotype; *7a,* tang. sec. showing pore canals leading from proloculus; *7b,* parallel but deeper section, showing numerous tapering chambers, thick walls and pore canals; *8,* vert. long. sec.; all ×35 (*1057).

Glomulina RHUMBLER, 1936, *1575, p. 198 [**G. fistulescens*; OD]. Test free, globular, proloculus followed by cyclogyrine tubular second chamber, later streptospirally coiled with chambers half coil in length; wall calcareous, imperforate; aperture rounded, terminal. *Rec.,* Baltic Sea.——FIG. 342,*3*. **G. fistulescens; 3a,b,* opposite sides; 3c, specimen viewed as in *3a* but in transmitted light to show chamber arrangement, ×45 (*1575).

[The genus was described as having secondary apertures on fistulose projections along the final chamber, as can be seen in the figure. It is uncertain, however, whether this is a characteristic of the foraminifer, or due to a parasite or other abnormal growth.]

Ophthalmina RHUMBLER, 1936, *1575, p. 217 [**O. kilianensis*; OD]. Test compressed, planispiral, proloculus followed by nonseptate cyclogyrine stage and later with 2 chambers to whorl; wall calcareous, imperforate; aperture at open end of final chamber. [*Ophthalmina* superficially resembles *Wellmanella* and *Pseudomassilina* but differs in having an early planispiral stage instead of early milioline one, and differs from *Pseudomassilina* in the simple, nonpitted or canaliculate wall. It differs from *Hauerinella* and *Zoyaella* in having only 2 chambers to each whorl.] *Rec.,* Eu.(N.Ger.).——FIG. 342,*9-11*. **O. kilianensis*; *9a,b,* opposite sides, ×50; *10,* ext., ×70; *11,* axial sec., ×70 (*1575).

Pseudovermiporella ELLIOTT, 1958, *698, p. 419 [**P. sodalica*; OD]. Test large, irregular, consisting of meandriform tubes, to 1.4 mm. diam., which may be free-growing and circular in section or closely appressed or attached and hemispherical in form; wall of finely crystalline calcite, pierced by numerous, closely set perforations, about 50 visible in single transverse section, in tangential section coarse pores appear to form round-pored mesh, inner continuous solid dark calcareous layer occurring within outer radially perforated layer, probably of secondary origin. [Originally regarded as questionably a primitive dasyclad alga, although also compared to foraminifers and bryozoans, this genus was later regarded as a true foraminifer (HENBEST, 1960, *898, p. B387).] *Perm.,* SW.Asia(Arabia)-N.Afr.(?Tunisia)-

?Japan.——Fig. 340,8. **P. sodalica*, Arabia; holotype showing meandriform tubes and coarse perforations appearing as mesh in tang. section, ×28 (*698).

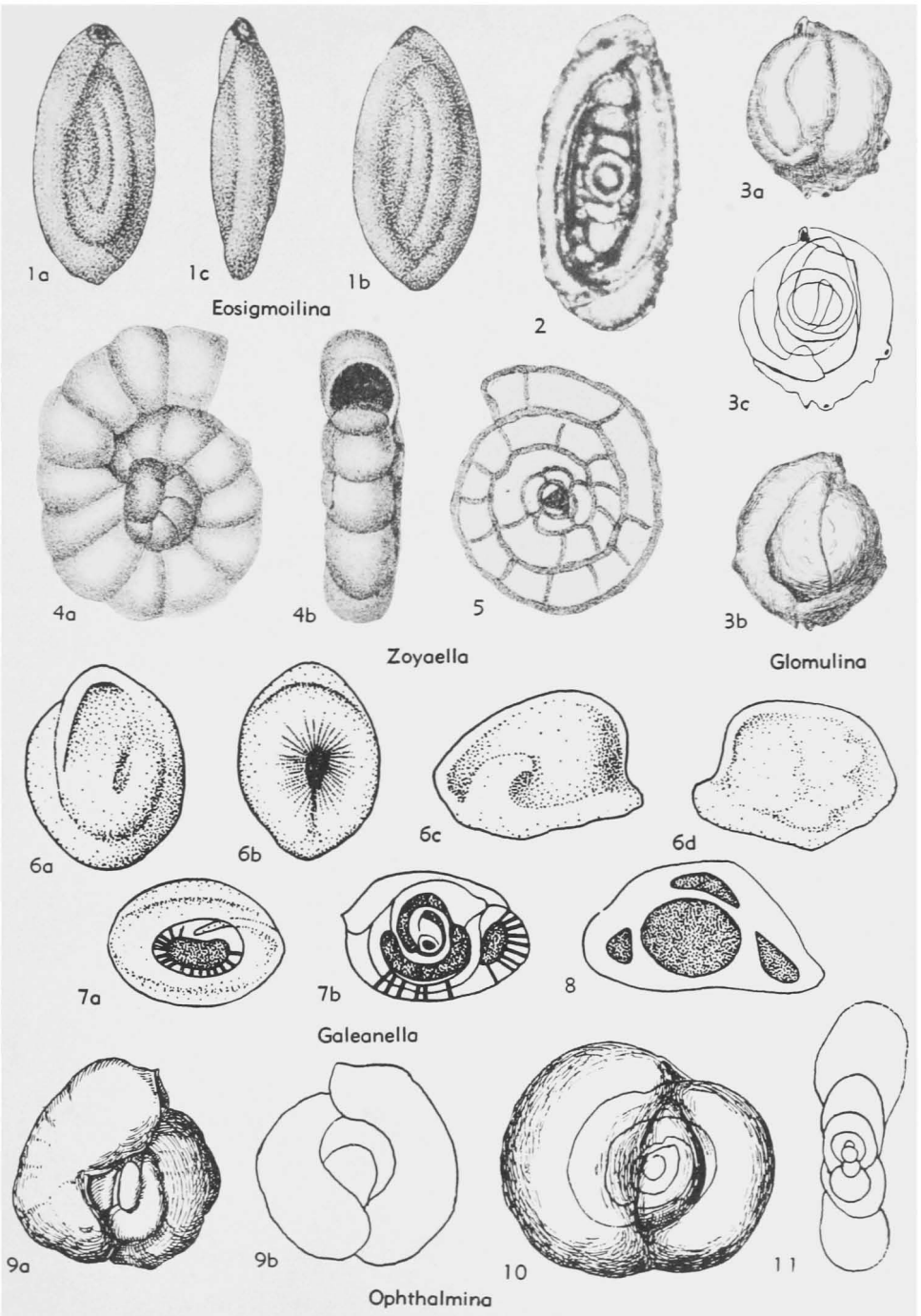


Fig. 342. Nubeculariidae (Ophthalmidiinae; *1,2, Eosigmoilina; 3, Glomulina; 4,5, Zoyaella; 6-8, Galeanella; 9-11, Ophthalmina*) (p. C450, C453).

Wiesnerella CUSHMAN, 1933, *458, p. 33 [**Planispirina auriculata* EGGER, 1893, *658, p. 245; OD]. Test planispiral in early stage, later chambers somewhat embracing, each one-half coil in length; wall thin, porcelaneous; aperture large, rounded, with everted lip. *Rec.*, Atl.O.-Gulf Mex.

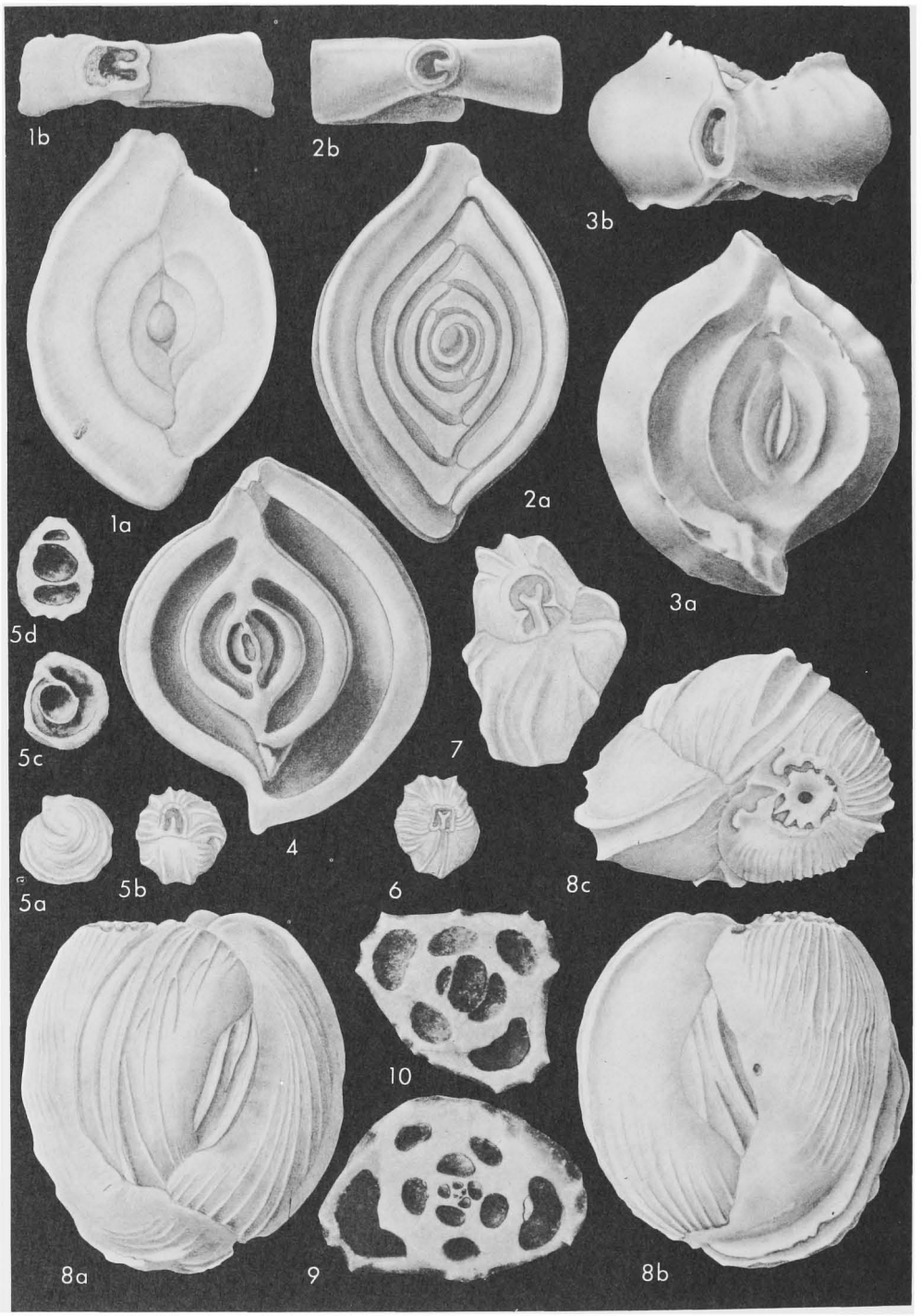


FIG. 343. Nubeculariidae (Spiroloculininae; *1-4, Spiroloculina; 5-10, Cribrolinoides*) (p. C453).

——Fig. 340,*9*. **W. auriculata* (Egger), Gulf Mex.; *9a-c*, opposite sides, top view, ×174 (*2117).

Zoyaella Loeblich & Tappan, 1962, *1185, p. 109 [*pro Ceratina* Goës, 1894, *804, p. 122 (*non* Latreille, 1802; *nec* Menge, 1868)] [**Ceratina trochamminoides* Goës, 1894, *804, p. 122; OD]. Test free, discoidal, proloculus followed by tubular second chamber, then streptospirally enrolled as in *Glomulina*, and finally planispiral, involute, with numerous chambers to whorl; wall calcareous, porcelaneous; aperture high arch at open end of final chamber. [*Zoyaella* differs from *Fischerina* in its early streptospiral stage, and from *Glomulina* in its later planispiral stage.] *Rec.*, N.Atl.O.(Azores).——Fig. 342,*4,5*. **Z. trochamminoides* (Goës); *4a,b*, side, edge views of holotype, ×21; *5*, equat. sec. showing chamber arrangement, ×37 (*804).

Subfamily SPIROLOCULININAE Wiesner, 1920

[Spiroloculininae Wiesner, 1920, p. 17, 18]

Proloculus followed by cornuspirine coil, adult chambers one-half coil in length; aperture commonly with phialine lip and with simple or bifid tooth. *U.Cret.-Rec.*

Spiroloculina d'Orbigny, 1826, *1391, p. 298 [**S. depressa*; SD Cushman, 1917, *404f, p. 29] [=*Spirolocunina, Spiroculina* Stöhr, 1877, *1840, p. 640 (*nom. null.*); *Flintia* Schubert, 1911, *1689b, p. 124 (type, *Spiroloculina robusta* Brady, 1884, *200, p. 150)]. Test free, commonly with flattened sides and lanceolate or fusiform outline, earliest stage may consist of single chamber completely encircling proloculus, later chambers (or all chambers in megalospheric forms) being added 2 to whorl on alternate sides and in single plane; wall calcareous, imperforate, porcelaneous; aperture at open end of final chamber, with simple or bifid tooth. *U.Cret.-Rec.*, cosmop.——Fig. 343, *1,2*. **S. depressa*, Plio., Eu.(Italy); *1a,b*, side, top views of megalospheric topotype, ×41; *2a,b*, side, top views of microspheric hypotype showing early cyclogyrine coil, ×105 (*2117).——Fig. 343,*3,4*. *S. robusta* Brady; *Rec.*, Carib. *(3)*, Gulf Mex. *(4)*; *3a,b*, side and top views of topotype, ×25; *4*, sectioned hypotype showing early stage, ×31 (*2117).

[Differs from *Massilina* in having a planispiral early stage, as can be seen in the figures, and all chambers are added in a single plane, whereas *Massilina* is quinqueloculine in the early stage. *Flintia* was described as differing from *Massilina* in being biloculine throughout, rather than having an early quinqueloculine stage. Galloway (1933, *762) regarded *Flintia* as a synonym of *Massilina*, but because of the absence of an early milioline stage in the type-species of *Flintia*, it is here regarded as a synonym of *Spiroloculina*.]

Cribrolinoides Cushman & LeRoy, 1939, *510, p. 15 [**Quinqueloculina disparilis* d'Orbigny var. *curta* Cushman, 1917, *404f, p. 49; OD]. Test quinqueloculine in adult, but early stage with planispirally wound second chamber forming

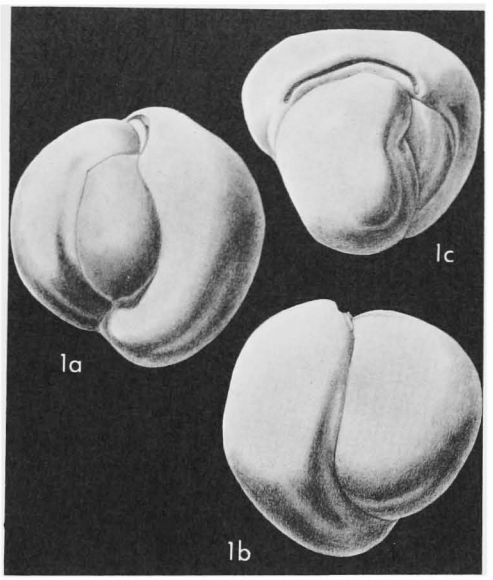


Fig. 344. Nubeculariidae (Spiroloculininae; *1, Planispirinoides*) (p. *C*453-*C*455).

complete volution around proloculus; aperture terminal, with simple linear tooth in earliest stages, later bifid and then with bifid tips elongating and fusing in ring, toothlike projections from ring then attaching first to opposite side of opening and then in various places, resulting in complex cribrate aperture. [Because of the early cyclogyrine coil, *Cribrolinoides* is here transferred from the Miliolidae to the Nubeculariidae, subfamily Spiroloculininae.] *Plio.-Rec.*, Indo-Pac.O. ——Fig. 343,*5-10*. **C. curta* (Cushman), Plio., Java; *5-8*, specimens showing changes in apert. development from 2-chambered stage with simple tooth to quinqueloculine stage developing apert. ring; *5a-d*, side and apert. views, long. and axial secs. of 2-chambered stage, ×15 (*510); *6,7*, intermediate stages showing aperture, ×15 (*510); *8a-c*, opposite sides and apert. view of adult specimen, ×15 (*2117); *9,10*, axial secs. of microspheric and megalospheric adults; all ×15 (*510).

Planispirinoides Parr, 1950, *1429, p. 287 [**Miliolina bucculenta* Brady, 1884, *200, p. 170; OD]. Test free, early stage planispirally coiled as in *Cyclogyra*, later chambers coiled in plane perpendicular to original plane of coiling and final chambers triloculine in same plane; wall calcareous, porcelaneous, imperforate; aperture an elongate slit, with a broad flaplike lip. [*Planispirinoides* differs from *Planispirina* in having the chambers of later stages coiled in a different plane and in development of a broad flaplike tooth. It differs from *Miliolinella* in possessing an early *Cyclogyra* stage.] *Rec.*, Atl.O.-Antarctic-Australia-

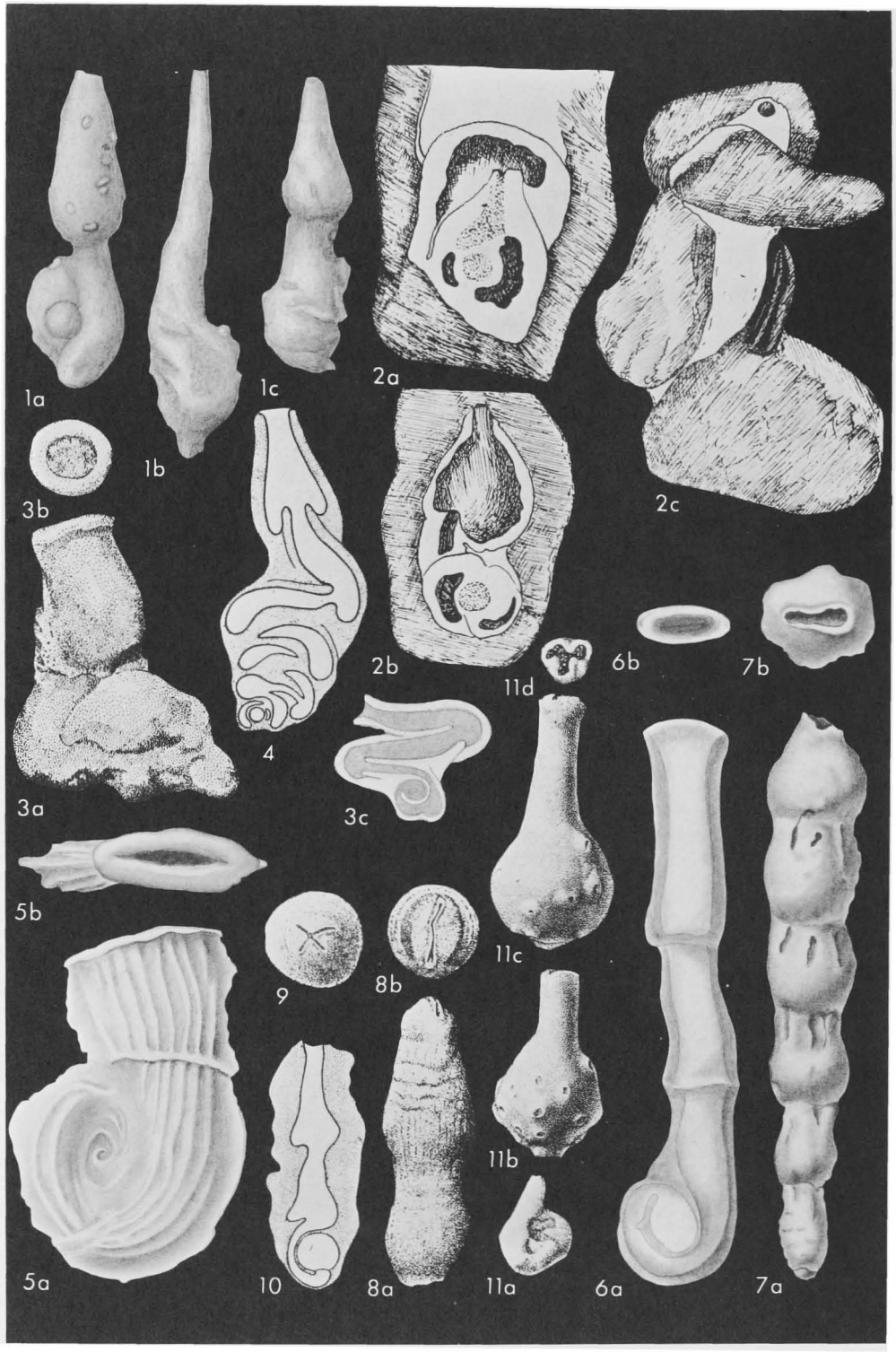


FIG. 345. Nubeculariidae (Nodobacilariinae; *1,2, Nodobacularia; 3,4, Meandroloculina; 5, Nodobaculariella; 6-11, Nodophthalmidium*) (p. C455-C456).

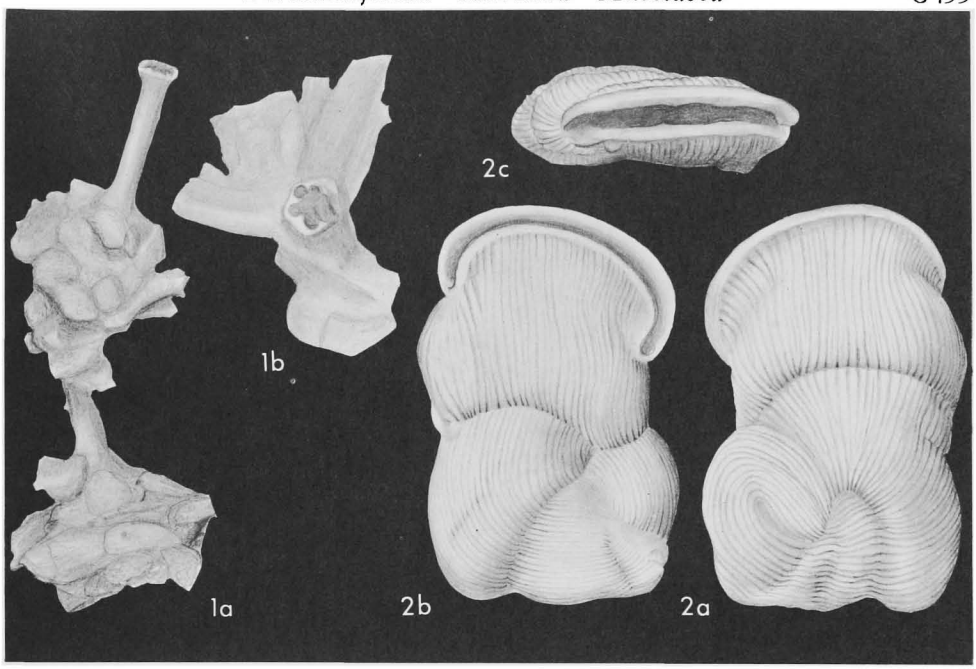


FIG. 346. Nubeculariidae (Nodobacullariinae; *1, Nubeculina; 2, Vertebralina*) (p. C456-C457).

Kerguelen Is.——FIG. 344,*1*. **P. bucculenta* (BRADY), Atl.; *1a-c,* opposite sides, top view, ×10 (*2117).

Subfamily NODOBACULARIINAE Cushman, 1927

[Nodobacullariinae CUSHMAN, 1927, p. 36] [=Nodophthalmidiinae CUSHMAN, 1940, p. 179]

Early portion planispiral, later chambers uncoiling. *Jur.-Rec.*

Nodobacularia RHUMBLER, 1895, *1568A, p. 87 [**Nubecularia tibia* JONES & PARKER, 1860, *999, p. 455; OD (M)] [=*Pseudonubeculina* BARTENSTEIN & BRAND, 1949, *94, p. 670 (type, *Nubecularia nodulosa* CHAPMAN, 1891, *308, p. 573); *Gymnesina* COLOM, 1959, *377, p. 16 (type, *G. glomerosa*)]. Test attached, consisting of globular proloculus surrounded by single coil of 2 or rarely 3 chambers which may not be discernible except in section, later portion uniserial, with chambers or chamber cavity pyriform in outline; wall calcareous and imperforate, and incorporating occasional sand grains; aperture at open tubular end of final chamber. *Jur.-Rec.,* cosmop.——FIG. 345,*1*. **N. tibia* (JONES & PARKER), L.Jur.(Lias.), Eng.; *1a,* lectotype (*999, fig. 51) showing early coil and pyriform later rectilinear chambers; *1b,c,* paratypes (*999, fig. 48, 49) showing generally obscure appearance of early coil, ×146 (*2117). ——FIG. 345,*2*. *N. glomerosa* (COLOM), Rec., Medit. Sea; *2a,* holotype showing early chamber arrangement, ×30; *2b,* paratype showing early development, ×30; *2c,* paratype showing coarsely agglutinated test, ×17 (*377).

[MACFADYEN (1939, *1199, p. 167) considered *Nubecularia tibia* as identical with *Bullopora rostrata* QUENSTEDT, basing his opinion on English Jurassic specimens, which he thought to be identical with QUENSTEDT's species. Topotypes of QUENSTEDT's species have perforate calcareous walls, however, and never include agglutinated material, and are thus generically distinct from the imperforate to agglutinated *Nodobacularia* with early coil and typically pyriform later uniserial chambers. *Pseudonubeculina* was described as completely uniserial, although no early stages were described, all tests being broken in the European Lower Cretaceous material studied. Early coiled stages were found in *Lagenammina pyriformis* TAPPAN, later transferred to *Nodophthalmidium*, from the Albian of Texas (*1154), a species which is probably conspecific with *Nubecularia nodulosa*. The thin connecting necks commonly result in broken tests. *Gymnesina glomerosa* differs from typical *Nodobacularia* only in coarseness of the agglutinated fragments and is therefore here regarded as congeneric. *Nodobacularia* differs from *Nubeculina* in lacking the phialine apertural lip and teeth, and from *Nodophthalmidium* in its simple aperture and agglutinated covering. The types of *Nubecularia tibia* JONES & PARKER are in the PARKER collection of the British Museum (Natural History). The lectotype, here designated (BMNH-P41672), and paratypes (BMNH-P41671) were isolated and mounted by us in 1953 from the original material of JONES & PARKER in the British Museum. Originally described as from the Triassic at Chellaston near Derby, this material was actually from the Lias of Leicestershire, England, according to the Catalogue of Foraminifera of the Parker Collection (Index to Boxes I-XLV, by T. RUPERT JONES). Three of the original specimens are here illustrated.]

Meandroloculina BOGDANOVICH, 1935, *151, p. 695 [**M. bogatschovi*; OD]. Proloculus followed by cyclogyrine second chamber, later chambers elongate and alternating in uncoiled zigzag, pseudobiserial manner, finally becoming rectilinear, with subpyriform chambers; wall calcareous, imperforate, thick; aperture terminal, rounded or irregular, with thick bordering lip. *Mio.(L.Sarmat.),* USSR (Trans. - Caucasus).—— FIG. 345,*3*. **M. bogatschovi*; *3a,b,* side, top views of holotype, ×33 (*152); *3c,* long. sec. showing early cham-

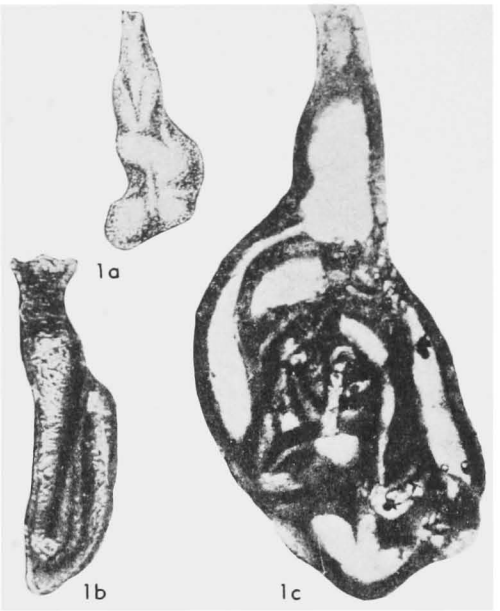


FIG. 347. Nubeculariidae (Nodobacullariinae; *1, Orthella*) (p. C456).

ber development, ×60 (*151).——FIG. 345,*4. M. litoralis* BOGDANOVICH; long. sec. showing early zigzag chambers and later tendency to become rectilinear, enlarged **(*152).**

Nodobacullariella CUSHMAN & HANZAWA, 1937, *505, p. 41 [**N. japonica*; OD]. Test similar to *Vertebralina,* but early coil completely planispiral and terminal aperture symmetrically placed. [The holotype was originally stated to be in the Institute of Geology and Paleontology, Tohoku Imperial University, Sendai, Japan, but the specimen figured as holotype (*505, pl. 5) is in the CUSHMAN collection, U.S. National Museum.] *Plio.-Pleist.,* Japan(Ryukyu Is.).——FIG. 345,*5. *N. japonica*; *5a,b,* side and apert. views of holotype, ×44 (*2117).

Nodophthalmidium MACFADYEN, 1939, *1199, p. 167 [**Nodobacularia compressa* RHUMBLER, 1906; *1571, p. 38; OD] [=*Sarmatiella* BOGDANOVICH, 1952, *152, p. 217 (type, *S. costata*); *Foraminella* BOGDANOVICH, 1960, *153, p. 19 (type, *F. obscura*) (*non Foraminella* SOWERBY, 1835; *nec* LEVINSEN, 1909]. Test free, proloculus rounded or ovate, followed by planispiral second chamber approximately half coil in length, adult chambers uniserial in development; wall calcareous, imperforate; aperture terminal, rounded or slitlike with lip, triradiate or cruciform. *Paleog.-Rec.,* Adriatic Sea-Medit. Sea-USSR.——FIG. 345,*6. *N. compressum* (RHUMBLER), Rec., Adriatic Sea; *6a,b,* side, top views of holotype, ×200 (*1571).——FIG. 345,*7. N. costatum* (BOGDANOVICH), Mio. (M.Sarmat.), USSR(Caucasus); *7a,* side view; *7b,* top view of different specimen; both ×70 (*152).——FIG. 345,*8-10. N. primum* (BOGDANOVICH), Mio.(M.Sarmat.), USSR(pre-Caucasus); ***8a,b, 9,*** side view and apert. views of 2 specimens, originally described as *Sarmatiella*, showing variation from slit to cruciform aperture, ×53; *10,* sec. showing early chamber arrangement, ×100 (*152).——FIG. 345,*11. N. obscurum* (BOGDANOVICH), Paleog., USSR(Kuban); *11a,* holotype showing early coil; *11b-d,* side and apert. views of final chamber of holotype showing parasitic borings, ×55 (*153).

[*Nodophthalmidium* differs from *Articulina* D'ORBIGNY in having a planispiral rather than milioline early stage. *Sarmatiella* differs only in surface ornamentation from the type of *Nodophthalmidium*, although in addition, some species of *Sarmatiella* develop a triradiate or cruciform aperture. *Foraminella* was described as having an early planispiral coil around the globular proloculus, followed by rectilinear chambers, the distinguishing character being the additional openings on the nipple-like protuberances occurring over the chambers and said to connect with the chamber interior by means of canals. As these openings seem obviously the result of a boring predator or parasite and are found in specimens of many species and genera, they are not considered a valid basis for generic separation, and the species *Foraminella obscura* is here placed in *Nodophthalmidium*. *Foraminella* is also a homonym of *Foraminella* SOWERBY, 1835, and of LEVINSEN, 1909.]

Nubeculina CUSHMAN, 1924, *418, p. 52 [**Sagrina divaricata* BRADY, 1879, *196b, p. 276; OD]. Test free, or possibly attached in early portion; second chamber coiling around globular proloculus, later chambers inflated and in rectilinear or slightly arcuate uniserial arrangement, may be separated by slender stolon-like necks; wall calcareous, imperforate, milky white, with much coarse agglutinated material on exterior of chambers; aperture terminal on tubular neck, with phialine lip and few inwardly directed teeth. *Rec.,* Pac.O.——FIG. 346,*1. *N. divaricata* (BRADY); *1a,* lectotype, showing agglutinated wall and stolon-like apert. necks, ×105; *1b,* top view of another specimen (broken chamber) showing apert. teeth, ×146 (*2117).

[*Nubeculina* differs from *Nodobacularia* in having an aperture with phialine lip and inwardly pointing teeth. The original syntypes of *Sagrina divaricata* BRADY are in the British Museum (Natural History), and a lectotype is here designated (BMNH-ZF3615, *ex* ZF2004, BRADY, 1884, *200, pl. 76, fig. 13) with paratypes (BMNH-ZF2004 and ZF2005), all from *Challenger* station 217A, Humboldt Bay, Papua, at 37 fathoms.]

Orthella E. V. BYKOVA in KIPARISOVA, *et al.,* 1956, *1040, p. 19 [**O. paalzowi*; OD]. Test with globular proloculus followed by streptospirally wound tubular chambers, coiling partially to entirely involute, whorl divisions obscure externally, final portion becoming uncoiled, with no distinct internal septa but chambers thickened basally and tapering distally into elongate necklike extension, thus separating chambers; wall calcareous, imperforate; aperture simple, rounded opening. *U. Jur.(U.Oxford.),* USSR.——FIG. 347,*1. *O. paalzowi*; *1a,b,* ext. views of paratypes, ×80, ×100; *1c,* long. sec. approx. ×200 (*1040).

Vertebralina D'ORBIGNY, 1826, *1391, p. 282 [**V. striata*; OD (M)]. Test free, flattened, early

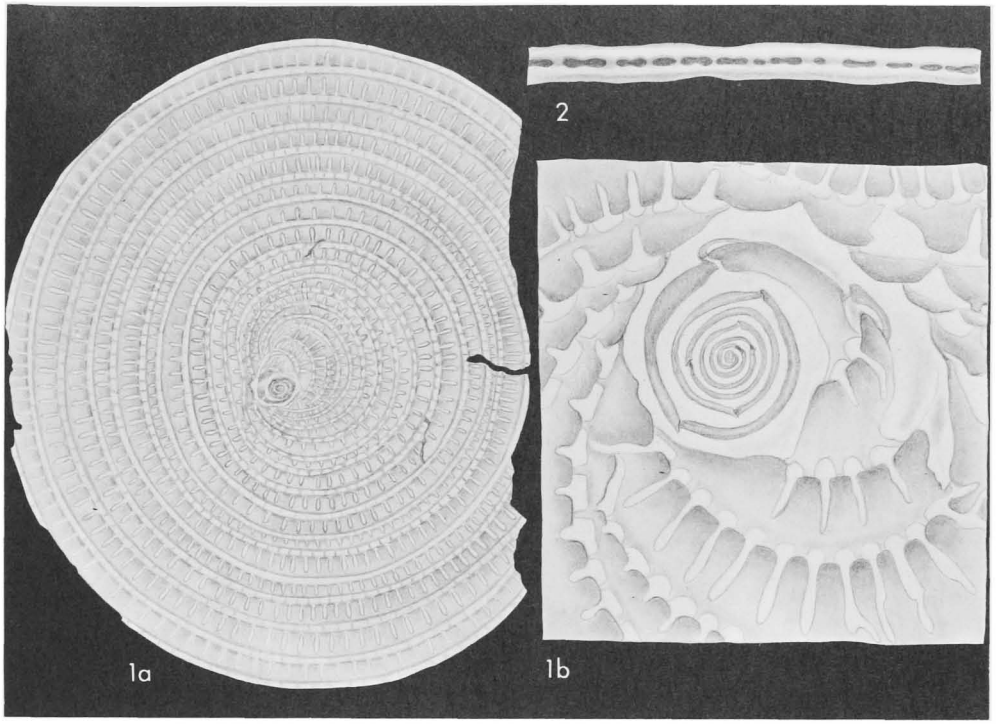


FIG. 348. Nubeculariidae (Discospirininae; *1,2, Discospirina*) (p. C457).

portion trochospiral, later uncoiling; wall calcareous, porcelaneous, surface may have longitudinal ribs or striae; aperture terminal, narrow, elongate slit with bordering lip, aperture most evident from umbilical side of coil. *Rec.*, Atl.O.-Pac.O.-Medit. Sea.——FIG. 346,2. **V. striata*, Delos Is., Grecian Arch.; *2a,b*, opposite sides showing trochospiral coil and aperture turned toward umbilical side; *2c*, top view showing simple slitlike aperture, ×64 (*2117).

Subfamily DISCOSPIRININAE Wiesner, 1931

[*nom. correct.* LOEBLICH & TAPPAN, 1961, p. 291 (*pro* subfamily Discospiriniinae WIESNER, 1931, p. 60, 73)] [=Krumbachininae WIESNER, 1920, p. 17]

Test discoidal, thin, proloculus followed by cornuspirine coil of several volutions, later chambers one-half coil in length and finally annular, may be incompletely divided into chamberlets; aperture comprising row of pores at margin of final chamber. *M.Mio.-Rec.*

Discospirina MUNIER-CHALMAS, 1902, *1328, p. 353 [**Orbitolites tenuissimus* CARPENTER in CARPENTER & JEFFREYS, 1870 (*279, p. 155, name and reference to description), CARPENTER in CARPENTER, JEFFREYS & THOMSON, 1870 (*280, p. 421, description only) =*Pavonina italica* COSTA, 1856 (*392, p. 178); OD] [=*Cyclophthalmidium* LISTER in LANKESTER, 1903 (*1094, p. 108) (obj.); *Krumbachina* WIESNER, 1920 (*2061, p. 14) (obj.); *Discospirinia* CUSHMAN, 1927 (*431, p. 37) (*nom. null.*)]. Test free, discoidal; globular proloculus followed by undivided coil of about 1.5 whorls and series of elongate tubular chambers, which at first comprise nearly complete coil in length, becoming progressively shorter to about one-half coil in length, this early nucleoconch projecting somewhat above general surface, chambers then abruptly becoming higher, flaring and flabelliform, and subdivided by few vertical partitions, at first only 3 or 4 partitions, which arise from basal wall, then chambers becoming more enveloping and finally annular, with increasingly numerous partitions that extend only partially toward chamber roof, leaving continuous open area just below roof for chamberlet intercommunication, chamberlets also connected with previous annular chambers and with exterior by slitlike apertural pores; sutures nearly flush to slightly limbate, best visible when specimen is dampened; wall calcareous, imperforate; aperture single row of slits around entire periphery. *M.Mio.-Rec.*, Eu.-Medit. Sea(Cyprus)-Atl.O.——FIG. 348,*1,2*. **D. italica* (COSTA), Rec., Atl.; *1a*, sectioned specimen showing chamber development, ×11; *1b*, central portion, ×58; *2*, edge view of portion of hypotype showing apertures, ×44 (*2117).

[*Discospirina* is similar to *Cornuspiroides* in its early cyclogyrine portion and later flabelliform development but differs in being chambered, in having secondary septa, and in its multiple aperture of peripheral slits, *Cornuspiroides* being nonseptate in the flabelliform stage and having a single elongate, terminal slitlike aperture.]

Family MILIOLIDAE Ehrenberg, 1839

[*nom. correct.* D'ORBIGNY in DE LA SAGRA, 1839, p. xxxix, 160 (*pro* family Miliolina EHRENBERG, 1839, table opp. p. 120)]——[All names referred to are of family rank; dagger (†) indicates *partim*]——[=Polythalama† LATREILLE, 1825, p. 161; *(nom. nud.)*; =Agathistègues D'ORBIGNY, 1826, p. 297 *(nom. nud.; nom. neg.)*; =Enthomostègues† D'ORBIGNY, 1826, p. 304 *(nom. nud.; nom. neg.)*; =Plicatilia EHRENBERG, 1839, table opp. p. 120 *(nom. nud.)*; =Fabularina EHRENBERG, 1839, table opp. p. 120; =Helicosorina† EHRENBERG, 1839, table opp. p. 120; =Multiloculidae D'ORBIGNY in DE LA SAGRA, 1839, p. xxxix, 169 *(nom. nud.)*; =Rhizopodes† DUJARDIN, 1841, p. 126, 240 *(nom. neg.; nom. nud.)*; =Tubularina AGASSIZ, 1844, p. 10 *(nom. nud.)*; =Nautiloidat SCHULTZE, 1854, p. 53 *(nom. nud.)*; =Multiloculidaeen ABICH, 1859, p. 106 *(nom. neg.)*; =Multoloculidaeen ABICH, 1859, p. 105 *(nom. null.)*]——[=Spherulaceat, Sphérulacés† DE BLAINVILLE, 1825, p. 369; =Sphaerulata† CROUCH, 1827, p. 40 *(nom. nud.)*; =Spherulidae† BRODERIP, 1839, p. 321 *(nom. nud.)*]——[=Miliolida SCHULTZE, 1854, p. 52; =Miliolitidae PARKER, 1858, p. 53; =Miliolidea REUSS, 1862, p. 374; Miliolidee SCHWAGER, 1876, p. 476, 483; =Miliolidina BÜTSCHLI in BRONN, 1880, p. 189; =Miliolletta HAECKEL, 1894, p. 164; =Miliolinidae RHUMBLER, 1895, p. 86; =Miliolinae DELAGE & HÉROUARD, 1896, p. 122; =Armiliolidia RHUMBLER, 1913, p. 341 *(nom. van.)*]——[=Hauerinidee SCHWAGER, 1876, p. 483; =Hauerinidae STEINMANN, 1881, p. 41; =Hauerinina LANKESTER, 1885, p. 846; =Hauerinae DELAGE & HÉROUARD, 1896, p. 124]

Test free, septate, typically with 2 chambers to whorl arranged in varying planes about longitudinal axis, may become rectilinear or involute, or may be subdivided into chamberlets; aperture terminal, simple, or with spatulate or bifid tooth, or cribrate. *Jur.-Rec.*

Subfamily QUINQUELOCULININAE Cushman, 1917

[Quinqueloculininae CUSHMAN, 1917, p. 41]——[All names cited of subfamily rank]——[=Miliolidea genuina REUSS, 1862, p. 374 *(nom. nud.)*; =Miliolidae opisthostreptae EIMER & FICKERT, 1899, p. 687 *(nom. nud.)*; =Massilininées LACROIX, p. 1 *(nom. neg.)*; =Massillininae THALMANN, 1941, p. 682; =Sigmoilopsinae VELLA, 1957, p. 18]

Wall simple; aperture with bifid tooth or modification of such. *Jur.-Rec.*

Quinqueloculina D'ORBIGNY, 1826, *1391, p. 301 [*nom. conserv.* proposed LOEBLICH & TAPPAN, 1962, *1184, p. 123 (ICZN pend.)] [**Serpula seminulum* LINNÉ, 1758, *1140, p. 786; SD PARKER & JONES, 1859, *1417a, p. 480] [=*Retorta* WALKER & BOYS, 1784, *2033, p. 3 *(nom. reject.* ICZN Op. 558); *Frumentarium* FICHTEL & MOLL, 1798, *716, p. 16 (obj.) *(nom. reject.,* proposed LOEBLICH & TAPPAN, 1962, *1184, p. 123, ICZN pend.); *Pollontes* DE MONTFORT, 1808, *1305, p. 247 (type, *P. vesicularis*) *(nom. reject.,* proposed LOEBLICH & TAPPAN, 1962, *1184, p. 123, ICZN pend.); *Adelosina* D'ORBIGNY, 1826, *1391, p. 303 (type, *A. laevigata, non Quinqueloculina laevigata* D'ORBIGNY, 1826, =*Q. longirostra* D'ORBIGNY, 1826, *1391, p. 303); *Uniloculina* D'ORBIGNY in DE LA SAGRA, 1839, *1611, p. 161 (type, *U. indica*); *Multiloculina* ABICH, 1859, *1, p. 105, 150 (type, *Serpula seminulum* LINNÉ, SD LOEBLICH & TAPPAN, herein); *Pollonites* BRADY, 1884, *200, p. 156 (*nom. van. pro Pollontes* DE MONTFORT, 1808); *Quinqueloculina (Lachlanella)* VELLA, 1957, *2001, p. 24 (type, *Q. (L.) cooki*)]. Test coiled, with chambers one-half coil in length and alternating regularly in 5 planes of coiling 72° apart, but with successive chambers in planes 144° apart, so that 3 chambers are visible from exterior on one side of test and 4 visible from opposite side; wall calcareous, porcelaneous, imperforate, with inner pseudochitinous layer, rarely with some agglutinated grains added to exterior; aperture terminal, rounded, with simple or bifid tooth. *Jur.-Rec.,* cosmop.——FIG. 349,*1*. **Q. seminulum* (LINNÉ), Rec., shore sands at Rimini, Italy; *1a-c,* opposite sides and apert. views of neotype (USNM), ×35 (*2117).——FIG. 349,*2,3*. *Q. longirostra* D'ORBIGNY, Plio., Italy; *2a-c,* opposite sides and top view of lectotype (MNHN) of *Adelosina laevigata* D'ORBIGNY; *3,* paratype consisting of proloculus only of *A. laevigata,* ×36 (*2117).——FIG. 349,*4*. *Q. cooki* VELLA, Rec., N.Z.; *4a-c,* opposite sides and apert. view of holotype, ×30 (*2001).

[A proposal was submitted to ICZN by LOEBLICH & TAPPAN (1962, *1184) to suppress the generic names *Frumentarium* FICHTEL & MOLL, 1798, and *Pollontes* DE MONTFORT, 1808, which would otherwise have priority over the more widely used *Quinqueloculina*. Because of the wide variety of forms included in *Q. seminulum* by various authors, the inadequate original description and figures, and loss of the original type, a neotype was designated from the original type locality and is here figured. The young megalospheric forms of *Quinqueloculina* were given the generic name *Adelosina* by D'ORBIGNY, 1826. The original types of *A. laevigata* D'ORBIGNY are in the Museum National d'Histoire Naturelle, Paris. A lectotype is here designated (*1395, pl. 20, figs. 22-24) and redrawn. The original figures show a distinct apertural tooth, but this was apparently broken away since the time of the original description; the tooth does not appear in the present figures. The 2-chambered lectotype and figured paratype, consisting of proloculus only, are from the Pliocene (Piacenzan) at Castell'Arquato, Italy. *A. laevigata* is the megalospheric generation of *Q. longirostra* D'ORBIGNY, 1826, also described from Castell'Arquato. *Lachlanella* was proposed as a subgenus of *Quinqueloculina* for species with subquadrate chambers, and a high, narrow aperture with elongate, narrow tooth. As these distinctions consist solely of relative dimensions, *Lachlanella* is here regarded as synonymous with *Quinqueloculina*.]

Cruciloculina D'ORBIGNY IN DE LA SAGRA, 1839, *1611, p. 182 [**C. triangularis* D'ORBIGNY, 1839, *1393, p. 72; SD (SM) D'ORBIGNY, 1839, *1393, p. 72]. Test free, chambers one-half coil in length, with longitudinal planes of successive chambers added 120° apart as in *Triloculina,* test rounded to triangular in section; sutures distinct, depressed; wall calcareous, imperforate, smooth or faintly striate; aperture complex, varying in shape from triradiate in young to cruciform or dendritic in adult, bordered by narrow lip, but without distinct tooth. [Differs from *Triloculina* in lacking the distinct tooth and developing a cruciform or dendritic aperture in the adult.] *Plio.-Rec.,* N.Atl.-S.Atl.O.-Japan.——FIG. 349,*5,6*. **C. triangularis,* Rec., Falk Is. *(5),* S. Georgia Is. *(6); 5a,b,* side, top views of lectotype, ×26 (*1173); *6a-c,* opposite sides and top view of another specimen, ×20 (*1173).

Dentostomina CARMAN, 1933, *270, p. 31 [**D. bermudiana*; OD]. Test free, quinqueloculine in

plan; wall with imperforate calcareous porcelaneous inner layer, external agglutinated layer of grains embedded in calcareous cement; aperture terminal, circular, with crenulate margin and bifid tooth. *Rec.*, N.Atl.O.(Bermuda Is.)-W. Indies(Cuba).——Fig. 350,*1*. **D. bermudiana*,

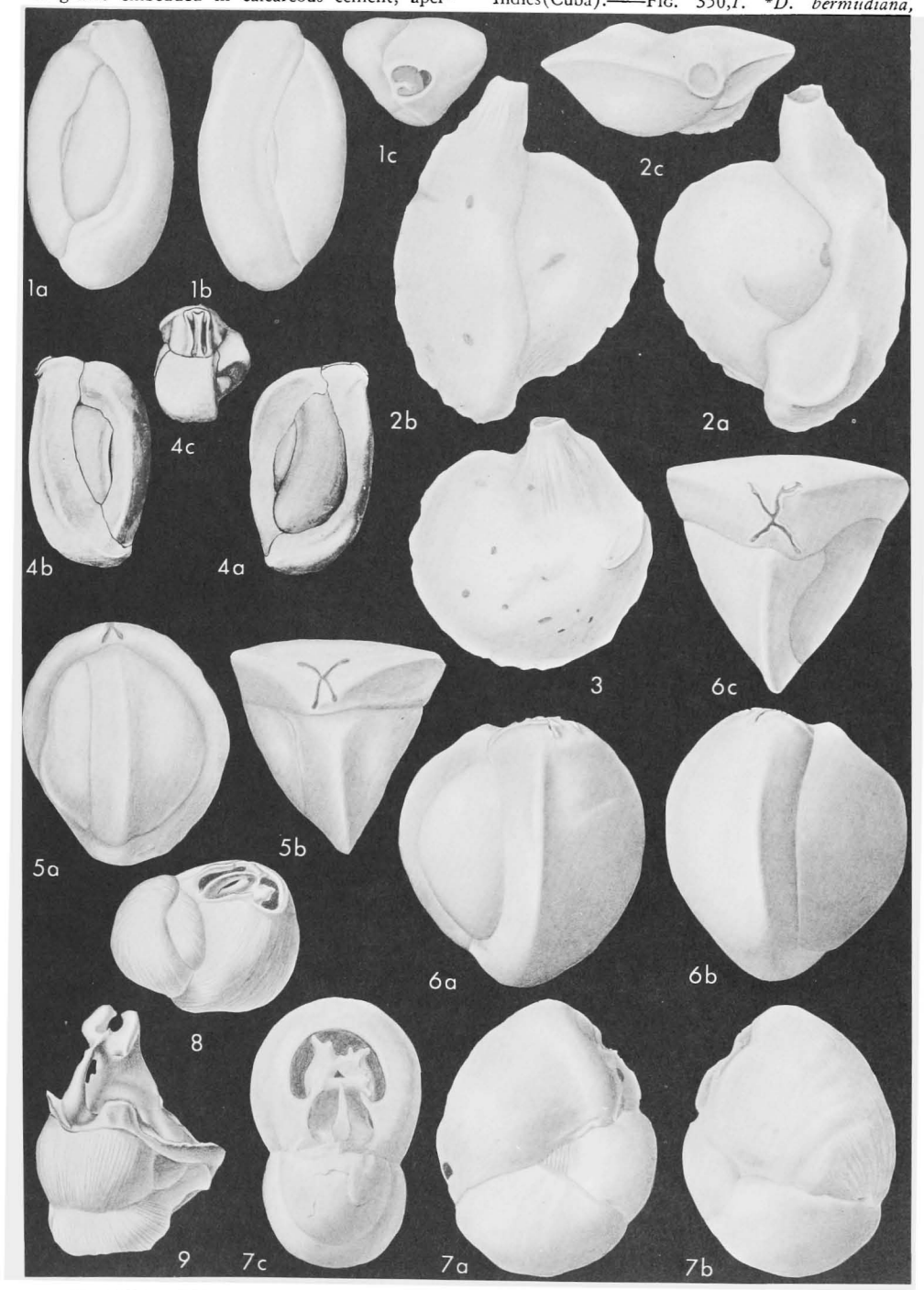


Fig. 349. Miliolidae (Quinqueloculininae; *1-4, Quinqueloculina; 5,6, Cruciloculina; 7-9, Flintina*) (p. C458, C461-C462).

off Bermuda; *1a-c*, opposite sides and top views of holotype, ×20 (*2117).

[Differs from *Quinqueloculina* in having a denticulate or crenulate apertural border and in its external agglutinated layer of the wall, which is less common in *Quinqueloculina*. In the original figures (*270, pl. 3, fig. 6c) the apertural view is shown as a mirror image of the true appearance,

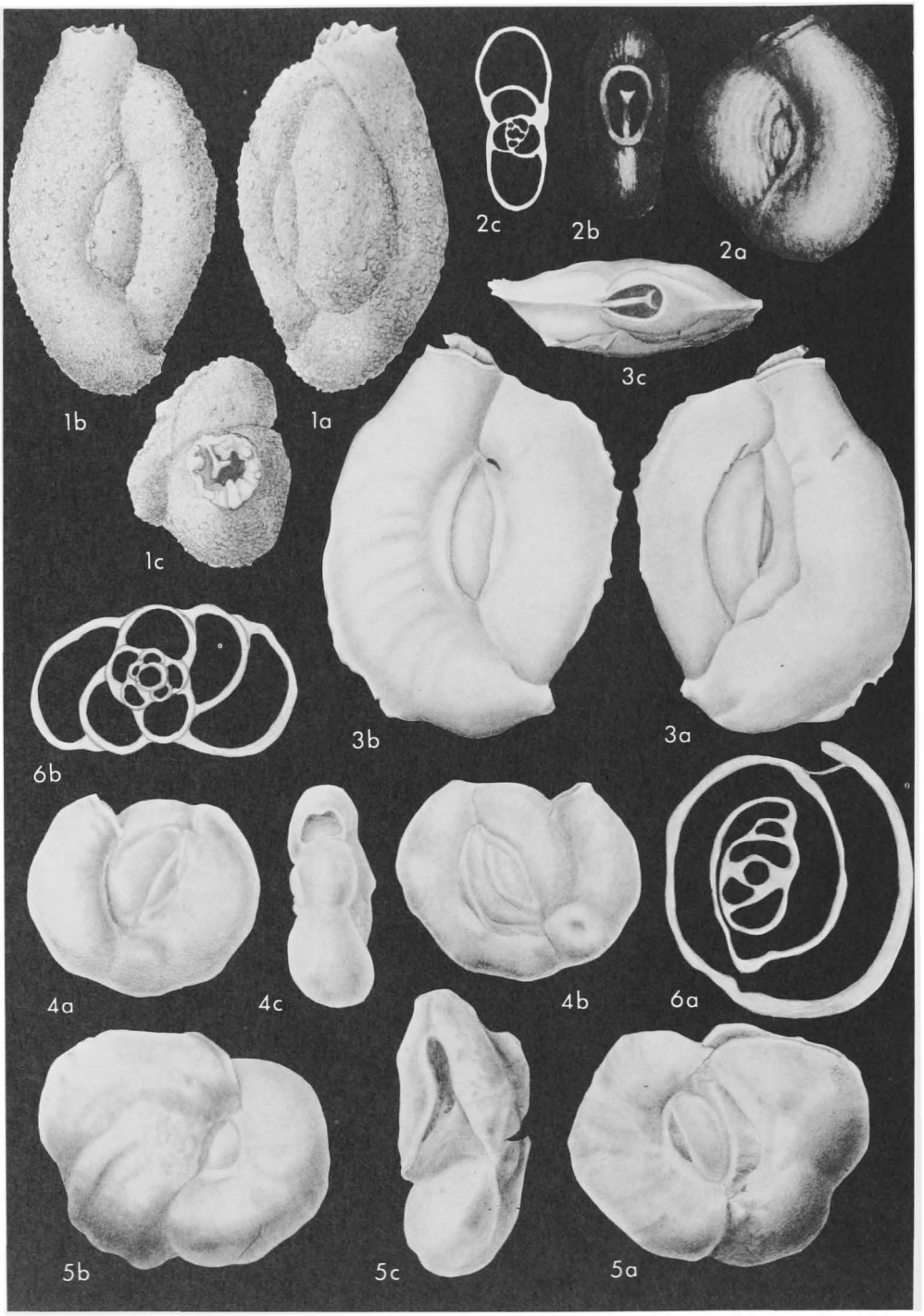


FIG. 350. Miliolidae (Quinqueloculininae; *1, Dentostomina; 2,3, Massilina; 4-6, Pateoris*) (p. C458-C462).

as can be seen by comparing figures 6b and 6c, for the final chamber (and aperture) of the holotype is at the right when viewed from the side where 4 chambers are visible. Therefore, in apertural view, the final chamber is at the left when the flatter side is at the bottom of the illustration.]

Flintina Cushman, 1921, *415, p. 465 [**F. bradyana*=*Miliolina fichteliana* Brady, 1884, *200, p. 169 (*non* d'Orbigny, 1839); OD]. Test free, ovate to rounded in outline, early portion with 2

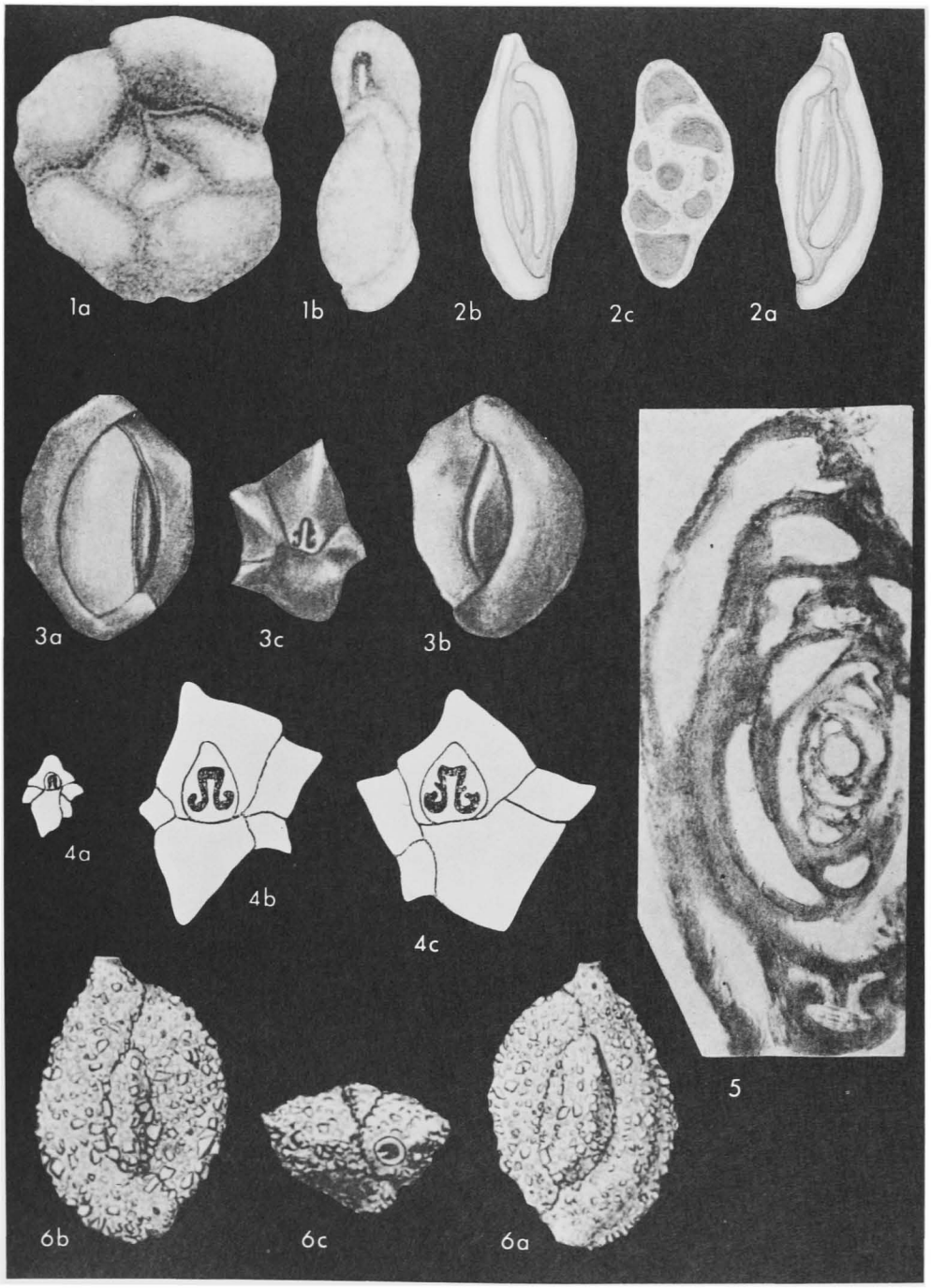


Fig. 351. Miliolidae (Quinqueloculininae; *1, Flintinella; 2, Palaeomiliolina; 3-5, Podolia; 6, Siphonaperta*) (p. C462, C466).

chambers to whorl in triloculine arrangement, later increasing to 3 in each whorl and tending to become planispiral, as in *Hauerina*; wall calcareous, imperforate, porcelaneous; aperture large, high, ovate opening partially filled by bifid tooth in young stage, later becoming keyhole-shaped, somewhat narrower against earlier chambers and expanding abruptly about one-third of distance up face, outer margin of aperture at this point acutely angled and acuminate, tooth in adult of type-species becoming very complex, 2 modified branches of early bifid tooth being much enlarged, many-pronged, curving up and around to rejoin above, with arched plate extending back within chamber from beginning of bifurcation to attach to interior of chamber, lower portion of tooth remaining bladelike at surface in lower portion of opening, but also expanding basally within final chamber to form broad, triangular attachment occupying almost one-third of chamber, only central area of this tooth being free. *Rec.*, Pac.O.——FIG. 349,*7-9*. **F. bradyana*, Philip. (Cebu Is.); *7a-c*, opposite sides and apert. view of holotype, ×15; *8*, oblique apert. view showing arched plate connecting bifid tooth to test wall; *9*, partially dissected specimen, outer wall of final chamber removed to show complex apert. tooth within, ×16 (*2117).

[Differs from *Triloculina* in its later subplanispiral development with three chambers per whorl, and in the more complex aperture and apertural tooth. It resembles *Hauerina* in the early milioline stage and later planispiral development but differs in being more involute and in having an open aperture and complex tooth, whereas *Hauerina* has a trematophore or sieve plate completely filling the apertural region. *Involvohauerina* differs in having a multiple cribrate aperture rather than an open aperture and complex tooth.]

Flintinella DIDKOVSKIY, 1960, *595, p. 1433 [**F. volhynica*; OD]. Test free, compressed, early stage similar to *Quinqueloculina*, with 2 chambers to whorl, later increasing to 3, resembling *Wellmanella* and *Pateoris*, with up to 6 chambers in final whorl, coiling partially involute, up to 5 whorls may be present, periphery rounded; sutures depressed, curved, nearly radial; wall calcareous, porcelaneous, smooth; aperture elongate opening at open end of final chamber, with lateral margins somewhat thickened and infolded, elongate, simple tooth occupying more than 0.75 length of apertural opening. [*Flintinella* differs from *Pateoris* in having an elongate simple apertural tooth.] *Mio.(M.Sarmat.)*, USSR(Ukraine).——FIG. 351,*1*. **F. volhynica*; *1a,b*, side, edge views of holotype, ×40 (*595).

Massilina SCHLUMBERGER, 1893, *1655, p. 76 [**Quinqueloculina secans* D'ORBIGNY, 1826, *1391, p. 303; SD CUSHMAN, 1917, *404f, p. 56] [=*Proemassilina* LACROIX, 1938, *1079, p. 3 (type, *Massilina rugosa* SIDEBOTTOM, 1904, *1738, p. 18)]. Test free, ovate in outline, somewhat flattened, proloculus followed by chambers one-half coil in length, early ones in quinqueloculine arrangement, later chambers added in single plane, on alternate sides, as in *Spiroloculina*; wall calcareous, porcelaneous, imperforate; aperture at open end of final chamber, with bifid tooth. *L. Cret.-Rec.*, cosmop.——FIG. 350,*2*. *M. rugosa* SIDEBOTTOM, Rec., Delos Is.; *2a,b*, side, apert. views of holotype; *2c*, sec. showing chamber arrangement, ×33 (*1738).——FIG. 350,*3*. **M. secans* (D'ORBIGNY), Rec., Greece(Delos Is.); *3a-c*, opposite sides, apert. views, ×24 (*2117).

Palaeomiliolina LOEBLICH & TAPPAN, n. gen. (Proposed by BOGDANOVICH, 1952 (*152, p. 41, 77, 86) without description or citation of included species and described by ANTONOVA, 1958 (*23, p. 915) with 3 included species, but without citation of type-species, hence a *nomen nudum* requiring type designation for validation.) [**Spirophthalmidium occultum* ANTONOVA, 1958, *24, p. 52; designated herein] [=*Palaeomiliolina* BOGDANOVICH, 1952, *152, p. 41, 77, 86 *(nom. nud)*; *Palaeomiliolina* ANTONOVA, 1958, *23, p. 915 *(nom. nud.)*]. Test similar to *Massilina*, but aperture lacking apertural tooth. *Jur. (Bajoc.-Oxford.)*, Eu.——FIG. 351,*2*. **P. occulta* (ANTONOVA), Bajoc., USSR(C.Caucasus); *2a,b*, opposite sides, ×160; *2c*, transv. sec., ×320 (*24).

Pateoris LOEBLICH & TAPPAN, 1953, *1162, p. 42 [**Quinqueloculina subrotunda* (MONTAGU) forma *hauerinoides* RHUMBLER, 1936, *1575, p. 206, 217, 226; OD]. Test quinqueloculine in early stage, with chambers one-half coil in length, later planispiral, with gradually shortened chambers so that slightly more than 2 chambers to coil may occur; wall porcelaneous; aperture at open end of chamber, varying from low arch to high, narrow slit with lateral margins somewhat infolded. *Rec.*, N.Sea-Pac.O.(Alaska).——FIG. 350, *4-6*. **P. hauerinoides* (RHUMBLER), Rec., Alaska; *4a-c, 5a-c*, opposite sides and edge views of hypotypes showing variation in chamber length and height of aperture, ×44; *6a,b*, long. and axial secs. showing early quinqueloculine development and later planispiral stage, ×66 (*1162).

[*Pateoris* differs from *Pseudomassilina* in its smooth, rather than punctate or canaliculate, wall. It is very similar to *Wellmanella* in the adult stage but quinqueloculine in the early stage, whereas *Wellmanella* was described as triloculine in the early stage without a quinqueloculine stage. No sections have been published for *Wellmanella*, and if a restudy of the type-species of *Wellmanella* shows a quinqueloculine stage to be present, *Pateoris* would become a junior synonym.]

Podolia SEROVA, 1961, *1720, p. 56 [**Hauerina lyra* SEROVA, 1955, *1719, p. 329 (=*Hauerina lyra* SEROVA, 1953, *1718, p. 63 *(nom. nud.)*; OD]. Test similar to *Quinqueloculina* in form and chamber arrangement, aperture lyre-shaped, wtih narrow, straight normal tooth and 2 lateral supplementary teeth projecting into opening. *Mio.(U.Torton.)*, USSR(Ukraine).——FIG. 351,*3-5*. **P. lyra* (SEROVA); *3a-c*, opposite sides and apert. view of holotype, ×40; *4a-c*, outline views of ontogenetic stages, showing development of complex aperture in adult (*1720); *5*, long. sec., ×250 (*1721).

Pseudomassilina LACROIX, 1938, *1079, p. 3 [**Massilina australis* CUSHMAN, 1932, *455, p. 32; OD]. Test broad and compressed, early chambers quinqueloculine, with 2 chambers to whorl, later planispiral, as in *Pateoris*, with gradually shortening chambers; wall porcelaneous, with interior network of fine canals opening into tiny pores in small pits at surface, but not opening into cham-

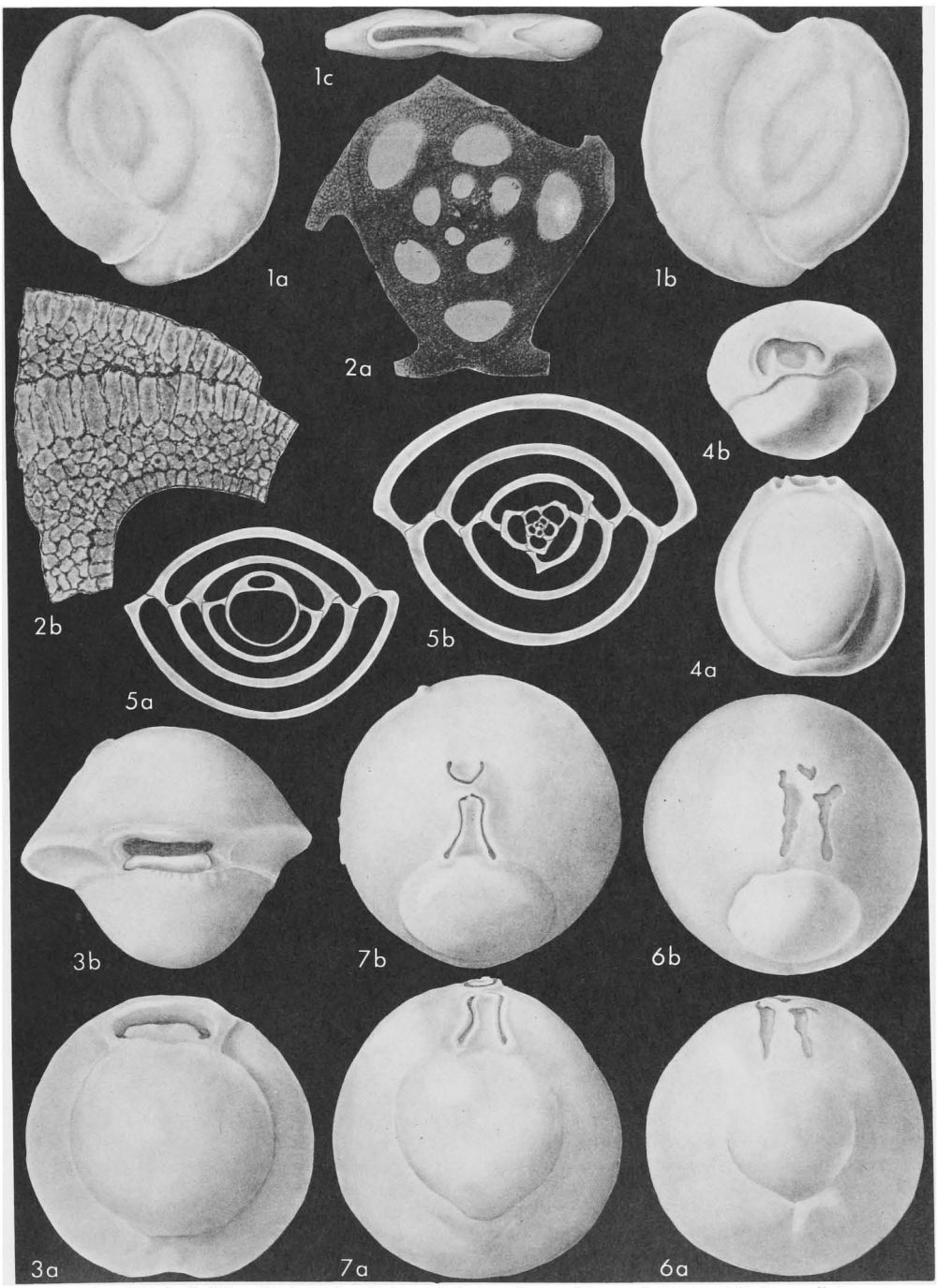


FIG. 352. Miliolidae (Quinqueloculininae; *1,2, Pseudomassilina; 3-5, Pyrgo; 6,7, Pyrgoella*) (p. C463-C465).

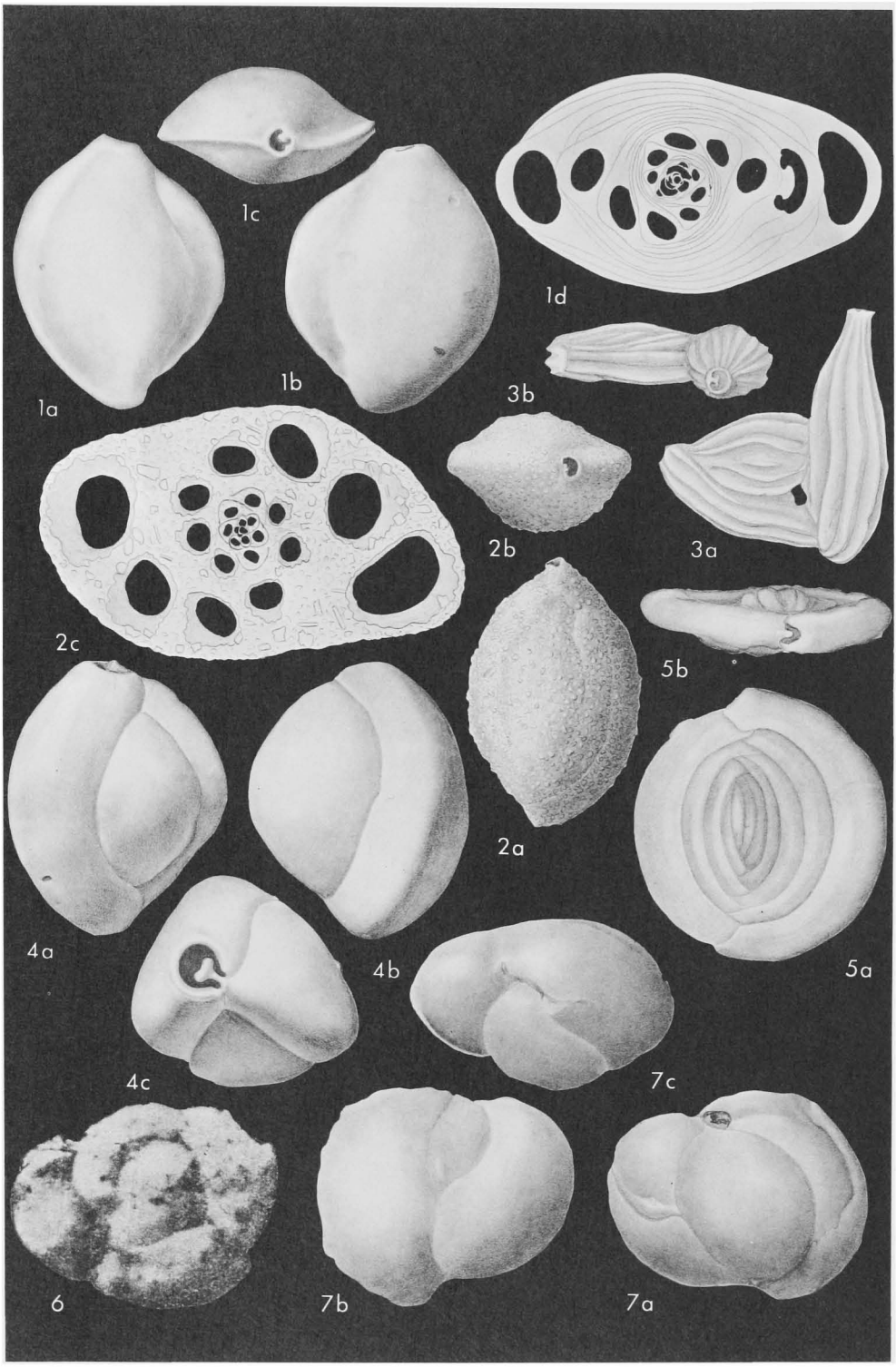


FIG. 353. Miliolidae (Quinqueloculininae; *1, Sigmoilina; 2, Sigmoilopsis; 3, Ptychomiliola; 4, Triloculina; 5, Spirosigmoilina; 6,7, Wellmanella*) (p. C465-C466).

ber cavity, being separated from it by imperforate pseudochitinous layer; aperture high slit with bordering lip, similar to that of *Pateoris*, without tooth. [Differs from *Pateoris* in its characteristic wall texture.] *Rec.*, Australia-Asia(Indochina)-Pac.O.-Red Sea(Gulf Aqaba)-E.Afr.(Kerimba Arch.).——Fig. 352,*1,2*. **P. australis* (Cushman), Rec., Cook Is.; *1a-c*, opposite sides and apert. views of holotype, ×50 (*2117); *2a*, enlarged photograph of central portion of axial sec. showing wall structure; *2b*, portion of wall enlarged, diagram showing crystalline pseudofibrous outer layer with vertical canals and inner layer with irregularly granular appearance (*1078).

Ptychomiliola Eimer & Fickert, 1899, *692, p. 687 [**Miliolina separans* Brady, 1881, *196c, p. 45; SD Cushman, 1928, *439, p. 154]. Test free, early chambers milioline in arrangement, later ones planispiral and evolute, about 3 to whorl, some rare specimens uniserial; wall calcareous, porcelaneous, imperforate, may be longitudinally costate; aperture terminal, rounded, produced on neck, with lip and distinct bifid tooth. [Differs from *Hauerina* in being more evolute, and in having apertural tooth instead of apertural pore plate or trematophore.] *Rec.*, S.Pac.O.——Fig. 353,*3*. **P. separans* (Brady), lectotype (here designated, BMNH-ZF 1902) from Storm Bay, Tasm.; *3a,b*, side, apert. views, ×16 (*2117).

Pyrgo Defrance, 1824, *597e, p. 273 [**P. laevis*; OD (M)] [=*Biloculina* d'Orbigny, 1826, *1391, p. 297 (type, *B. bulloides*); *Praelacazina* Hofker, 1959, *952, p. 372 (type, *Biloculina fragilis* Hofker, 1927, *927, p. 173)]. Test free, inflated, discoidal to ovate, proloculus followed by chambers one-half coil in length; in microspheric form early chambers arranged in quinqueloculine pattern, later triloculine, and finally biloculine; megalospheric forms may be biloculine throughout development, with successive discoidal to hemispherical chambers opposing each other; wall calcareous, imperforate, porcelaneous; aperture terminal, near junction of 2 last chambers, rounded to elongate, with distinct and commonly bifid tooth. [*Pyrgo* differs from *Biloculinella* in having a bifid tooth instead of a broad apertural flap nearly filling the aperture. No locality or horizon was given in the original description of *Pyrgo laevis*.] *Jur.-Rec.*, cosmop.——Fig. 352,*3*. **P. laevis*, Plio.(Piacenz.), Eu.(Italy); *3a,b*, side and apert. views showing relatively broad tooth of this species, ×38 (*2117).——Fig. 352,*4*. *P. williamsoni* (Silvestri), Rec., N.Am.(Alaska); *4a,b*, side and apert. views of species with distinctly bifid tooth, ×33 (*1162).——Fig. 352,*5*. *P. sarsi* (Schlumberger), Rec., Eu.(N.Sea); *5a,b*, secs. of megalospheric and microspheric forms showing chamber arrangement, ×20 (*1654).

Pyrgoella Cushman & E. M. White, 1936, *540, p. 90 [**Biloculina sphaera* d'Orbigny, 1839, *1393, p. 66; OD]. Test free, subglobular, with strongly overlapping chambers in biloculine arrangement, as in *Pyrgo*; wall calcareous, imperforate, porcelaneous; aperture in young with large triangular tooth, in adult V-shaped opening may be divided into 2 elongate openings with original tooth attached at both ends, with one or more supplementary sinuate, straight, or chevron-shaped openings also present. [*Pyrgoella* resembles *Pyrgo* and *Biloculinella* in chamber development but differs in having a more complex aperture, like that of *Cruciloculina*. *Cribropyrgo* is like the present genus, but has a regularly cribrate aperture with numerous small openings in place of the cruciform or chevron-like openings of *Pyrgoella*.] *Pleist.-Rec.*, S.Atl.O.-USA (Calif.)-Gulf Mex.——Fig. 352,*6,7*. **P. sphaera* (d'Orbigny), Pleist., USA(Calif.)*(6)*, Rec., Gulf Mex. *(7)*; *6a,b*, side and apert. views, ×48; *7a,b*, side and apert. views of hypotype, ×48 (*2117).

Fig. 354. Miliolidae (Quinqueloculininae; *Triloculina*) (p. *C*466).

Sigmoilina Schlumberger, 1887, *1651, p. 118 [**Planispirina sigmoidea* Brady, 1884, *200, p. 197; SD Cushman, 1917, *404f, p. 60]. Test free, ovate in outline, in microspheric generation with earliest chambers opposite, then with plane of chamber addition changing so that it forms sigmoid curve, successive chambers at first in planes about 120° apart but angle gradually enlarging to 180° in adult stage, chambers with broad lateral extensions which obscure all preceding chambers except penultimate one, giving external biloculine appearance; wall calcareous, thick, imperforate, porcelaneous; aperture terminal, rounded, with tooth. [Differs from *Pyrgo* in having a gradual change from a pseudoquinqueloculine stage to one with chambers added 180° apart, so that the changing plane of coiling forms a sigmoid curve.] *M.Eoc.-Rec.*, cosmop. ——Fig. 353,*1*. **S. sigmoidea* (Brady), Rec., Carib.; *1a-c*, opposite sides and top view of hypo-

type, ×46 (*2117); *1d,* sec. showing chamber arrangement, ×55 (*1651).

Sigmoilopsis FINLAY, 1947, *717e, p. 270 [**Sigmoilina schlumbergeri* SILVESTRI, 1904, *1760, p. 267; OD]. Test free, ovate, with chambers one-half coil in length, at first quinqueloculine in arrangement, then with increasing angle between planes of coiling of successive chambers, so that chambers are nearly opposing, but changing plane of coils results in early sigmoid curve, extremities of curve spiraling outward, much as in *Sigmoilina*; wall agglutinated with calcareous cement enclosing sand, calcareous shell fragments and sponge spicules; aperture terminal, rounded, with small tooth. *Mio.-Rec.,* Eu.-Atl.O.-Carib.-Australia-N.Z.——FIG. 353,*2*. **S. schlumbergeri* (SILVESTRI), Rec., Atl.; *2a,b,* side and apert. views of hypotype showing small bifid tooth, ×48 (*2117); *2c,* horiz. sec. showing chamber arrangement, originally referred to *Sigmoilina celata* (COSTA), ×42 (*1651).

[Differs from *Sigmoilina* in having an agglutinated wall and less enveloping chambers so that more than the final pair are visible externally and the interior does not have the laminated appearance of *Sigmoilina*. Originally it was described (*717e, p. 270) as differing further in its possession of an apertural tooth, but one is also here shown to be present in *Sigmoilina*. THALMANN (1961, *1905, p. 321) cited the reference to *Sigmoilina schlumbergeri* SILVESTRI, 1904, and commented "Probably a nomen nudum." *Sigmoilina schlumbergeri* SILVESTRI, 1904, was defined as a *nom. nov.*, but actually was a new species including *Miliolina celata* (COSTA) of BRADY in TIZARD & MURRAY, 1882, and *Planispirina celata* of BRADY, 1884, SILVESTRI, 1893, and FLINT, 1899, and *Sigmoilina (Planispirina) celata* SCHLUMBERGER, 1887 (*non Spiroloculina celata* COSTA, 1856). Although no illustrations were published by SILVESTRI (1904) for this new species, a description was given and a reference was made to illustrations by BRADY, 1884, FLINT, 1899, and SCHLUMBERGER, 1887 (including that here refigured). Hence, this is a valid species and not a *nomen nudum*. No type-specimen was selected for the present species, although FINLAY, 1947, defined *Sigmoilopsis* for *S. schlumbergeri* as interpreted and figured by CUSHMAN, 1946, and BRADY, 1884. A lectotype is here designated as the specimen figured by BRADY, 1884 *200, pl. 8, figs. 1a,b) from *Porcupine* station 23, west of Ireland at 630 fathoms, and in the BMNH.]

Siphonaperta VELLA, 1957, *2001, p. 19 [**S. macbeathi*; OD]. Test with chamber arrangements as in *Quinqueloculina,* but wall agglutinated as in *Sigmoilopsis* and with simple ridgelike tooth and porcelaneous phialine lip. *Pleist.-Rec.,* Australia-N.Z.——FIG. 351,*6*. **S. macbeathi,* L.Pleist., N.Z.; *6a-c,* opposite sides and apert. views of holotype, ×36 (*2001).

Spirosigmoilina PARR, 1942, *1426, p. 361 [**Spiroloculina tateana* HOWCHIN, 1889, *966, p. 3; OD]. Test with early chambers in sigmoid arrangement as in *Sigmoilina,* later chambers 180° apart, as in *Massilina*; wall porcelaneous; aperture terminal, with short tooth. *Mio.,* Australia.——FIG. 353,*5*. **S. tateana* (HOWCHIN); side, apert. views of topotype, ×115 (*2117).

Triloculina D'ORBIGNY, 1826, *1391, p. 299 [**Miliolites trigonula* LAMARCK, 1804, *1085c, p. 351; SD CUSHMAN, 1917, *404f, p. 65] [=*Renoidea* BROWN, 1827, *244, p. 1 (type, *R. glabra*); *Spidestomella* COSTA, 1856, *392, p. 370 (type, *S. globulifera*); *Miliolina* WILLIAMSON, 1858, *2065, p. 83 (type, *Triloculina laevigata* D'ORBIGNY, 1826, *1391, p. 300); *Trillina* MUNIER-CHALMAS, 1882, *1322, p. 424 (type, *Triloculina strigillata* D'ORBIGNY, 1850, *1397b, p. 409)]. Test free, with chambers each one-half coil in length, early chambers at least in microspheric generation in quinqueloculine arrangement, later triloculine, with successive chambers added in planes 120° apart, only final 3 chambers visible externally; wall calcareous, imperforate, porcelaneous, or rarely with surficial agglutinated layer; aperture terminal, typically wtih bifid tooth; gametes biflagellate, with axostyle. [*Triloculina* differs from *Quinqueloculina* in its later triloculine development, from *Miliolinella* in having a bifid tooth instead of a broad apertural flap, and from *Cruciloculina* in having a simple, rounded aperture with a bifid tooth.] *Jur.-Rec.,* cosmop.——FIG. 353,*4*. **T. trigonula* (LAMARCK), Eoc. (Lutet.), Eu.(Hauteville, Fr.); *4a-c,* opposite sides, apert. view, ×31 (*2117).——FIG. 354. *T. rotunda* D'ORBIGNY, Rec., Atl.O.; biflagellate gamete with axostyle, ×6,000 (*820a).

Wellmanella FINLAY, 1947, *717e, p. 270 [**W. kaiata*; OD] [=*Hechtina* BARTENSTEIN & BRAND, 1949, *94, p. 669 (type, *H. praeantiqua*)]. Test similar to *Pateoris* but with triloculine, rather than quinqueloculine, early stage, and later stage with 3 or 4 chambers to whorl, aperture at open end of final chamber, varying from low arch to slit with infolded margins, as in *Pateoris*. [No sections showing early growth stages have been published, hence it is possible that an early quinqueloculine stage may be present and that *Pateoris* thus is a junior synonym of *Wellmanella.*] *L.Cret.(M.Valangin.)-U.Eoc.,* N. Z.-Ger. —— FIG. 353,*6*. **W. kaiata,* U.Eoc., N.Z.; holotype, ×35 (*717e).——FIG. 353,*7*. *W. praeantiqua* (BARTENSTEIN & BRAND), L.Cret.(U.Valangin.), Ger.; *7a-c,* opposite sides and edge of topotypes, ×111 (*2117).

Subfamily MILIOLINELLINAE Vella, 1957

[Miliolinellinae VELLA, 1957, p. 20]

Wall simple, with broad, flat tooth or flap partially closing aperture. *Eoc.-Rec.*

Miliolinella WIESNER, 1931, *2063, p. 63, 65, 107 [**Vermiculum subrotundum* MONTAGU, 1803, *1298, p. 521; OD] [=*Triloculinella* RICCIO, 1950, *1577, p. 90 (type, *T. obliquinodus*)]. Test free, triloculine in chamber arrangement; sutures distinct; wall calcareous, porcelaneous, imperforate; aperture at open end of chamber, partially covered by broad, low flap which leaves only crescentic opening. [Differs from *Triloculina* in possessing a large broad, flaplike tooth constricting the aperture rather than a simple or bifid tooth.] *Oligo.-Rec.,* Eu.-N.Am.-Pac.O.-Antarctic.——FIG. 355,*1,2*. **M. subrotunda* (MONTAGU); Rec., Ire. *(1),* Delos Is., Greece *(2)*; *1a-c,* opposite sides

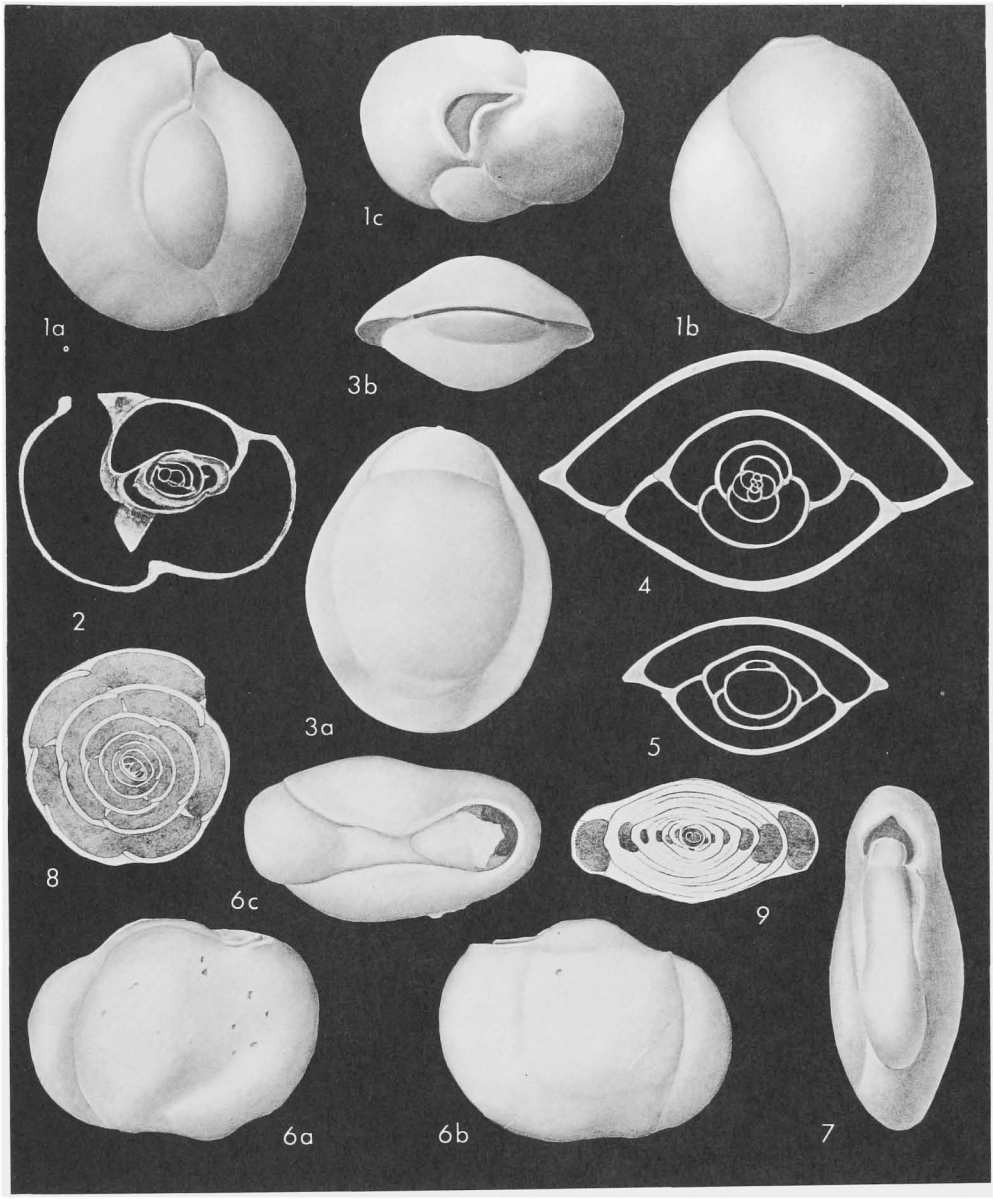


FIG. 355. Miliolidae (Miliolinellinae; *1,2, Miliolinella; 3-5, Biloculinella; 6-9, Nummoloculina*) (p. C466-C468).

and top view showing apert. flap, ×73 (*2117); *2*, horiz. sec., ×56 (*1738).

Biloculinella WIESNER, 1931, *2063, p. 69 [**Biloculina labiata* SCHLUMBERGER, 1891, *1654, p. 556; OD]. Test free, discoidal to ovate, proloculus followed by chambers one-half coil in length, early chambers in microspheric form arranged in quinqueloculine pattern, later chambers in triloculine arrangement and finally biloculine, with involute coiling, leaving only final pair of chambers visible, megalospheric form may be biloculine throughout development; wall calcareous, imperforate, porcelaneous; aperture terminal, nearly covered by broad flap, so that only narrow crescentic opening remains. [*Biloculinella* differs from *Pyrgo* in having a broad, flaplike lip, instead of a bifid apertural tooth. The lectotype and paratypes of *Biloculina labiata* SCHLUMBERGER are in the collections of the Sorbonne, University of Paris.] *Eoc. - Rec.*, Medit. Sea-Antarctic-N. Am. ——FIG. 355,*3-5*. **B. labiata* (SCHLUMBERGER), Rec., Medit.; *3a,b*, side, top views of paratype,

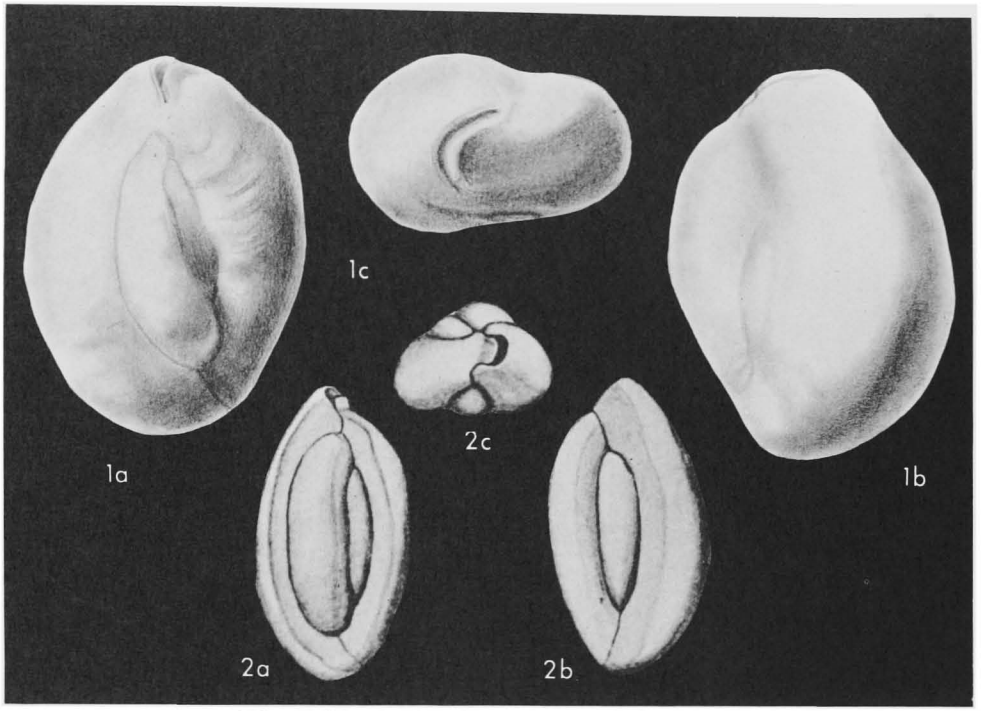


FIG. 356. Miliolidae (Miliolinellinae; *1,2, Scutuloris*) (p. C468).

×70 (*2117); *4,* microspheric test sectioned to show early quinqueloculine stage, ×87 (*1654); *5,* megalospheric test, sectioned to show biloculine development throughout, ×85 (*1654).

Nummoloculina STEINMANN, 1881, *1837, p. 31 [**Biloculina contraria* D'ORBIGNY, 1846, *1395, p. 266; OD]. Test free, discoidal to biconvex, early portion in milioline arrangement with 2 chambers to whorl, later planispiral with 3 chambers to whorl, increasing in adult to 5 or 6 low, broad chambers to whorl; sutures obscure; wall calcareous, imperforate, composed of successive laminae added over entire test, thickening wall and obscuring chamber division; aperture at open end of final chamber, semicircular in outline, but largely filled by broad spatulate tooth extending upward from base of opening and leaving open only small crescentic remnant of aperture. [*Nummoloculina* differs from *Fischerina* in having a broad spatulate flap in the aperture, instead of a high open aperture. *Hauerina* has a cribrate trematophore in the aperture, instead of a simple tooth.] *Mio.-Rec.,* Eu.-Atl.O.-Medit.Sea-Indo-Pac. —— FIG. 355,*6-9*. **N. contraria* (D'ORBIGNY), Mio., Aus. *(6),* Rec., Scot. (off Skye) *(7-9)*; *6a-c,* opposite sides and edges of topotype, apert. flap slightly broken, ×48 (*2117); *7,* edge view showing well-preserved apert. flap, ×20 (*200); *8,9,* equat. and axial secs. enlarged (*1837).

Scutuloris LOEBLICH & TAPPAN, 1953, *1162, p. 41 [**S. tegminis*; OD] [=*Quinquinella* VELLA, 1957, *2001, p. 21 (type, *Q. hornibrooki*)]. Test free, chambers in quinqueloculine arrangement; wall calcareous, imperforate; aperture at end of chamber and nearly filled by broad, low flap. [*Scutuloris* differs from *Miliolinella* in having a quinqueloculine chamber arrangement and from *Quinqueloculina* in having a broad flap filling the aperture, in place of the bifid tooth characteristic of the latter.] *Rec.,* Arctic.-Pac.O.——FIG. 356,*1*. **S. tegminis,* Alaska; *1a-c,* opposite sides and top view of holotype, ×66 (*1162).——FIG. 356,*2*. *S. hornibrooki* (VELLA), N.Z.(Cook Strait); *2a-c,* opposite sides and top view of holotype, ×60 (*2001).

Subfamily MILIOLINAE Ehrenberg, 1839

[*nom. transl.* RHUMBLER, 1895, p. 87 (*ex* family Miliolina EHRENBERG, 1839)] [=Miliolininae BRADY, 1881, p. 43; =Haueriinae BRADY, 1884, p. 62; =Trematoforininae SILVESTRI, 1937, p. 80 *(nom. nud.)*]

Wall simple; with cribrate aperture (trematophore). *U.Cret.-Rec.*

Miliola LAMARCK, 1804, *1085c, p. 349 [**Miliolites saxorum* LAMARCK, 1804; SD CUSHMAN, 1927, *432, p. 125 [=*Miliolites* LAMARCK, 1804, *1085c, p. 349 (type, *M. saxorum,* SD LOEBLICH & TAPPAN, herein) (obj.); *Miliolithes* CUVIER, 1817, *542a, p. 376 (*nom. van. pro Miliolites* LAMARCK) (obj.); *Saxicoline* DESHAYES, 1830, *590, p. 231 *(nom. neg.)* (obj.); *Pentellina* MUNIER-CHALMAS, 1882, *1322, p. 424 (obj.); *Saxicolina* SHERBORN, 1896, *1731b, p. 404 (*nom. correct. pro Saxicoline* DESHAYES, 1830) (obj.)]. Test with quinquelo-

culine chamber arrangement; aperture with trematophore (cribrate). *Eoc.*, Eu.-N.Am.——Fig. 357,*2,3*. **M. saxorum* (Lamarck), Eoc. (Lutet.), Fr.; *2a-c*, opposite sides and apert. view, ×26 (*2117); *3*, transv. sec. showing chamber arrangement, ×50 (*1664).

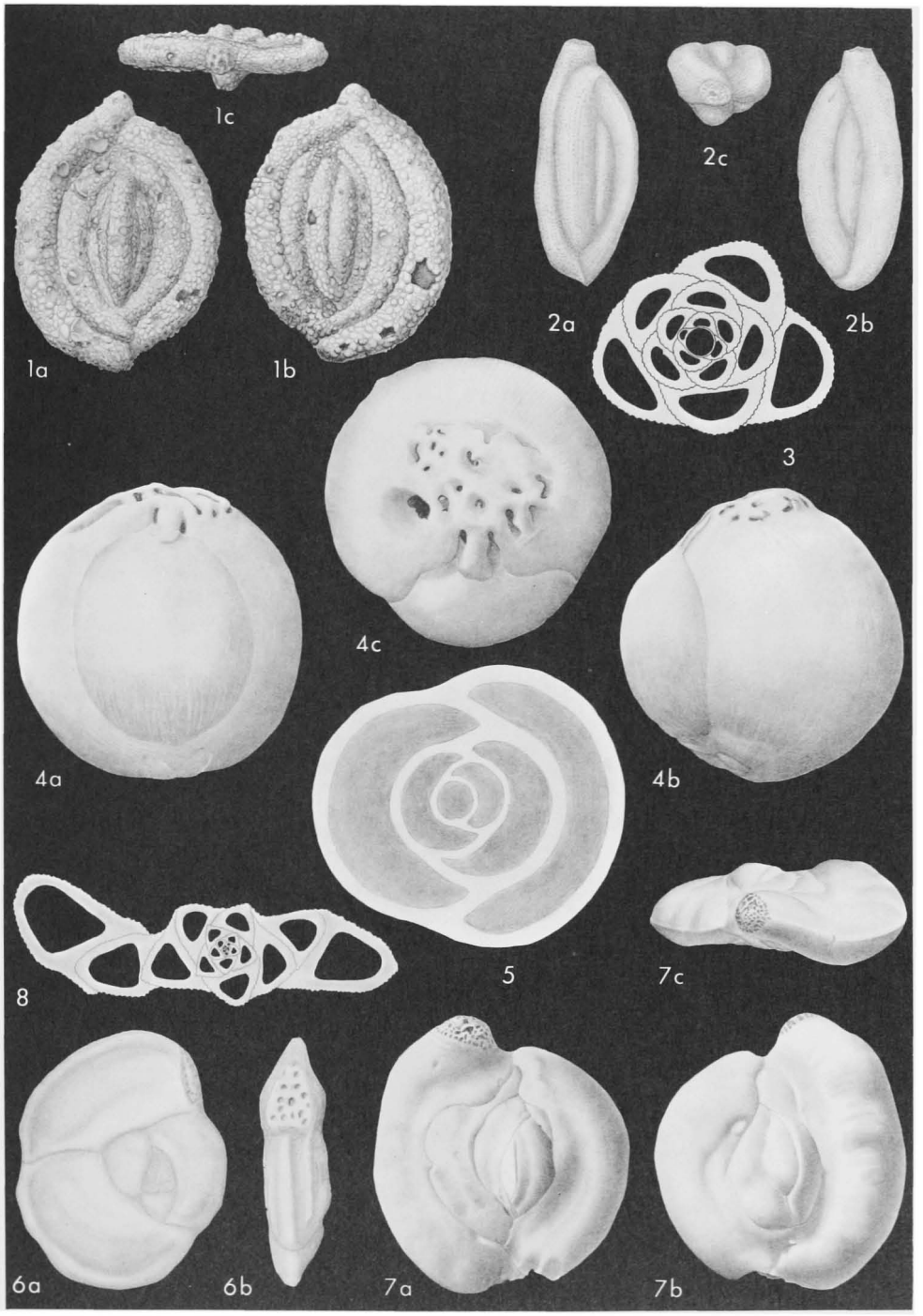


Fig. 357. Miliolidae (Miliolinae; *1, Ammomassilina; 2,3, Miliola; 4,5, Cribropyrgo; 6, Hauerina; 7,8, Heterillina*) (p. C468-C470).

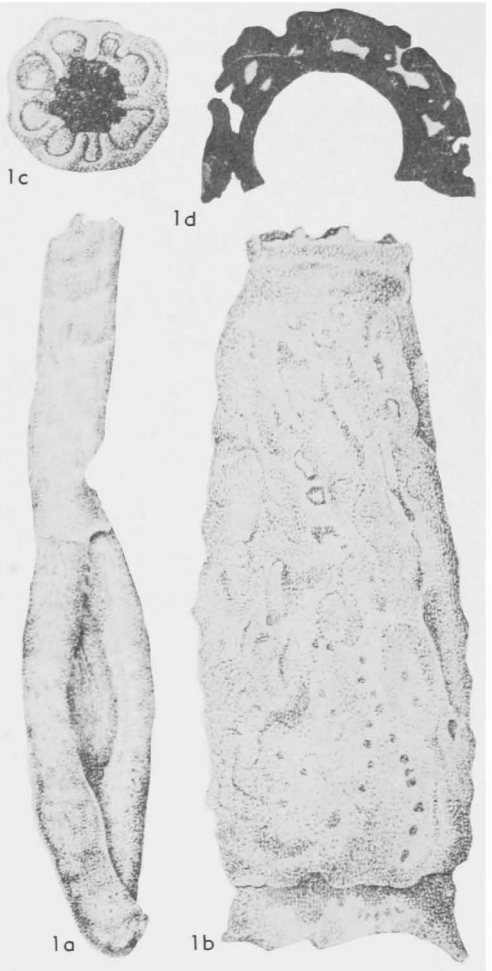


FIG. 358. Miliolidae (Miliolinae; *1, Dogielina*) (p. C470).

Ammomassilina CUSHMAN, 1933, *458, p. 32 [**Massilina alveoliniformis* MILLETT, 1898, *1284b, p. 609; OD]. Test free, early chambers milioline in development, later chambers added in single plane; wall agglutinated; aperture with trematophore. [Differs from *Schlumbergerina* in having later chambers added in a single plane.] *Rec.*, Malay Arch.(Malay).——FIG. 357,*1*. **A. alveoliniformis* (MILLETT); *1a-c*, opposite sides and apert. view, ×29 (*2117).

Cribropyrgo CUSHMAN & BERMÚDEZ, 1946, *493, p. 119 [**C. robusta*; OD]. Test free, subglobular, chamber arrangement as in *Pyrgo*; aperture cribrate, consisting of numerous irregular openings scattered over protruding terminal portion of final chamber. [Differs from *Pyrgoella* in having a cribrate, rather than chevron-shaped or cruciform aperture, and from *Fabularia* in having a simple interior.] *Rec.*, Carib.——FIG. 357,*4,5*. **C. robusta*, Cuba; *4a-c*, side, edge, and top views of holotype; *5*, sectioned paratype, all ×17 (*2117).

Dogielina BOGDANOVICH & VOLOSHINOVA, 1949, *154, p. 185 (*non Dogielina* RAABE, 1959) [**D. sarmatica*; OD]. Test with early chambers in milioline arrangement, as in *Quinqueloculina*, later uncoiling, with rectilinear chambers; wall calcareous, spongy in structure, surface with pits and grooves; aperture terminal, with toothlike infoldings from apertural wall giving radiate appearance. *U.Mio. (Sarmat.)*, Carpath.——FIG. 358,*1*. **D. sarmatica*; *1a*, side view of holotype, ×47; *1b*, surface of uniserial chamber, ×115; *1c*, apert. view showing infolded wall, ×115; *1d*, partial section of wall showing spongy structure, ×150 (*154).

Hauerina D'ORBIGNY in DE LA SAGRA, 1839, *1611, p. xxxviii [**H. compressa* D'ORBIGNY, 1846, *1395, p. 119; SD (SM)]. Test free, lenticular to discoidal, compressed, subcircular in outline, early stages quinqueloculine, later planispiral with 3 or more chambers to whorl; aperture series of pores in the sievelike trematophore. [Differs from *Heterillina* in having 3 or more chambers to whorl in adults, rather than 2.] *Eoc.-Rec.*, cosmop. ——FIG. 357,*6*. **H. compressa*, Mio., Eu.(Aus.); *6a,b*, side, apert. views of holotype, ×57 (*1166).

Heterillina MUNIER-CHALMAS & SCHLUMBERGER in SCHLUMBERGER, 1905, *1664, p. 131 [**H. guespellensis* SCHLUMBERGER, 1905; SD CUSHMAN, 1928, *439, p. 150] [=*Heterillina* MUNIER-CHALMAS & SCHLUMBERGER, 1883, *1329, p. 862 *(nom. nud.)*]. Test free, ovate in outline, flattened, chambers one-half coil in length, at first in quinqueloculine arrangement, later added on opposite sides as in *Spiroloculina*; sutures depressed; aperture terminal, multiple, with trematophore. [*Heterillina* differs from *Massilina* in having an apertural plate with numerous pores, and in lacking a bifid tooth. It differs from *Hauerina* in having all chambers one-half coil in length, whereas in adult *Hauerina* 3 chambers occur in each whorl. The types of *H. guespellensis* are from the middle Eocene at Le Guespelle, France, and are deposited in collections of the Sorbonne, University of Paris, France. Figured paratypes are from this locality.] *M.Eoc.-Oligo.*, Eu.(Fr.).——FIG. 357,*7,8*. **H. guespellensis*, M.Eoc.; *7a-c*, opposite sides and apert. view of paratype, ×27 (*2117); *8*, transv. sec. showing chamber arrangement, ×30 (*1664).

Idalina SCHLUMBERGER & MUNIER-CHALMAS, 1884, *1668, p. 629 (*non* NORMAN, 1890) [**I. antiqua* SCHLUMBERGER & MUNIER-CHALMAS, 1884, =*Biloculina antiqua* D'ORBIGNY, 1850, *1397b, p. 210 *(nom. nud.)*, =*Triloculina cretacea* D'ORBIGNY, 1850, *1397b, p. 210 *(nom. nud.)* (*non Biloculina antiqua* KARRER, 1867); OD (M)]. Test free, ovoid, initial stage quinqueloculine followed successively by triloculine and biloculine stages and finally with completely enveloping chambers in adult, one or more of early stages may be lacking in some specimens; aperture in quinqueloculine stage

with simple tooth, in triloculine stage with crenulate border in addition to tooth, in biloculine stage with more strongly marked crenulations and adult with raised trematophore pierced by numerous irregular openings. *U.Cret.(Senon.)*, Eu. ——Fig. 359,*1-5*. **I. antiqua*, topotypes, Fr.;

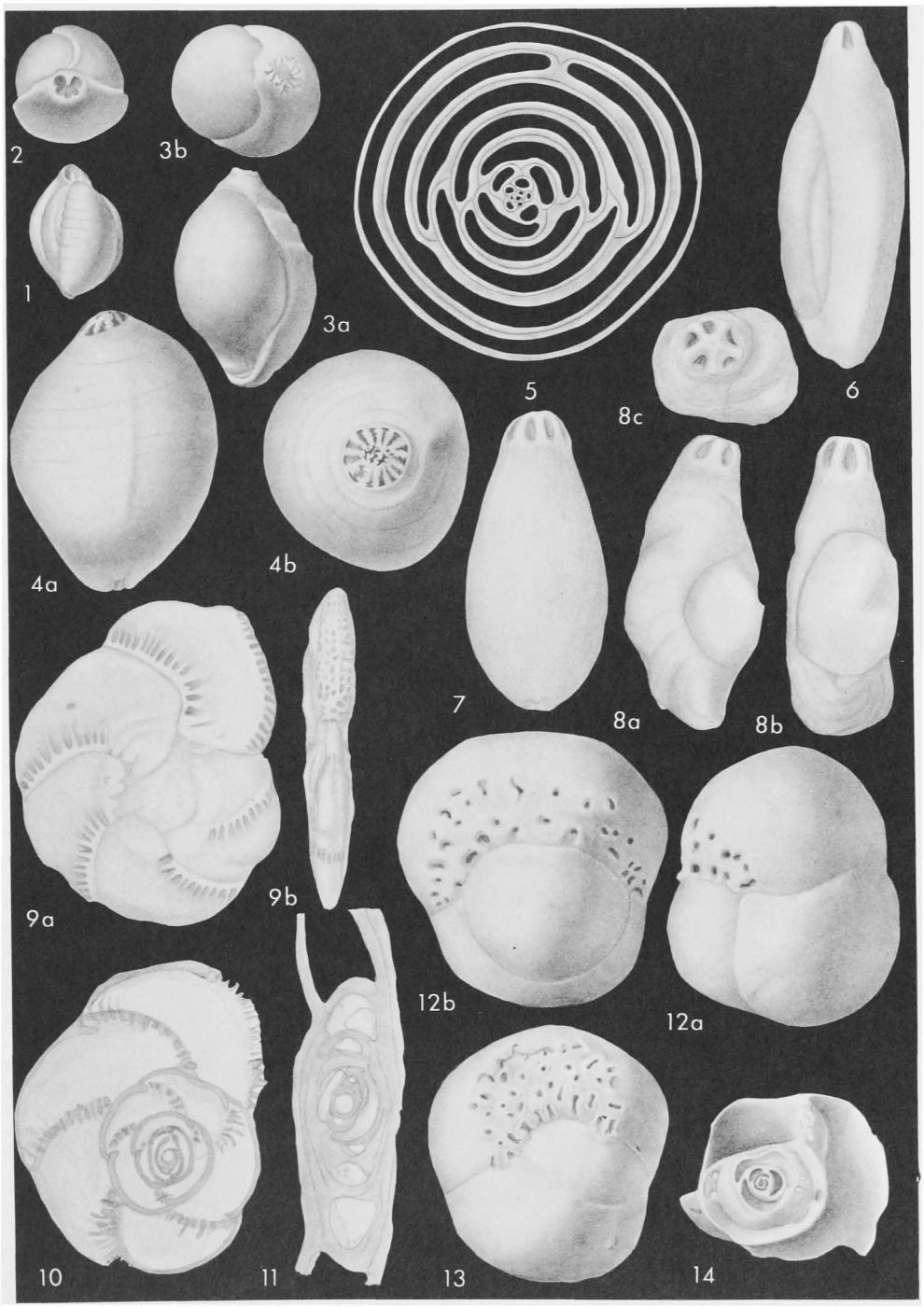


Fig. 359. Miliolidae (Miliolinae; *1-5, Idalina; 6-8, Nevillina; 9-11, Polysegmentina; 12-14, Involvohauerina*) (p. C470-C472).

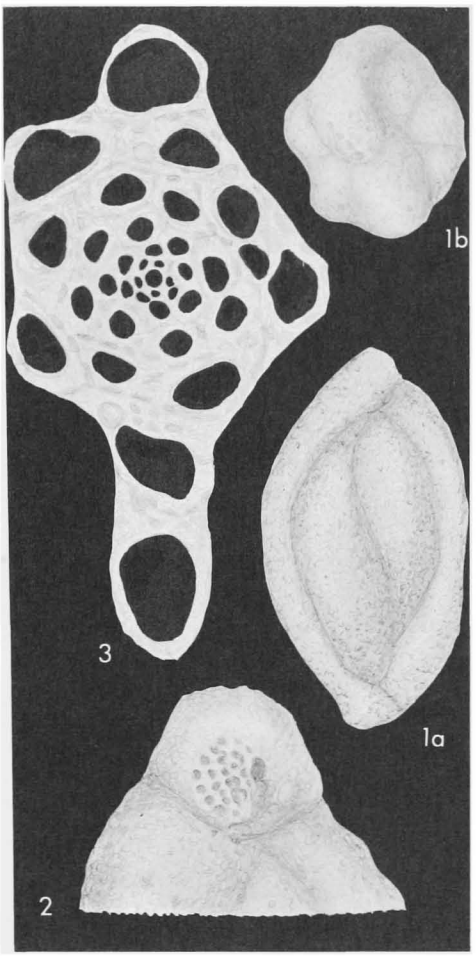


FIG. 360. Miliolidae (Miliolinae; *1-3, Schlumbergerina*) (p. C472-C473).

1, young quinqueloculine specimen with simple tooth, ×17 (*1330); *2,* triloculine specimen with crenulate apertural border, ×11 (*1330); *3a,b,* biloculine specimen, side and top views showing dendritic aperture, ×15 (*2117); *4a,b,* side, top views of adult with completely overlapping chambers and complex apert. trematophore, ×8 (*2117); *5,* horiz. sec. of adult showing chamber development, ×16 (*1330).

[*Idalina* was validly described in 1884 (although not figured) and the type-species by monotypy was referred to as "*Idalina antiqua,* d'Orb." SCHLUMBERGER & MUNIER-CHALMAS stated (*1668, p. 630), "*L'Idalina antiqua,* d'Orb. sp., comprend les deux genres *Biloculina antiqua* et *Triloculina cretacea* mentionnés par D'ORBIGNY dans son Prodrôme (Étage 21e, nos 353 et 359)." The species *Biloculina antiqua* and *Triloculina cretacea* were *nomina nuda,* however, and the species *I. antiqua* correctly should be credited to SCHLUMBERGER & MUNIER-CHALMAS who first described it. *Idalina* differs from *Fabularia* in having a final enveloping stage and in lacking the labyrinthic interior. The holotype was from the Senonian, zone of *Hippurites cornuvaccinum* and *H. organisans,* Étang de Berre, near Martigues, Dept. Bouche du Rhône, France.]

Involvohauerina LOEBLICH & TAPPAN, 1955, *1166, p. 14 [**I. globularis*; OD]. Test free, early portion quinqueloculine, later tending to become planispiral and involute with 3 chambers to whorl and only those chambers of last whorl visible; aperture areal, cribrate, with numerous irregularly shaped pores. [Differs from *Hauerina* in being almost globular, rather than compressed, and in being involutely coiled, rather than evolute.] *Rec.,* Atl.O.-Pac.O.——FIG. 359,*12-14*. **I. globularis,* Atl.; *12a,b,* side, apert. views of holotype; *13,* apert. view of paratype showing more complex aperture; *14,* dissected paratype showing chamber development; all ×20 (*1166).

Nevillina SIDEBOTTOM, 1905, *1739, p. 1 [**Biloculina coronata* MILLETT, 1898, *1284a, p. 263; OD (M)]. Test free, pyriform in outline, early chambers triloculine in plan, later biloculine, adult chambers completely embracing early ones, aperture of each succeeding chamber at opposite ends of test; wall smooth or marked by some transverse wrinkles; aperture terminal, rounded opening surrounded by additional radiating slits, between encurved lamellae which meet in ring around small central opening. [The holotype of *Biloculina coronata* is in the BMNH-ZF3626, from the Malay Archipelago. The original reference states that it occurred at Station 18, but the slide is labeled Station 19.] *Rec.,* Malay Arch. (Malay)-Ind.O.——FIG. 359,*6-8*. **N. coronata* (MILLETT), Malay; *6,* triloculine specimen, ×79; *7,* adult specimen with completely overlapping chambers, ×36; *8a-c,* side, edge and top views of holotype, ×79 (*2117).

Polysegmentina CUSHMAN, 1946, *483, p. 1 [**Hauerina circinata* BRADY, 1881, *196c, p. 47; OD]. Test free, discoidal, early portion milioline in plan, later planispiral and slightly involute, with 3 to 6 chambers in final whorl, later chambers being relatively shorter, so that number per whorl gradually increases; wall thickened, calcareous, imperforate; aperture consisting of numerous irregular pores in trematophore, marginal row of pores being left exposed in earlier chambers and remaining as sutural pores connecting with interior. [Differs from *Hauerina* in its peculiar sutural retral processes bordering the relict lateral pores of previous apertures, which continue to connect with the interior.] *Rec.,* Pac.O.——FIG. 359,*9-11*. **P. circinata* (BRADY); *9a,b,* side, edge views of lectotype, ×47; *10,* horiz. sec. showing chamber arrangement and apertural pores, ×47; *11,* axial sec. of central area showing early chamber arrangement and lamellar wall, ×109 (*1166).

Schlumbergerina MUNIER-CHALMAS, 1882, *1322, p. 424 [**S. areniphora*; OD]. Test free, milioline in development, but with chambers added in more than 5 planes; wall agglutinated; aperture with trematophore, lateral rather than terminal in position. [MUNIER-CHALMAS described this form

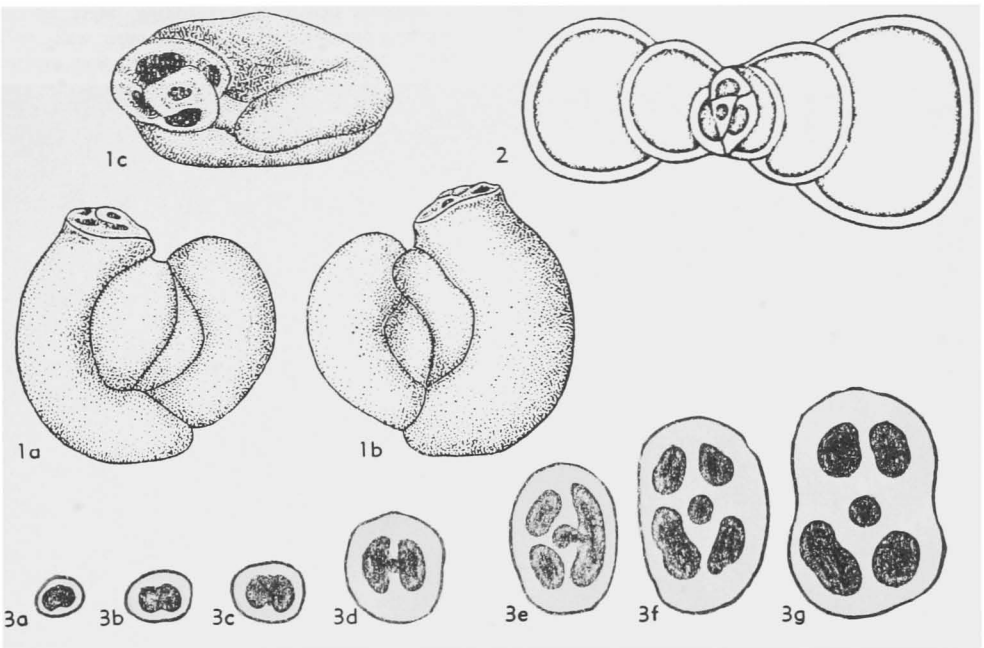


FIG. 361. Miliolidae (Miliolinae; *1-3, Tortonella*) (p. C473).

as having 5 chambers externally, but in his figure of the type, 5 chambers are visible from one side of the test. None of the types of MUNIER-CHALMAS preserved in collections of the Sorbonne, Paris, France, show a test with only 5 chambers externally. Even in the early stage no quinqueloculine development is seen. *Schlumbergerina* differs from *Ammomassilina* in having chambers added in many planes, rather than in a single plane in the adult.] *Rec.*, Pac.O.-Gulf Mex.——FIG. 360,*1-3*. **S. areniphora*; Samoa *(1)*, Torres Straits *(2)*, Philip. *(3)*; *1a,b*, side, top views of lectotype, ×28; *2*, apert. region of paratype, ×64; *3*, sectioned specimen showing chambers added in numerous planes, ×64 (*2117).

Tortonella DIDKOVSKIY, 1957, *593, p. 1138 [**T. bondartschuki*; OD]. Test free, flattened, early stage triloculine, later chambers added in single plane, 2 chambers to whorl or more rarely spreading somewhat so that 2 chambers do not quite complete volution; aperture large and rounded, with modified tooth, resulting in central perforation surrounded by 4 additional openings. *Mio.(Torton.)*, USSR(Ukraine).——FIG. 361,*1-3*. **T. bondartschuki*; *1a-c*, opposite sides and apert. view of holotype, ×25; *2*, transv. sec. showing early triloculine stage, followed by planispiral stage, ×48; *3a-g*, diagram. outlines of apertures of progressively larger specimens showing change from simple to bifid tooth to ringlike tooth attached in 4 places to leave 5 openings, ×55 (*593).

[*Tortonella* is close in appearance to *Cribrolinoides*, and apparently has a similar apertural development from simple opening and tooth to ringlike apertural tooth, and finally multiple openings. Although the definition of *Tortonella* stated that the early stage was quinqueloculine (which would make it a synonym of *Cribrolinoides*), the sectioned specimen figured shows only a triloculine early stage; hence both are provisionally recognized.]

Subfamily FABULARIINAE Ehrenberg, 1839

[*nom. correct.* LOEBLICH & TAPPAN, 1961, p. 293 (*pro* subfamily Fabularidea REUSS, 1862, p. 375)]

Interior complex; chambers subdivided into chamberlets; aperture multiple. *U.Cret. (Senon.)-Rec.*

Fabularia DEFRANCE, 1820, *579a, p. 557 [**F. discolites* DEFRANCE in BRONN, 1825, *209, p. 43 (=*Nummulites ovata* DE ROISSY, 1805, *1584, p. 59); SD (SM) DEFRANCE in BRONN, 1825, *209, p. 43]. Test free, large, early stage biloculine in megalospheric form, at first quinqueloculine in microspheric forms, then triloculine, adults biloculine; wall thick, interior subdivided by secondary partitions; surface ornamented by fine striae and punctations; aperture with large trematophore pierced with numerous irregular openings. *M.Eoc.(Lutet.)-Rec.*, Eu.(Fr.)-Afr.-N.Am.——FIG. 362,*1-4*. **F. ovata* (DE ROISSY), M.Eoc. (Lutet.), Fr.; *1a-c*, opposite sides and apert. view of juvenile triloculine specimen, ×10 (*2117); *2a,b*, side, edge views of biloculine specimen, surface abraded to show wall characters, ×10 (*2117); *3*, horiz. sec. of microspheric specimen, ×41; *4*, horiz. sec. of megalospheric specimen, ×35 (*1664).

Austrotrillina PARR, 1942, *1426, p. 361 [**Trillina howchini* SCHLUMBERGER, 1893, *1656, p. 119, 123; OD]. Test with chamber arrangement as in *Triloculina*, new chambers adding layers against previous ones as well as new chamber wall; wall thick, new outer portion alveolar, that against

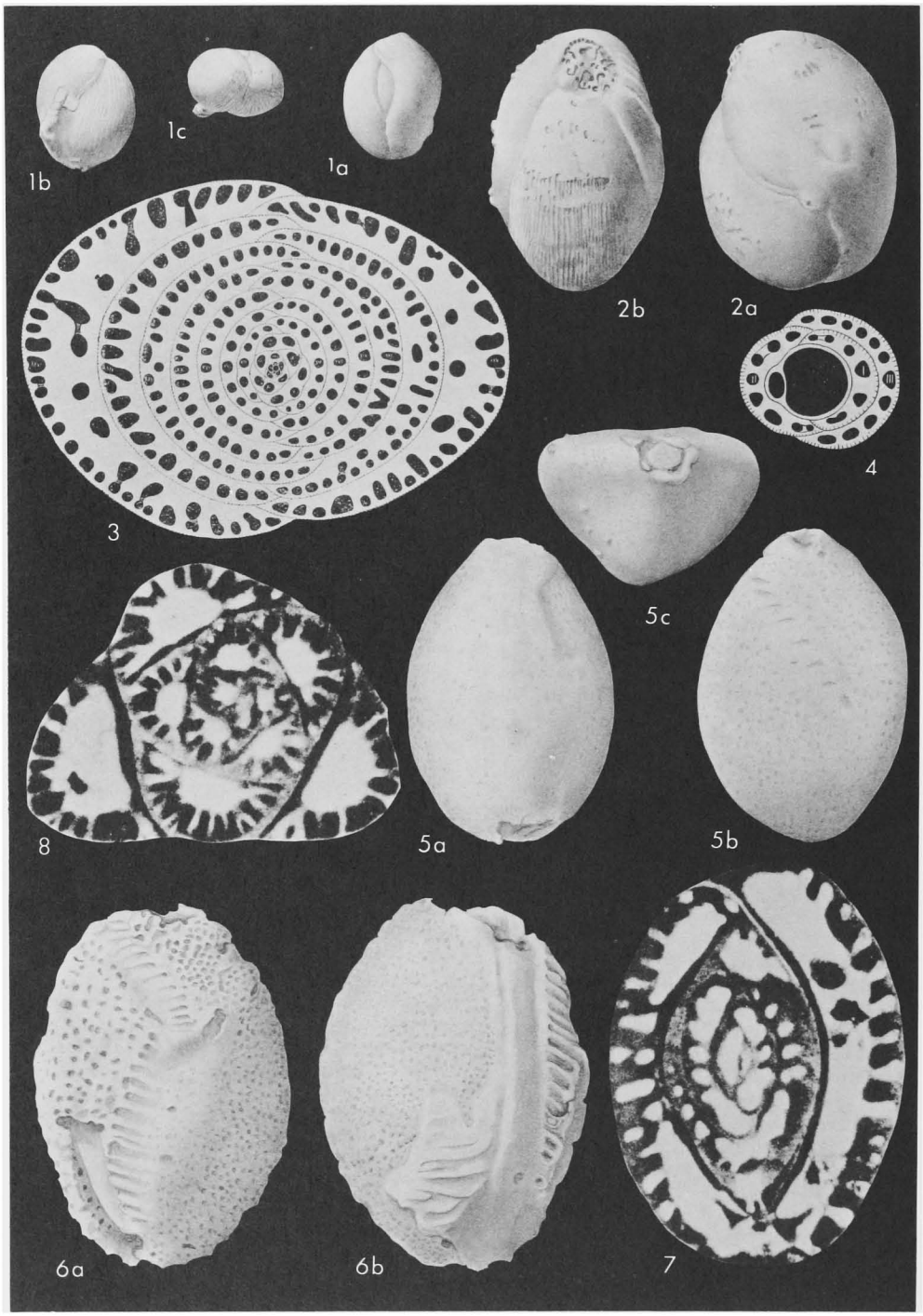


FIG. 362. Miliolidae (Fabulariinae; *1-4, Fabularia; 5-8, Austrotrillina*) (p. C473-C476).

previous chambers thin and simple in structure; chamber cavity undivided; aperture terminal, with trematophore. [*Austrotrillina* was defined to include some of the species placed by SCHLUMBERGER in *Trillina,* the type-species of which (*T. strigillata* D'ORBIGNY) is a true *Triloculina*; hence,

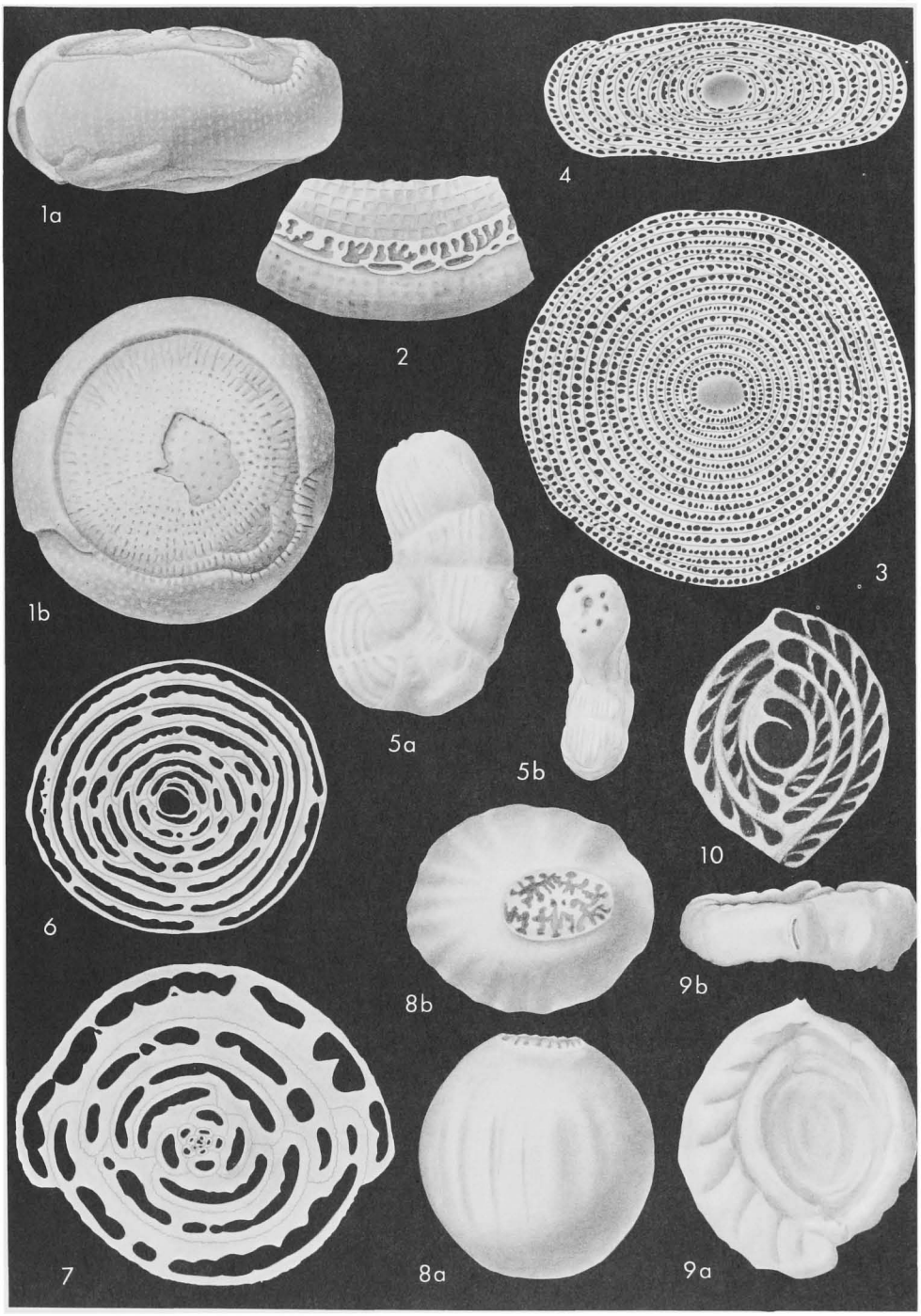


FIG. 363. Miliolidae (Fabulariinae; *1-4, Lacazina; 5, Raadshoovenia; 6-8, Periloculina; 9-10, Riveroina*) (p. C476-C477).

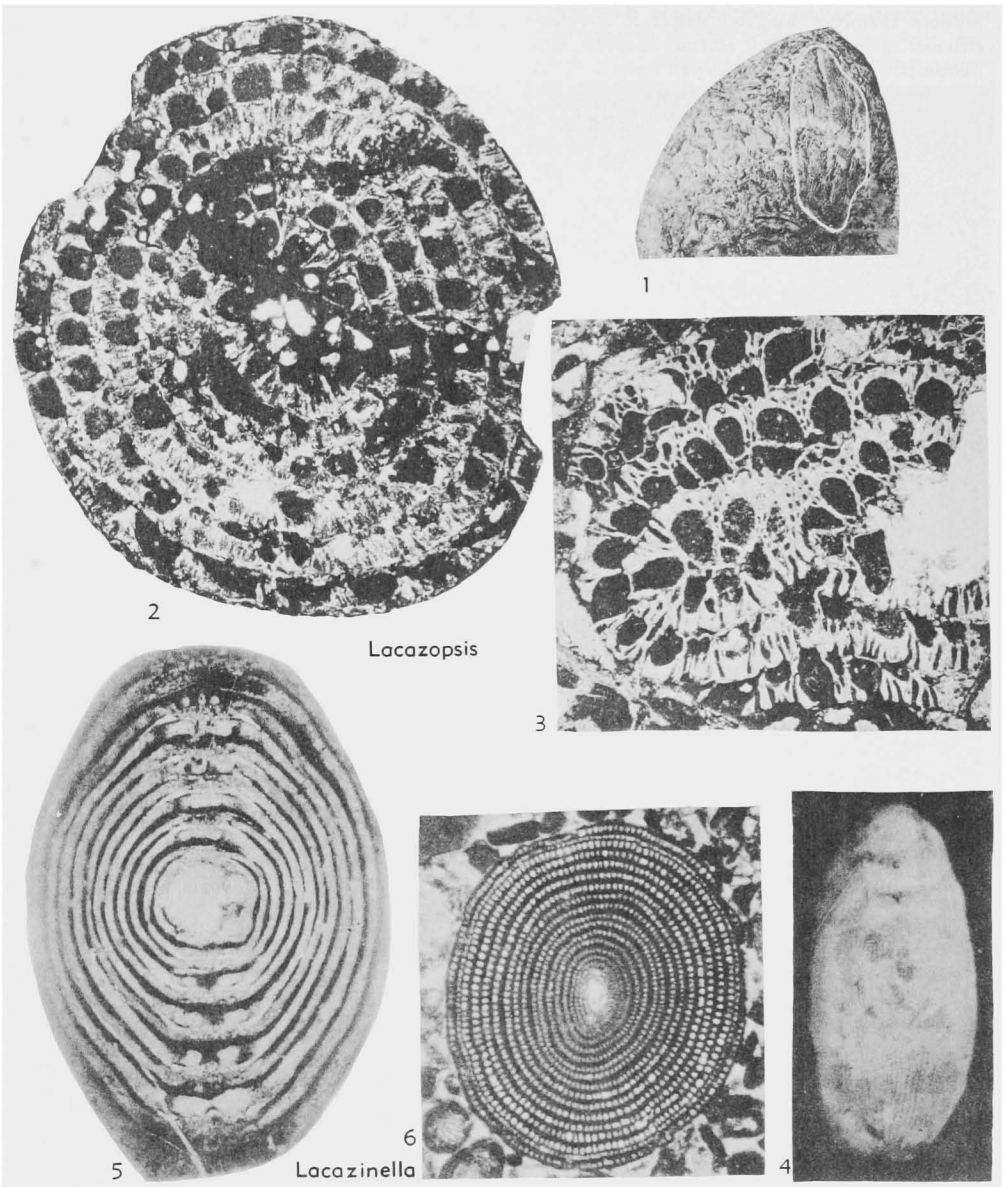


FIG. 364. Miliolidae (Fabulariinae; *1-3, Lacazopsis; 4-6, Lacazinella*) (p. C477).

Trillina is a junior synonym of *Triloculina*.] *Eoc.-Mio.*, Pac.O.-Australia-Asia(Iraq.)-E.Afr.(Somaliland).——FIG. *362,5-8*. **A. howchini* (SCHLUMBERGER), Mio., Australia; *5a-c*, opposite sides and top view of specimen, ×35 (*2117); *6a,b*, opposite sides of eroded specimen in which alveolar wall character is evident, ×35 (*2117); *7,8*, long. and transv. secs., ×53 (*361).

Lacazina MUNIER-CHALMAS, 1882, *1324, p. 472 [**Alveolina compressa* D'ORBIGNY, 1850, *1397b, p. 210; OD]. Test free, discoidal; chambers biloculine, being added alternately on each side of test, subdivided by numerous small longitudinal pillars; aperture large, circular, ringlike, at entire margin of final chamber, covered by similarly ringlike trematophore with irregular openings separated by anastomosing denticulations. [*Lacazina* differs from *Periloculina* in having a ringlike aperture and trematophore instead of a small circular aperture and discoidal trematophore.

D'ORBIGNY's types are from the Senonian, Martigues and La Fare, Dept. Bouche du Rhône, France.] *U.Cret.(Senon.),* Eu.——FIG. 363,*1-4*. **L. compressa* (D'ORBIGNY), Santon., Sp. *(1),* Senon., Fr. *(2-4)*; *1a,b,* edge and apert. views, ×8 (*2117); *2,* part of test showing trematophore, ×15; *3,4,* horiz. and axial secs., enlarged (*1330).

Lacazinella CRESPIN, 1962, *394A, p. 337 [**Lacazina wichmanni* SCHLUMBERGER, 1894, *1656A, p. 295; OD]. Test large, 2-3 mm. in length, elongate-ovate in outline, circular in section, each chamber completely enveloping test, only final chamber visible externally, proloculus subspherical, each successive chamber with aperture at opposite end of test from that of preceding one, chamber interiors partially filled by longitudinal internal perforated ribs which anastomose somewhat below apertural region; wall calcareous, porcelaneous, imperforate, surface smooth or longitudinally grooved; aperture terminal cribrate, consisting of trematophore at one end of long axis. [Differs from *Lacazina* in having completely embracing chambers, elongate axis, and endoskeleton of ribs, rather than pillars, and from *Periloculina* in lacking an early milioline development.] *U.Eoc., ?Oligo.,* W.Pac.O.(New Guinea-Moluccas Is.).——FIG. 364,*4-6*. **L. wichmanni* (SCHLUMBERGER); *4,* side view, ×14; *5,* vert. sec. showing completely enveloping chambers with apertures at alternate ends and sectioned trematophore, ×20; *6,* horiz. sec. showing radiating vert. ribs, ×18 (*394A).

Lacazopsis DOUVILLÉ, 1930, *629, p. 247 [**L. termieri*; OD (M)]. Test free, to 22 mm. in length, regularly fusiform, with completely enveloping chambers that alternate from pole to pole, subdivided into chamberlets by longitudinal and transverse interseptal partitions; wall calcareous, agglutinated, outer regular layer thin, inner layer with anastomosing pillars that form irregular network, tangential section appearing reticulate, and perpendicular section showing nearly parallel pillars; aperture terminal, cribrate. [*Lacazopsis* has the general form of *Lacazina* but is much larger. The wall was described as finely agglutinated and reticulate, rather than calcareous imperforate. It was originally placed with the trematophorate miliolids, but restudy of the wall character is necessary to determine if it actually is porcelaneous. The Fiche-Type H. DOUVILLÉ 37 (4), Institut Français du Pétrole, stated that the chamber appearance suggested a cheilostome bryozoan.] *U.Cret.(Senon.),* N.Afr.(Morocco).——FIG. 364, *1-3*. **L. termieri*; *1,* specimen (outlined) on pebble, ×2; *2,* transv. sec. showing annular chambers and interseptal partitions, ×20; *3,* oblique sec. showing at left interseptal pillars perpendicular to surface and at right alveolar structure, ×20 (*629).

Periloculina MUNIER-CHALMAS & SCHLUMBERGER, 1885, *1330, p. 308 [**P. zitteli*; OD (M)]. Test free, ovoid, in adult consisting of completely embracing chambers, microspheric form with initial quinqueloculine stage followed by triloculine, biloculine, and finally embracing development, megalospheric form either triloculine or biloculine in young; wall commonly with longitudinal ornamentation, internal wall of chambers with longitudinal ridges which may become sufficiently produced to touch opposite wall and secondarily subdivide chamber; aperture elongate and crescentic with denticulate margin in early stage, with trematophore pierced by irregular anastomosing openings in adults. [Differs from *Idalina* in having the interior of the chambers subdivided by internal longitudinal ribs. It differs from *Lacazina* in having a platelike, instead of ringlike, trematophore and in having internal ribs instead of the radiating pillars characteristic of *Lacazina.*] *U.Cret.(Senon.),* Eu. (Fr.).——FIG. 363,*6-8*. **P. zitteli*; *6,7,* transv. secs. of megalospheric (×18) and microspheric (×42) forms; *8a,b,* side, apert. views, ×12 (*1330).

Raadshoovenia VAN DEN BOLD, 1946, *155, p. 123 [**R. guatemalensis*; OD]. Test free, early chambers in quinqueloculine arrangement, later 4 to 6 chambers to whorl in planispiral coil, adult uncoiling and rectilinear; later chambers with secondary interseptal partitions, visible as ridges at surface of slightly eroded specimens; aperture terminal, multiple. *L.Eoc.,* C.Am.(Guat.).——FIG. 363,*5*. **R. guatemalensis; 5a,b,* side, top views, ×15 (*2117).

Riveroina BERMÚDEZ, 1939, *121b, p. 248 [**R. caribaea*; OD]. Test free, planispiral, with chambers one-half coil in length, as in *Spiroloculina,* but interior of chambers with oblique secondary septa, those of each chamber projecting toward its apertural end; aperture terminal, single, elongate curved slit. *Rec.,* Carib. Sea.——FIG. 363, *9,10*. **R. caribaea; 9a,b,* side, apert. views of paratype, ×76 (*2117); *10,* sectioned paratype, ×50 (*121b).

Subfamily TUBINELLINAE Rhumbler, 1906

[Tubinellinae RHUMBLER, 1906, p. 25] [=Artubinia RHUMBLER, 1913, p. 352 *(nom. van.)*]

Early milioline stage reduced; later portion uniserial, with rudimentary septa; aperture formed by open end of final chamber. *M.Eoc.-Rec.*

Tubinella RHUMBLER, 1906, *1571, p. 25 [**Articulina funalis* var. *inornata* BRADY, 1884, *200, p. 186; SD CUSHMAN, 1928, *439, p. 151] [=*Artubinum* RHUMBLER, 1913, *1572b, p. 352 (obj.) *(nom. van.)*; *Tubinellina* WIESNER, 1931, *2063, p. 67 (type, *Articulina funalis* BRADY, 1884, *200, p. 185)]. Test free, with vestigial early milioline stage consisting of bulbous proloculus and closely appressed second chamber, reversing direction of growth; later chambers

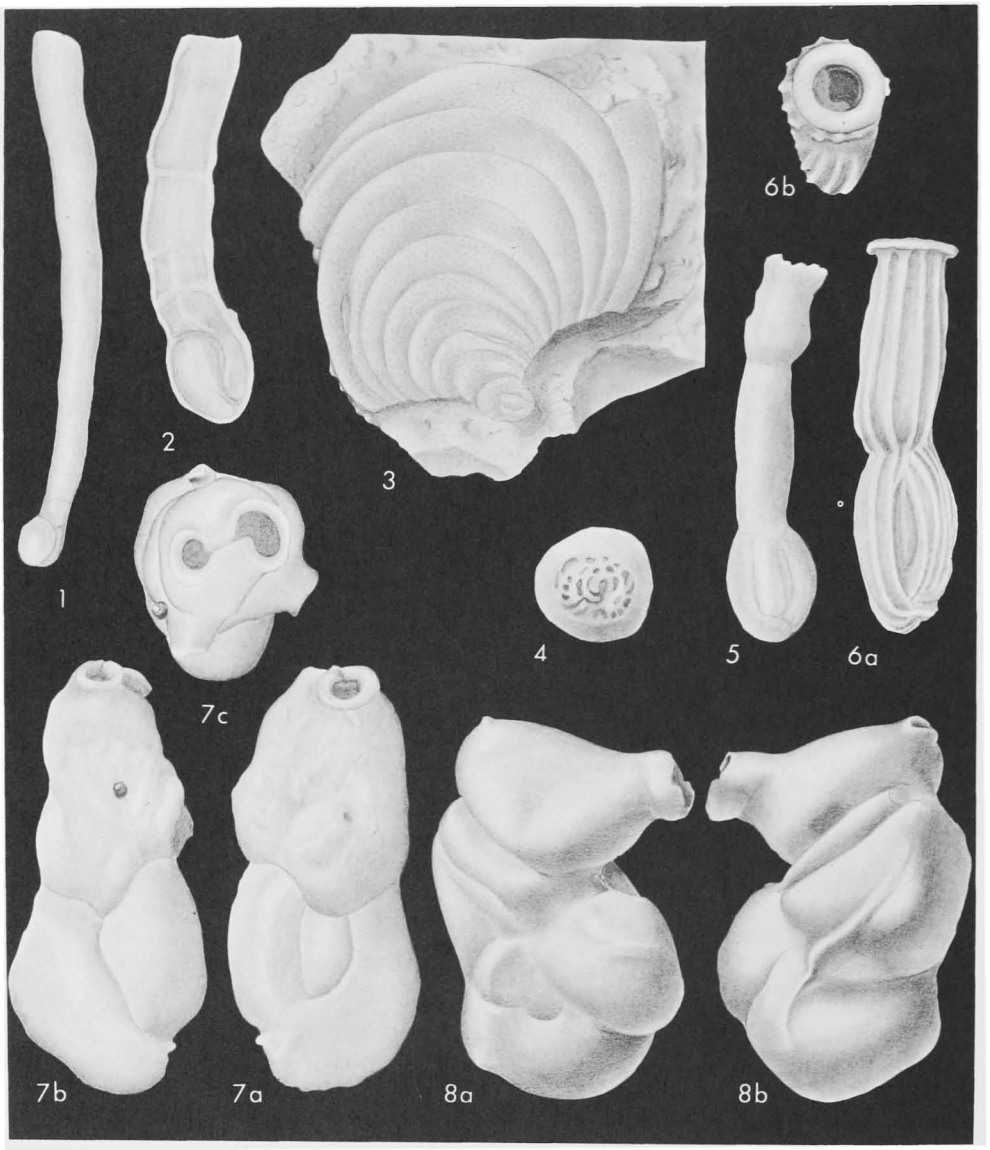


FIG. 365. Miliolidae (Tubinellinae; *1,2, Tubinella; 3, Pavoninoides; 4,5, Poroarticulina; 6, Articulina; 7,8, Parrina*) (p. C477-C480).

cylindrical, uniserially arranged; septa vestigial, consisting of slight transverse thickenings of wall, visible in transmitted light; aperture at open end of tube. [*Tubinella* is very close to *Articulina* in possessing a milioline early stage, although much reduced, and is probably derived from *Articulina* by reduction of the septa to mere wall thickenings.] *Rec.*, Pac.O.-Atl.O.——FIG. 365,*1,2*. **T. inornata* (BRADY), Rec., Ind.O.(Kerguelen Is.); *1*, side view of lectotype, ×48; *2*, paratype, ×105 (*1166).

Articulina D'ORBIGNY, 1826, *1391, p. 300 [**A. nitida*; OD (M)] [=*Ceratospirulina* EHRENBERG, 1858, *683, p. 11 (type, *C. spratti*)]. Test in early stage milioline, later rectilinear, ornamentation may consist of longitudinal costae; aperture in adult terminal, rounded, with everted margin. *M.Eoc.-Rec.*, cosmop.——FIG. 365,*6*. **A. nitida*, M.Eoc.(Lutet.), Eu.(Fr.); *6a,b*, side, top views of topotype, ×83 (*2117).

Parrina CUSHMAN, 1931, *448, p. 20 [=*pro Silvestria* SCHUBERT, 1921, *1694, p. 166 (*non* VERHOEFF, 1895; *nec* BRIAN, 1902)] [**Nubecularia bradyi* MILLETT, 1898, *1284a, p. 261; OD] [=*Erichsenella* TINOCO, 1955, *1935, p. 19 (type, *E. kegeli*)]. Test with early stage milioline, later

chambers irregularly uniserial; aperture rounded, without tooth and commonly with more than one aperture on terminal chamber. [*Parrina* was defined by CUSHMAN as "irregularly coiled" in the early stage, but both the type-species of *Parrina* and that of *Erichsenella* have a more or less well-

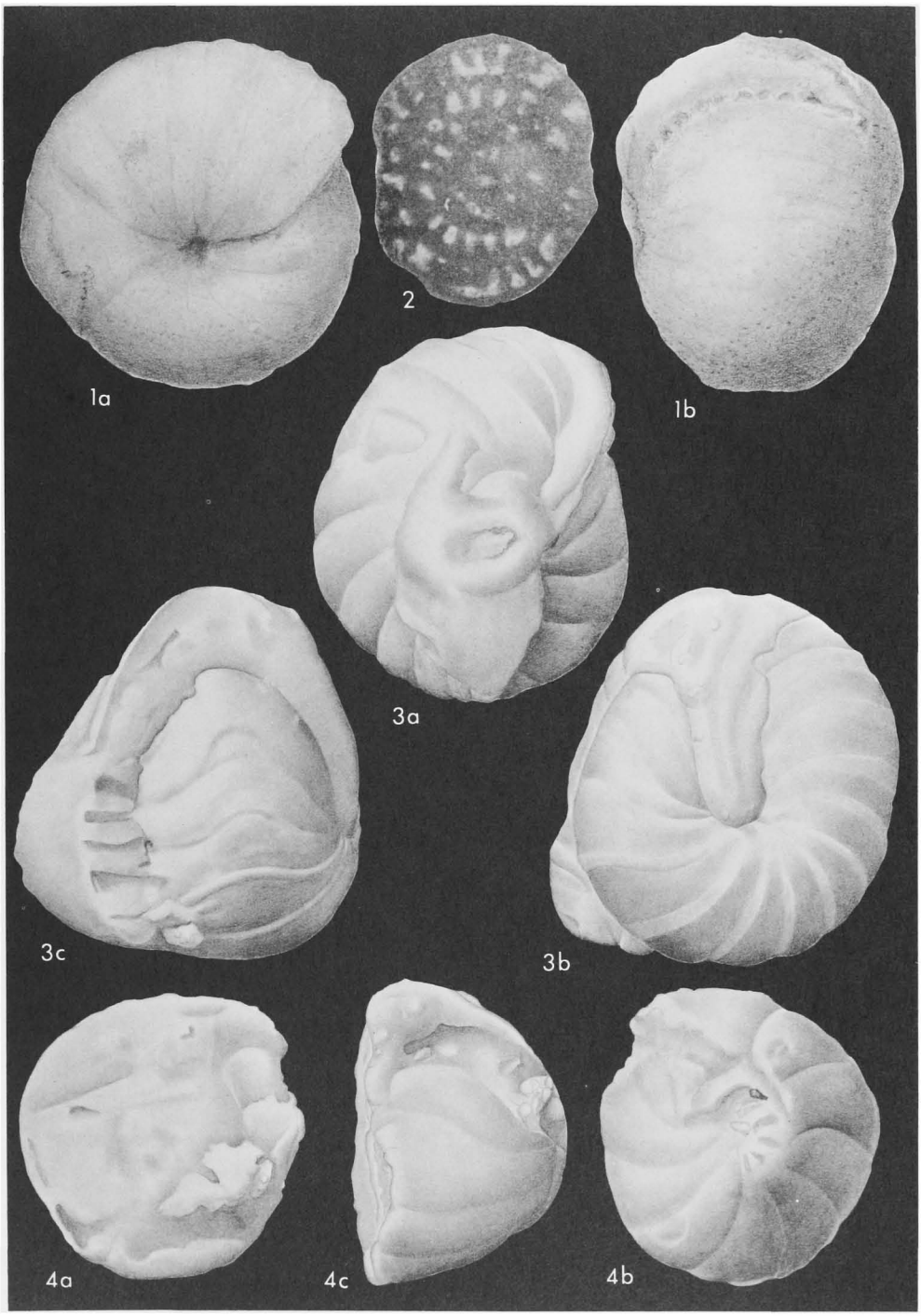


FIG. 366. Barkerinidae; *1,2, Barkerina; 3,4, Rabanitina* (p. C481-C482).

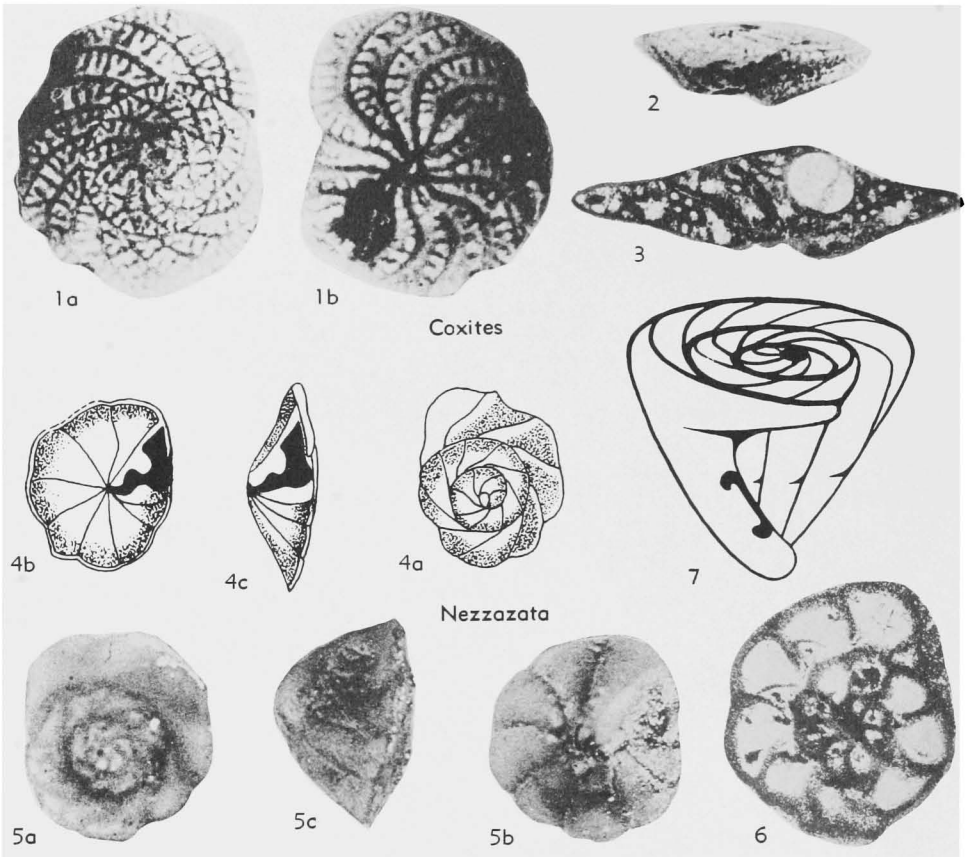


FIG. 367. Barkerinidae; *1-3, Coxites; 4-7, Nezzazata* (p. C481).

developed milioline stage, although this may be somewhat obscured by the irregular later chambers. *Parrina* differs from *Articulina* in being irregular in later development and in having more than one asymmetrically placed aperture.] *Rec.*, W.Pac.O.-Atl.O.——FIG. 365,*7*. **P. bradyi* (MILLETT), Rec., W.Pac.(Fiji Is.); *7a-c*, opposite sides and top view of hypotype, showing milioline early stage and numerous apertures on final chamber, ×89 (*2117).——FIG. 365,*8*. *P. kegeli* (TINOCO), Rec., Atl.O.(Brazil); *8a,b*, opposite sides of topotype, ×99 (*2117).

Pavoninoides BERMÚDEZ, 1949, *123, p. 58 [**P. panamensis*; OD]. Test flabelliform, chambers in early stage in triloculine arrangement, later uniserial, with rapidly increasing breadth; wall calcareous, imperforate, but with surface pitting; aperture multiple, single row of pores on peripheral margin of final chamber. *U.Eoc.*, C.Am.(Panama).——FIG. 365,*3*. **P. panamensis*; side view of holotype, ×28 (*2117).

Poroarticulina CUSHMAN, 1944, *479, p. 52 [**P. glabra*; OD]. Test with early chambers in quinqueloculine arrangement, later uniserial, rectilinear; aperture in early stage with tooth, in uniserial stage terminal, cribrate. *Mio.*, Eu.(Rumania).——FIG. 365,*4,5*. **P. glabra*; *4*, top view of holotype; *5*, side view of paratype, ×74 (*2117).

Family BARKERINIDAE Smout, 1956

[Barkerinidae SMOUT, 1956, p. 342] [=Barkerininae LOEBLICH & TAPPAN, 1961, p. 280 (*nom. transl. ex* family Barkerinidae SMOUT, 1956)]

Test trochospiral in early stage, later planispiral and involute, or planispiral throughout; chambers subdivided by transverse partitions; wall imperforate, calcareous, microgranular (?recrystallized); aperture single or multiple. *Cret.(Alb.-Turon.)*.

[As defined by SMOUT, the Barkerinidae included only *Barkerina*, *Coxites*, and *Rabanitina*, all characterized by a complexly folded plate subdividing the chambers. Although this is represented only by a small tooth plate in *Nezzazata*, the similarity in the imperforate granular wall and the *Nezzazata*-like juvenile stage of *Rabanitina* suggests such a relationship. The Barkerinidae are stated not to be agglutinated, the granular, commonly recrystallized imperforate wall suggesting a relationship to the porcelaneous foraminifers, as noted by SMOUT (*1805). The proloculus is not followed by a spiral passage as in the Nubeculariidae nor are the chambers coiled about an elongate axis as in the Miliolidae. The family Barkerinidae is here placed in the Miliolacea. The subdivided cham-

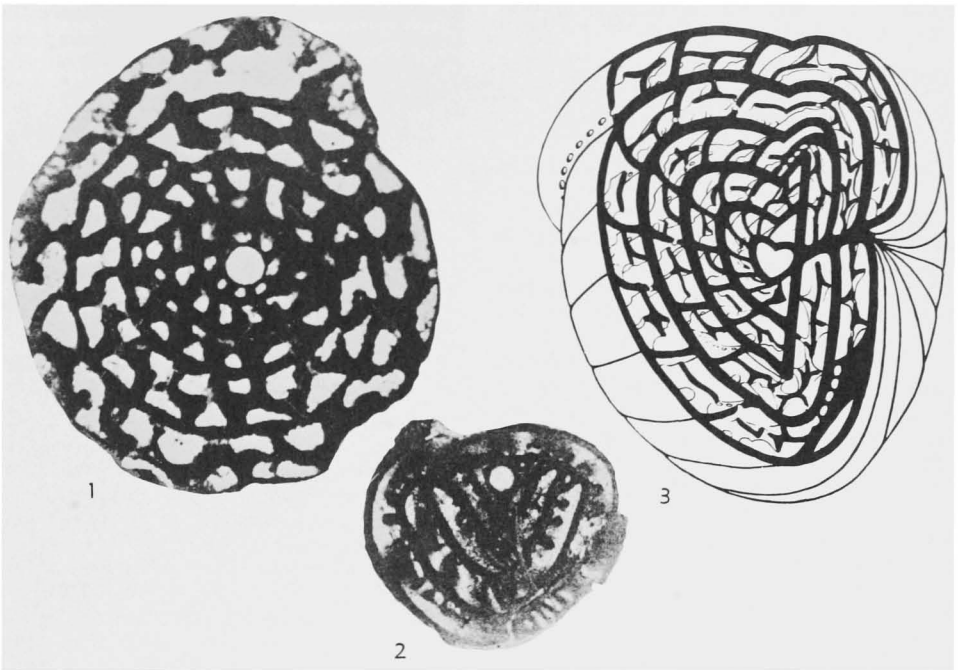


FIG. 368. Barkerinidae; *1-3, Rabanitina* (p. C482).

bers are similar to the Soritidae and Alveolinidae, but the early trochospiral development is distinct.]

Barkerina FRIZZELL & SCHWARTZ, 1950, *753, p. 5 [**B. barkerensis*; OD]. Test planispirally coiled, involute; chambers numerous, low and broad, subdivided internally by transverse partitions, visible on eroded specimens; wall of microgranular calcite; aperture comprising row of arched openings at base of septal face. *L.Cret.(Alb.)*, USA (Tex.).——FIG. 366,*1,2*. **B. barkerensis*; *1a,b*, side, edge views of holotype, ×86 (*2117); *2*, sec. showing subdivided chambers, ×60 (*753).

Coxites SMOUT, 1956, *1805, p. 342 [**C. zubairensis*; OD]. Test trochospiral, unequally biconvex, with all whorls visible on flattened spiral side, only final whorl visible on low conical umbilicate opposite side, periphery acute; chambers numerous, low and curved, with long marginal prolongation as in *Nezzazata*, with incomplete oblique longitudinal plate extending from roof to floor of each chamber, transverse partitions in all chambers, commonly simple, more rarely forked; sutures curved, flush but distinct; wall of thin, imperforate, granular calcite, without arenaceous particles, internal structure visible through thin, almost transparent wall; apertural characters unknown as apertural face is broken in all specimens observed. *U.Cret.(Turon.)*, SW. Asia(Iraq).——FIG. 367,*1-3*. **C. zubairensis; 1a,b*, opposite sides of holotype; *2*, edge view of paratype; *3*, axial sec., ×40 (*1805).

Nezzazata OMARA, 1956, *1389, p. 887 [**N. simplex*; OD] [=*Begia* SMOUT, 1956, *1805, p. 339 (type, *B. gyra*)]. Test trochospiral, plano-convex to unequally biconvex, all whorls visible from flattened to slightly convex spiral side, only those of final whorl visible around closed umbilical region; chambers with projection at periphery similar to tectum of *Alabamina*; wall calcareous, imperforate (*1805, *1527) or possibly finely perforate (*1389), microgranular in structure, described as nonlamellar, septa single (monolamellar); aperture a narrow interiomarginal opening from near umbilicus to periphery, bending up apertural face parallel to peripheral margin, internal tooth plate extending between adjacent septa may attach to outer chamber wall where it shows as slight indentation of suture. *Cret.(Alb.-Turon.)*, Afr.-Asia(Israel-Iraq).—— FIG. 367,*4*. **N. simplex*, U.Cret.(Cenoman.), Egypt; *4a-c*, opposite sides and edge view of holotype, ×38 (*1389).——FIG. 367,*5-7*. *N. gyra* (SMOUT), U. Cret.(Turon.), Iraq; *5a-c*, opposite sides and edge view of holotype, ×40; *6*, horiz. sec., showing tooth plates, ×40; *7*, oblique diagram of exterior, showing tectum, angled aperture and apert. tooth, enlarged (*1805).

[The position of this genus is doubtful. It was placed in the Ceratobuliminidae by SMOUT (*1805), though it lacks an aragonitic wall. It was compared to the "Rotaliidea" by OMARA (*1389) but regarded as differing from that superfamily in its granular wall. REISS (*1527) referred the genus to the Barkerinidae. The photomicrographs given by SMOUT and REISS suggest the recrystallized porcelaneous

wall as figured by Wood (*2073, pl. 13, fig. 2) for *Alveolinella,* and the family Barkerinidae is here regarded as having a porcelaneous wall.]

Rabanitina Smout, 1956, *1805, p. 343 [**R. basraensis*; OD]. Test subspherical, early stage trochospiral, plano-convex and umbilicate on elevated umbilical side, then changing abruptly to completely involute, globular form; in all adult chambers, complex longitudinal perforated plate roughly parallels spiral wall, but it is twisted and buttressed to chamber floor and roof; sutures flush or slightly depressed, septa radial; shell calcareous, nonlamellar, microgranular, without arenaceous matter, porcelaneous, imperforate, but shell material altered in described specimens, surface not ornamented; aperture not observed. [*Rabanitina* is similar to *Barkerina* in the adult, but differs in having an early conical trochospiral stage.] *U.Cret.(L.Cenom.),* Iraq.——Fig. 366,*3,4*; 368,*1-3*. **R. basraensis;* 366,*3a-c,* opposite sides and edge view of involute adult specimen, ×40 (*2117); 366,*4a-c,* opposite sides and edge view of young trochospiral specimen, ×40 (*2117); 368,*1,2,* subequat. and axial secs., ×30; *3,* block diagram showing relationship of axial and equat. secs., enlarged (*1805).

Family SORITIDAE Ehrenberg, 1839

[*nom. correct.* Galloway, 1933, p. 132 (*pro* family Soritina Ehrenberg, 1839, table opposite p. 120)]——[All names cited are of family rank; dagger(†) indicates *partim*]——[=Planulacea and Planulacés de Blainville, 1825, p. 370 (*nom. nud.*); =Polythalamat Latreille, 1825, p. 161 (*nom. nud.*); =Cristata Crouch, 1827, p. 40 (*nom. nud.*); =Helicostèguest d'Orbigny, 1826, p. 268 (*nom. nud.; nom. neg.*); =Enthomostèguest d'Orbigny, 1826, p. 304 (*nom. nud.; nom. neg.*); =Cristacidae Broderip, 1839, p. 321 (*nom. nud.*); =Helicosorinat Ehrenberg, 1839, table opp. p. 120 (*nom. nud.*); =Asterodiscinat Ehrenberg, 1839, table opp. p. 120; =Myrioporina Agassiz, 1844, p. 16 (*nom. nud.*); =Nautiloidat Schultze, 1854, p. 53 (*nom. nud.*); =Heliostegiat Reuss, 1860, p. 151, 205 (*nom. nud.*)]——[=Orbitolitidae Gray, 1840, *fide* Agassiz, 1844, p. 19 (cited in error as Gray, 1804); =Orbitulitidea Reuss, 1862, p. 376; =Orbitulitideae Gümbel, 1870, p. 27; =Orbiculinida Jones in Griffith & Henfrey, 1875, p. 319; =Orbitulitidee Schwager, 1876, p. 483; =Orbitulita Marriott, 1878, p. 31; =Orbitolitina Bütschli in Bronn, 1880, p. 192; =Familie des Orbitolites Douvillé, 1902, p. 290 (*nom. neg.*); =Familie des Orbiculines Douvillé, 1902, p. 297 (*nom. neg.*)]——[=Soritida Schultze, 1854, p. 53]——[=Peneroplidae Reuss, 1860, p. 151; =Peneroplideae Reuss, 1860, p. 217; =Peneroplidea Reuss, 1862, p. 379; =Peneroplida Schmarda, 1871, p. 165; =Peneroplidee Schwager, 1876, p. 483; =Peneroplidina Bütschli in Bronn, 1880, p. 190; =Peneroplinae Delage & Hérouard, 1896, p. 124; =Peneroplididae Lister in Lankester, 1903, p. 143]——[=Cristellaridae Reuss, 1860, p. 151, 205; =Cristellaridea Reuss, 1862, p. 307, 335, 368; =Cristellarideae Gümbel, 1870, p. 54; =Cristellarida Schmarda, 1871, p. 165; =Cristellaroidi Schwager, 1876, p. 477; =Cristellarioidea Schwager, 1877, p. 19; =Cristellariidae Wedekind, 1937, p. 98]——[=Poritida Schmarda, 1871, p. 165; =Keramosphaerina Lankester, 1885, p. 847; =Keramosphaerinae Delage & Hérouard, 1896, p. 127; =Keramosphaeridae Lister in Lankester, 1903, p. 143; =Meandropsinidae Henson, 1948, p. 77] [=Soritina Ehrenberg, 1838, p. 200 (*nom. nud.*); genus invalid until 1840] [Also =Orbitulitida Haeckel, 1894, p. 185]

Wall calcareous, porcelaneous, may be pitted or perforated in early stage; chambers planispiral, later serial, flabelliform or cyclical; interior simple or labyrinthic; aperture single and simple, dendritic, or multiple. [Because of its type-species, *Cristellaria* is a synonym of *Peneroplis,* hence the family and subfamily names based on *Cristellaria* are included here.] *U.Trias.-Rec.*

Subfamily PENEROPLINAE Schultze, 1854

[*nom. correct.* Cushman in Eastman, 1913, p. 39 (*pro* subfamily Peneroplida Schultze, 1854, p. 53)]——[All names cited are of subfamily rank]——[=Cristellarida Schultze, 1854, p. 53; =Cristellarinae Rhumbler, 1895, p. 91; =Peneroplidinae Brady, 1884, p. 62; =Spirolininae Cushman, 1927, p. 54]

Test close-coiled in early stage, later may be uncoiled or annular; chambers simple, not divided into chamberlets; aperture rounded, slitlike, or series of pores on final septal face. *U.Trias.-Rec.*

Peneroplis de Montfort, 1808, *1305, p. 258 [**Nautilus planatus* Fichtel & Moll, 1798, *716, p. 91; OD] [=*Cristellaria* Lamarck, 1816, *1089, p. 14 (type, *Nautilus planatus* Fichtel & Moll, =*C. squammula* Lamarck, 1822, *1090, p. 607 (obj.), SD Children, 1823, *337, p. 117=153); *P. (Peneroplis)* d'Orbigny in de la Sagra, 1839, *1611, p. 59 (obj.); *Archiacina* Munier-Chalmas in Vasseur, 1878, *1987, p. 1049 (type, *Cyclolina armorica* d'Archiac in Tournour, 1868, *1947, p. 376); *Laevipeneroplis* Šulc, 1936, *1850, p. 161 (type, *Peneroplis karreri* Wiesner, 1923, *2062, p. 95, 96); *Puteolus* Hofker, 1950, *933a, p. 394 (type, *Peneroplis protea* d'Orbigny, 1839, *1611, p. 60) (*non Puteolus* Monterosato, 1888); *Puteolina* Hofker, 1952, *933c, p. 450 (*nov. nom. pro Puteolus* Hofker, 1950, *non* Monterosato, 1888)]. Test compressed, planispirally enrolled at least in early stages, later may be uncoiled and flaring, external form variable; chambers broad, low, not subdivided; wall porcelaneous, surface smooth, pitted, or more commonly, longitudinally striate; aperture terminal, row of slits in slight depression along the apertural face. [*Puteolus* (=*Puteolina*) was based on a species with pitted rather than striate surface ornamentation. We do not regard ornamentation as of generic importance.] *?U.Cret., Eoc.-Rec.,* cosmop.——Fig. 369,*1*. **P. planatus* (Fichtel & Moll), Rec., Medit. Sea; *1a,b,* side, edge views, ×45 (*2117).——Fig. 369,*2,3*. *P. proteus* d'Orbigny; Rec., W.Indies *(2),* Bermuda *(3);* side views, ×30 (*200).——Fig. 369,*4,5*. *P. armorica* (d'Archiac), M.Oligo., Eu.(Fr.); topotypes, showing tendency of species to become cyclical, ×37 (*2117).

Dendritina d'Orbigny, 1826, *1391, p. 285 [**D. arbuscula*; SD Cushman, 1927, *433, p. 189] [=*Peneroplis (Dendritina)* d'Orbigny in de la Sagra, 1839, *1611, p. 58 (obj.); *Meneghinia* O. Silvestri, 1889, *1792, p. 53 (*non Meneghinia* Fucini, 1931) (type, *M. nautiliformis*); *Neopeneroplis* Didkovskiy, 1958, *594, p. 1252 (type, *N. sarmaticus*)]. Test free, planispirally enrolled,

nearly or completely involute; chambers simple, not subdivided; surface smooth or striate; aperture dendritic, on apertural face. *Eoc.-Rec.*, Eu.-Carib.-Afr.-Atl.O.——Fig. 370,*1*. **D. arbuscula*, Mio., Fr.; *1a,b*, side, apert. views, enlarged (*1391).

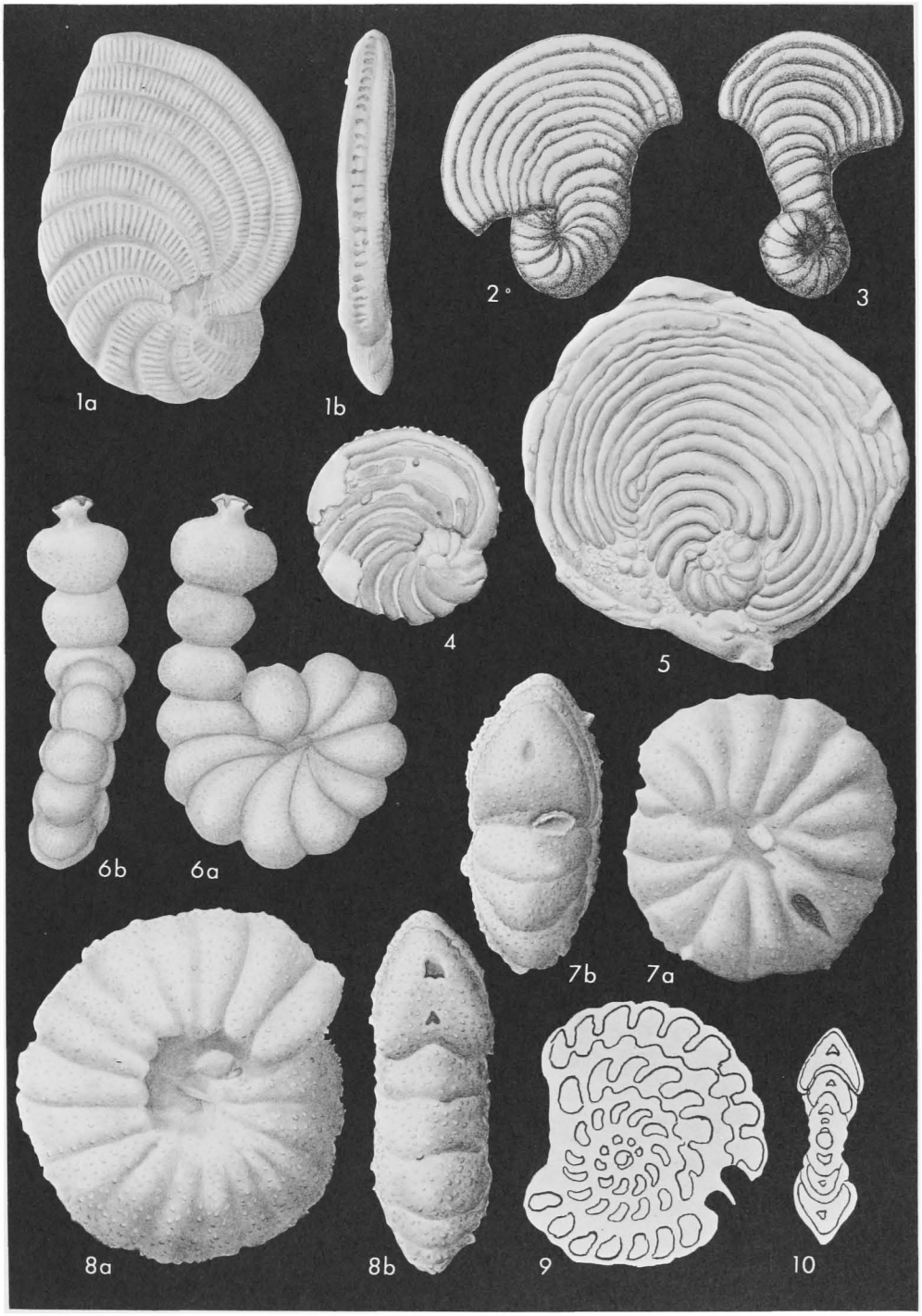


Fig. 369. Soritidae (Peneroplinae; *1-5, Peneroplis; 6, Monalysidium; 7-10, Praepeneroplis*) (p. C482, C484).

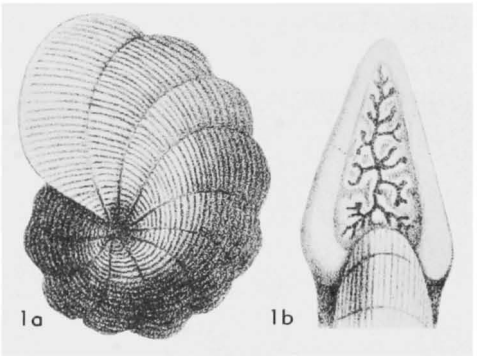


FIG. 370. Soritidae (Peneroplinae; *1, Dendritina*) (p. C482-C483).

Monalysidium CHAPMAN, 1900, *314, p. 3 [**Peneroplis (Monalysidium) sollasi*; OD] [=*Peneroplis (Monalysidium)* CHAPMAN, 1900, *314, p. 3 (obj.)]. Test free, with early subglobular chambers arranged in evolute planispiral coil, later uncoiled and rectilinear; wall calcareous, distinctly perforate in appearance; aperture terminal, somewhat produced on neck with phialine, fimbriate lip. *Rec.*, Pac.O.——FIG. 369,*6*. **M. sollasi*, Funafuti Atoll; *6a,b*, side, edge view of holotype, ×105 (*1166).

Praepeneroplis HOFKER, 1952, *933c, p. 463 [*pro Protopeneroplis* HOFKER, 1950, *933a, p. 393 (*non* WEYNSCHENCK, 1950)] [**Peneroplis senoniensis* HOFKER, 1949, *931, p. 41; OD]. Test free, closely enrolled, planispiral, slightly evolute, with numerous chambers to whorl of triangular transverse section; sutures radial, depressed; wall porcelaneous; aperture areal, simple, ovate, or with a toothlike projection from lower margin resulting in triangular opening. [*Praepeneroplis* is similar to *Dendritina* in its close-coiled planispiral test but differs in the simple areal, rather than dendritic, aperture.] *U.Cret.(Senon.)*, Eu. (Neth.).——FIG. 369,*7-10*. **P. senoniensis* (HOFKER); *7a,b*, *8a,b*, side and edge views, ×86 (*2117); *9,10*, equat. and axial secs., ×50 (*933b).

Renulina LAMARCK, 1804, *1085c, p. 353 (*non* DE BLAINVILLE, 1825; *nec* BLAKE, 1876) [**R. opercularia*; OD (M)] [=*Renulites* LAMARCK, 1804, *1085c, p. 353 (obj.); *Renulinites* LAMARCK, 1804, *1085c, p. 353 (*nom. null.*)]. Test enrolled in early stage, with tubular chambers nearly full whorl in length, later reduced to 2 or 3 to whorl, then expanding in height and rapidly expanding in breadth, resulting in flabelliform test; surface of type-species smooth; aperture single narrow elongate slit extending length of terminal face. [Differs from *Peneroplis* in having a single slitlike aperture rather than a row of pores.] *M.Eoc.(Lutet.)*, Eu. (Fr.).——FIG. 371,*1*. **R. opercularia*; *1a,b*, side, apert. views, ×62 (*2117).

Spirolina LAMARCK, 1804, *1085c, p. 244 [**S. cylindracea*; SD CUSHMAN, 1927, *432, p. 125] [=*Spirolinites* LAMARCK, 1804, *1085c, p. 245 (obj.); *Coscinospira* EHRENBERG, 1839, *667, p. 110, 131 (type, *C. hemprichii*, SD LOEBLICH & TAPPAN, herein); *Spirulina* EHRENBERG, 1843, *670, p. 167 (*nom. van., pro Spirolina* LAMARCK, 1804, *non Spirulina* BORY, 1826); *Spiralina* BROWN, 1944, *246, p. 145 (*nom. van. pro Spirolina* LAMARCK, 1804) (*non Spiralina* HARTMANN, 1840; *nec* CHASTER, 1898; *nec* MARTENS, 1899)]. Test planispirally enrolled and biumbilicate in early stage, later uncoiling and cylindrical; chambers short; wall calcareous, porcelaneous, surface smooth or many be longitudinally striate; aperture terminal, rounded, with numerous toothlike projections extending into opening. *Eoc.-Rec.*, Eu.-N.Am.-Medit. Sea-Carib. Sea-Atl.O.-Pac.O.——FIG. 371,*2*. **S. cylindracea*, M.Eoc.(Lutet.), Fr.; *2a,b*, side, top views of topotype, ×54 (*2117).

Triasina MAJZON, 1954, *1205, p. 245 [**T. hantkeni*; OD]. Test free, numerous small chambers planispirally arranged in 7 to 9 whorls; short radial septa; wall calcareous, porcelaneous, imperforate, surface with small nodes; apertural character unknown. *U.Trias.*, Eu.(Hung.).——FIG. 372,*1-3*. **T. hantkeni*; *1,2*, ext., ×138; *3*, equat. sec., ×150 (*1205).

Vandenbroeckia MARIE, 1958, *1223, p. 128 (*nom. correct.* ELLIS & MESSINA, 1940, *700, *pro Vandenbroekia* MARIE, 1958, *nom. imperf.*) [**V. munieri*; OD]. Test compressed, early stage en-

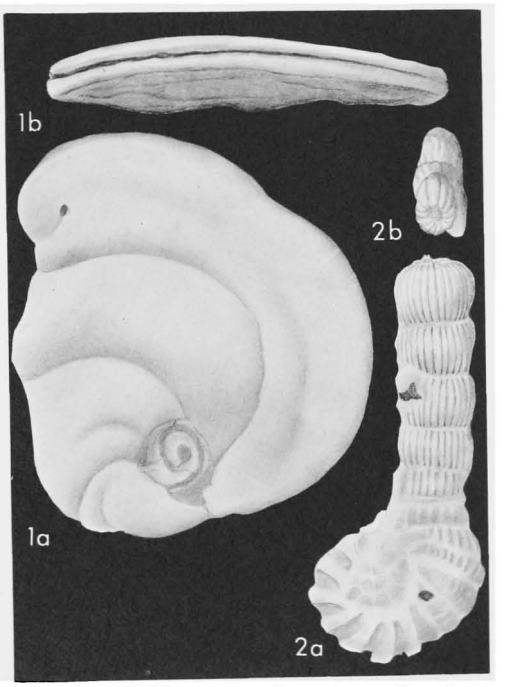


FIG. 371. Soritidae (Peneroplinae; *1, Renulina; 2, Spirolina*) (p. C484).

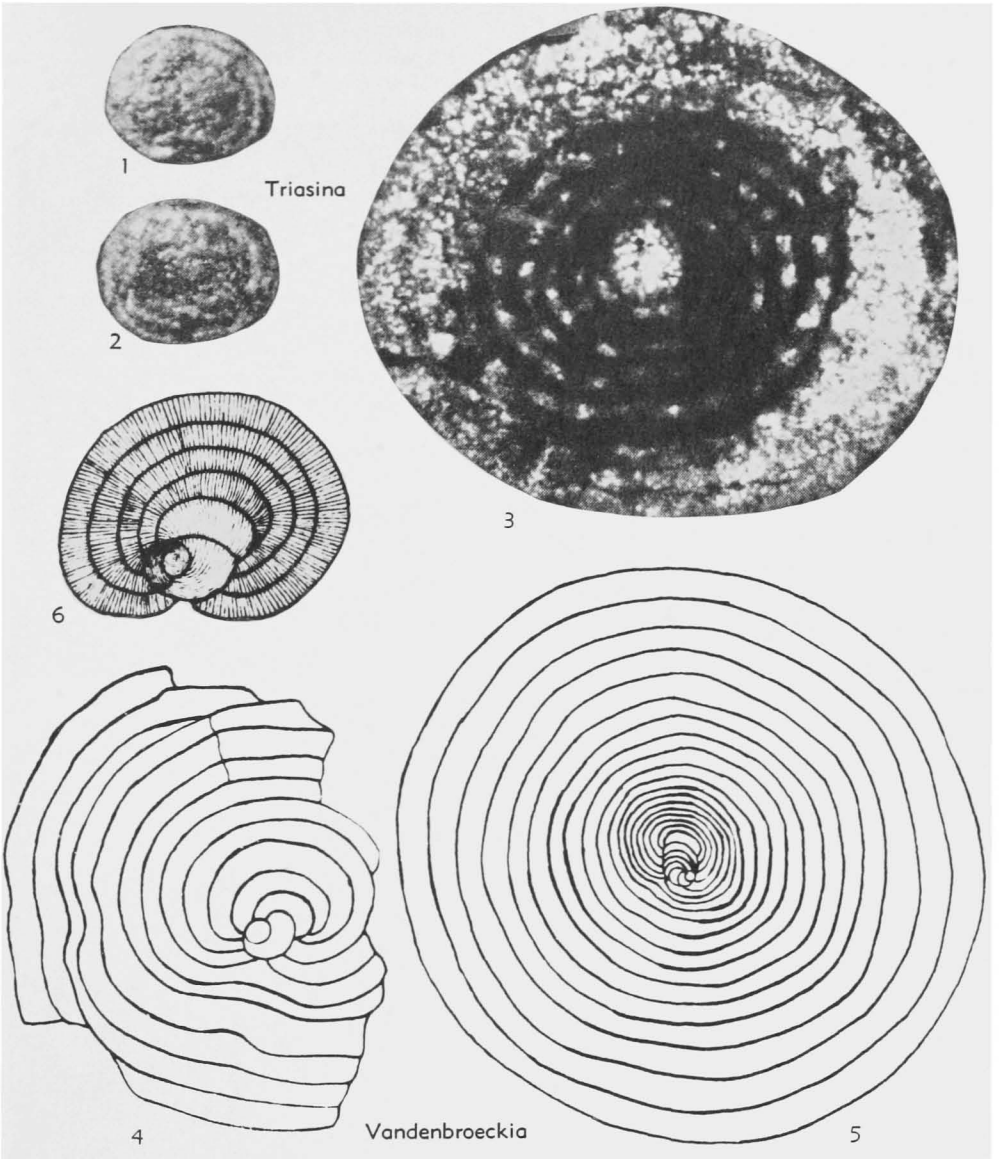


FIG. 372. Soritidae (Peneroplinae; *1-3, Triasina; 4-6, Vandenbroeckia*) (p. C484-C485).

rolled, later with chambers increasing rapidly in breadth and finally cyclical, interior not subdivided; surface may have longitudinal striae; aperture row of circular perforations on periphery. *U.Cret.(Senon.),* Eu.(Fr.).——FIG. 372,*4-6*. **V. munieri*; *4,* outline of megalospheric holotype, ×13.5; *5,* microspheric test, ×13.5; *6,* early portion of megalospheric test showing ornamentation, ×19 (*1223).

Subfamily MEANDROPSININAE Henson, 1948

[*nom. transl.* SIGAL in PIVETEAU, 1952, p. 202 (*ex* family Meandropsinidae HENSON, 1948)] [=Broekininae MARIE, 1958, p. 128]

Early stage planispirally coiled, later may be discoidal, operculiform, flabelliform, cylindrical or conical in shape; subepidermal chamberlets in marginal zone, with interseptal pillars; aperture commonly cribrate. *U.Cret.-Paleoc.*

Meandropsina MUNIER-CHALMAS in SCHLUMBERGER, 1898, *1658, p. 336 [**M. vidali* SCHLUMBERGER, 1898, *1658, p. 337; SD CUSHMAN, 1928, *439, p. 220] [=*Cyclomeandropsina* HENSON, 1950, *903, p. 5, 18 *(nom. nud.)*]. Test discoidal, enrolled, with very low and numerous chambers

containing many incomplete transverse partitions; outer margin of chambers may become meandriform; aperture multiple, in rows on periphery. *U.Cret.(Senon.)*, Eu.-SW.Asia.——Fig. 373,*1-3*. **M. vidali* Schlumberger, Sp.; *1a,b*, ext. and portion showing surface, ×4, ×10; *2*, equat.

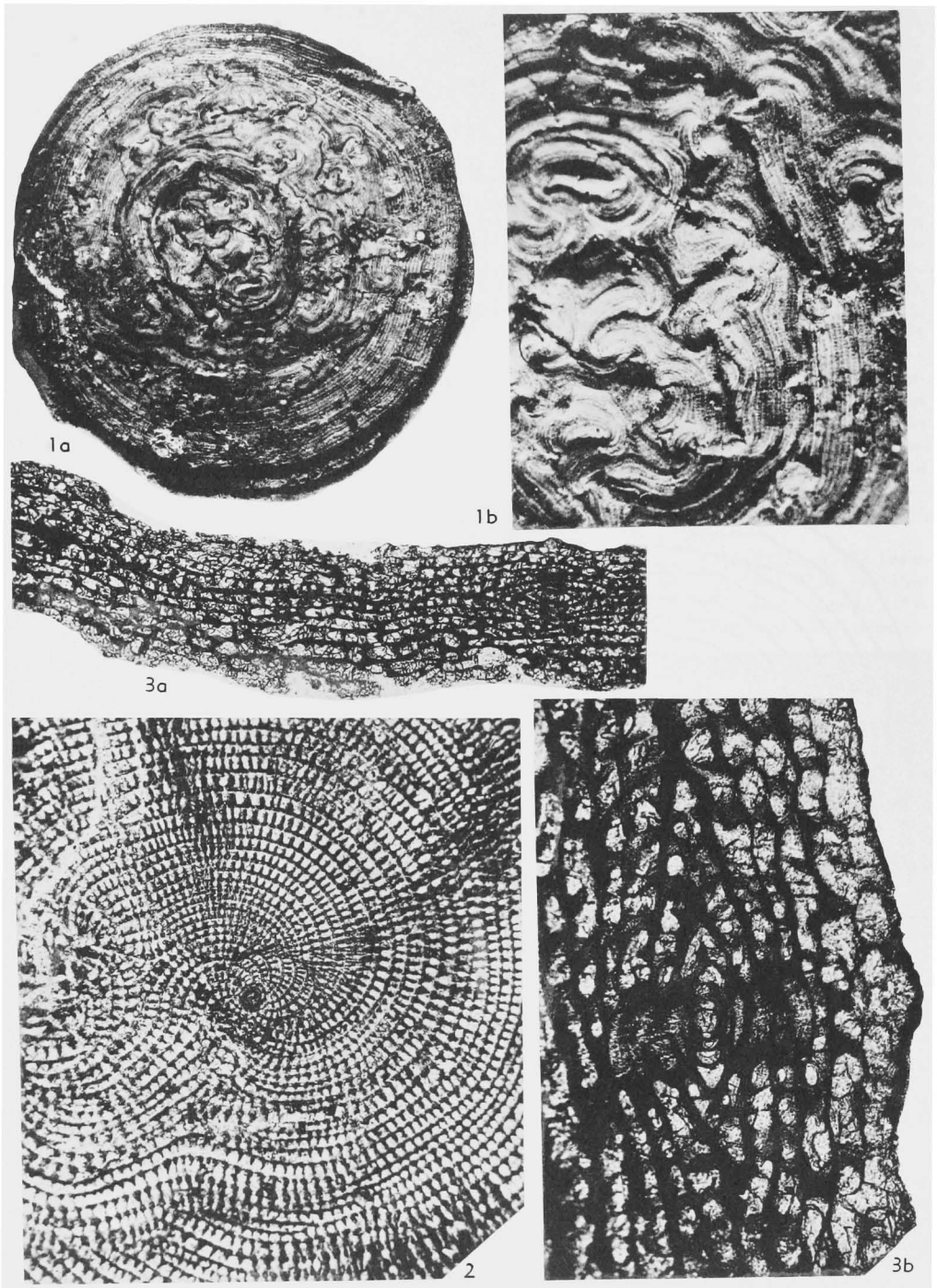


Fig. 373. Soritidae (Meandropsininae; *1-3, Meandropsina*) (p. C485-C487).

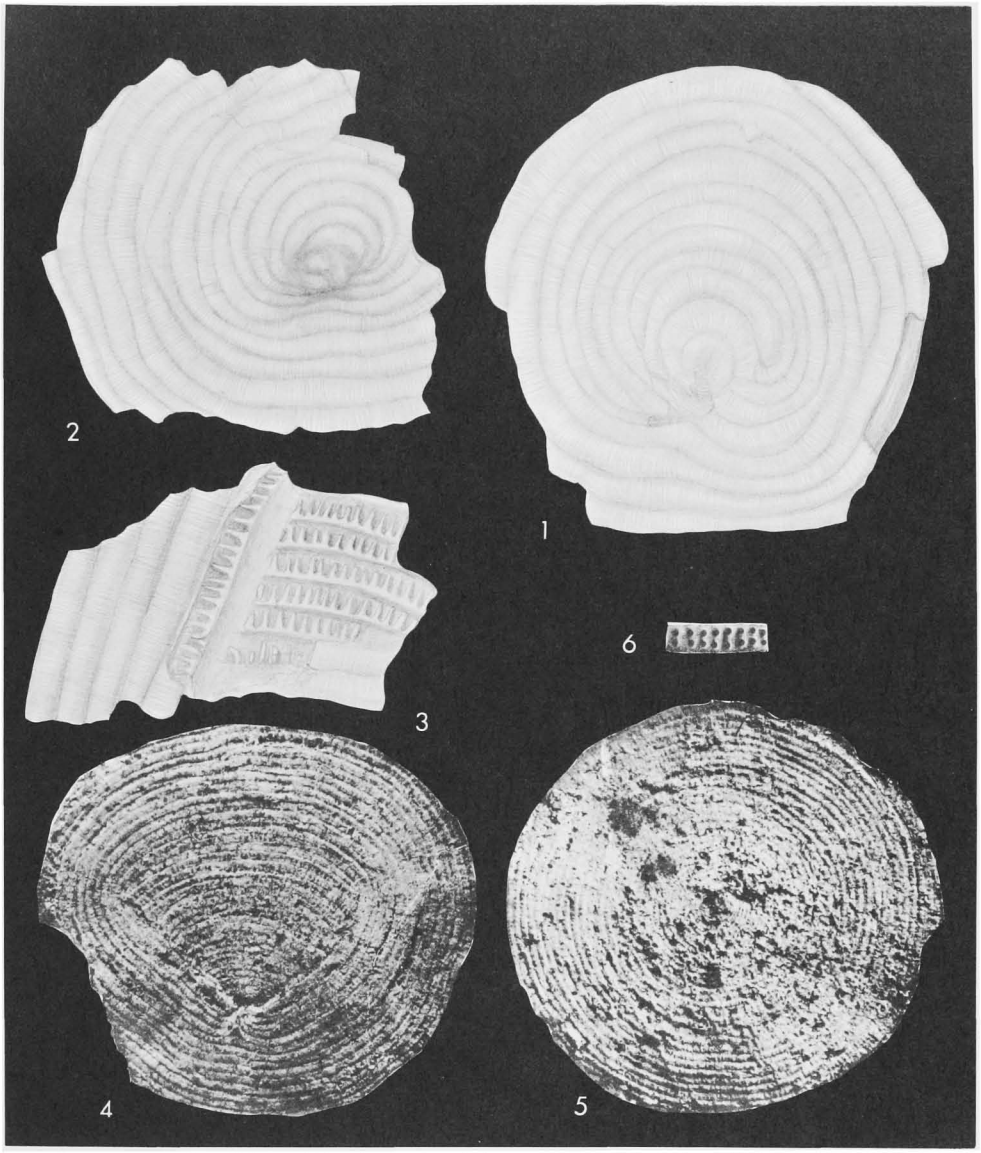


FIG. 374. Soritidae (Meandropsininae; *1-6, Broeckina*) (p. C487).

sec., ×4.5; *3a,b,* axial sec. and portion showing initial coil, ×40, ×185 (*1658).

Broeckina MUNIER-CHALMAS, 1882, *1323, p. 471 [**Cyclolina dufresnoyi* D'ARCHIAC in D'ARCHIAC & HAIME, 1854, *39, p. 205; OD] [=*Praesorites* DOUVILLÉ, 1902, *614, p. 291 (type, *P. moureti*); *Broekina* MARIE, 1958, *1223, p. 125 *(nom. van.)*]. Test discoidal, early stage with more or less well-developed coil of few chambers, which enlarge rapidly in breadth to become cyclical; interior complex, with secondary incomplete transverse partitions; wall porcelaneous; aperture consisting of 2 rows of circular openings on peripheral margin of final chamber. [The synonymy of *Broeckina* and *Praesorites* was noted by MARIE (1958, *1223). *Praesorites* is here suppressed as it is a junior synonym.] *U.Cret.(Senon.),* Eu. ——FIG. 374,*1,2*. **B. dufresnoyi* (D'ARCHIAC), Fr. (side views of specimens of MUNIER-CHALMAS, Paris); *1,* ×17; *2,* ×10 (*2117).——FIG. 374,*3-6*. *B. moureti* (DOUVILLÉ), L.Campan., Fr.; *3,* holotype, fragment with surface partially abraded showing chamberlets, ×12 (*2117); *4,5,* paratype, ×5; *6,* portion of margin showing aperture, ×24 (*614).

Edomia HENSON, 1948, *902, p. 84 [**E. reicheli*; OD]. Test large, flattened; chambers numerous, microspheric form apparently cyclogyrine in early

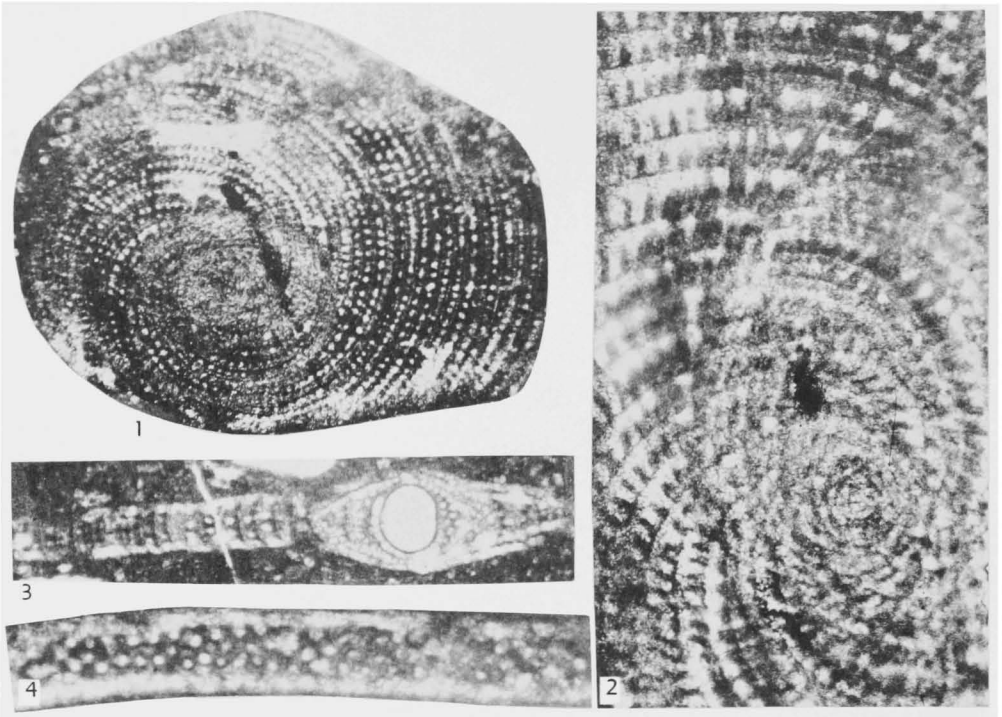


FIG. 375. Soritidae (Meandropsininae; *1-4, Edomia*) (p. C487-C488).

stage, megalospheric form with spherical proloculus and long, tubular second chamber, then numerous planispiral, involute chambers as in *Meandropsina,* with incomplete transverse interseptal partitions projecting inward from both surfaces of test, those of succeeding chambers aligned, irregularly distributed interseptal pillars occurring in central layers of later chambers; large pores pierce septa between pillars. *U.Cret.(Cenom.-Turon.),* SW.Asia(Palest.-Iran).——FIG. 375,*1-4*. **E. reicheli,* Cenom., Palest.; *1,* equat. sec. of paratype, ×26; *2,* slightly oblique equat. sec. showing interseptal partitions, ×70; *3,* axial sec. of megalospheric form, ×36; *4,* tang. sec. parallel to septum showing apert. pores, ×60 (*2115).

Fallotia DOUVILLÉ, 1902, *614, p. 298 [**F. jacquoti*; OD] [=*Fascispira* A. SILVESTRI, 1940, *1789, p. 230 (type, *F. colomi*); *Ayalaina* SEIGLIE, 1961, *1715, p. 346 (type, *Meandropsina? rutteni* PALMER, 1934, *1408, p. 252]. Test lenticular, planispirally enrolled and involute, chambers low, numerous, and internally subdivided by transverse partitions but not compressed and annular as in *Meandropsina,* although rarely chambers become meandriform, number of whorls numerous; aperture row of pores at basal margin of apertural face. *U.Cret.,* Eu.-W.Indies(Cuba). ——FIG. 376,*1-3*. **F. jacquoti,* Fr.; *1,* side view of holotype, ×7.5; *2,* fragment showing marginal meandriform deformation of chambers, ×3; *3a,b,* transv. sec. parallel to axis showing minute chamberlets and portion, enlarged, ×6.3, ×18 (*2117).——FIG. 376,*4*. *F. colomi* (A. SILVESTRI), Maastricht., Sp.; *4a,b,* side, apert. views of topotype, ×47 (*2117).

Nummofallotia BARRIER & NEUMANN, 1959, *89, p. 228 [**Nonionina cretacea* SCHLUMBERGER, 1899, *1660, p. 460 (=*Goupillaudina sanctipetri* MARIE, 1957, *1222b, p. 869); OD]. Test planispirally enrolled and involute; chambers numerous, apparently subdivided by secondary, transverse septa; originally type-species described as having calcareous perforate umbilical "button" later shown to be a product of recrystallization, when present resulting in umbilically inflated test; wall calcareous, imperforate; aperture interiomarginal. *U. Cret.(Senon.),* Eu.——FIG. 377,*1-6*. **N. cretacea* (SCHLUMBERGER), Sp. *(1,2),* Fr. *(3-6); 1,* equat. sec., ×85; *2,* axial sec. showing umbilical "buttons" on both sides of test, ×100 (*1660); *3,* axial sec. showing lenticular original form and very small amount of recrystallization, stated to be ×30 [doubtful]; *4,* axial sec. of specimen with advanced stage of recrystallization (umbilical "button" appearing white) and original internal structure almost completely resorbed, ?×30; *5,* equat. sec. of free specimen, ×50; *6,* detached umbilical "button," ×50 (*89).

[The umbilical "button," due to recrystallization of the test, tends to become detached from the remainder of the

shell and has been described as various "species" of different rotaliform genera. The "buttons" have been shown in thin sections to be varied in development, sometimes appearing on only one side of the test, though commonly they are developed to a variable degree on both sides. They are best observed in axial sections. The original internal structure of the test is not well known, no free specimens occurring without the recrystallized central

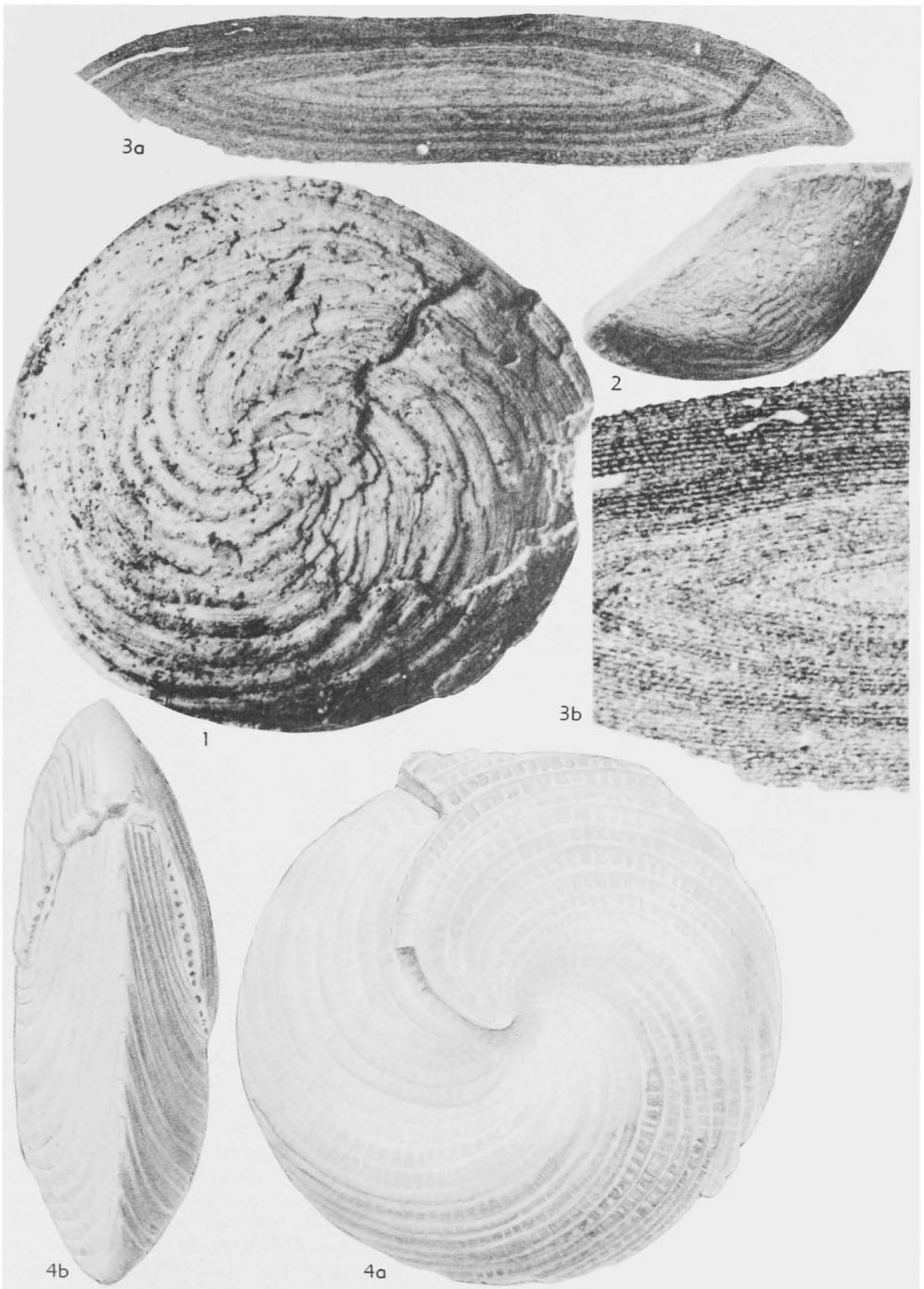


FIG. 376. Soritidae (Meandropsininae; *1-4, Fallotia*) (p. C488).

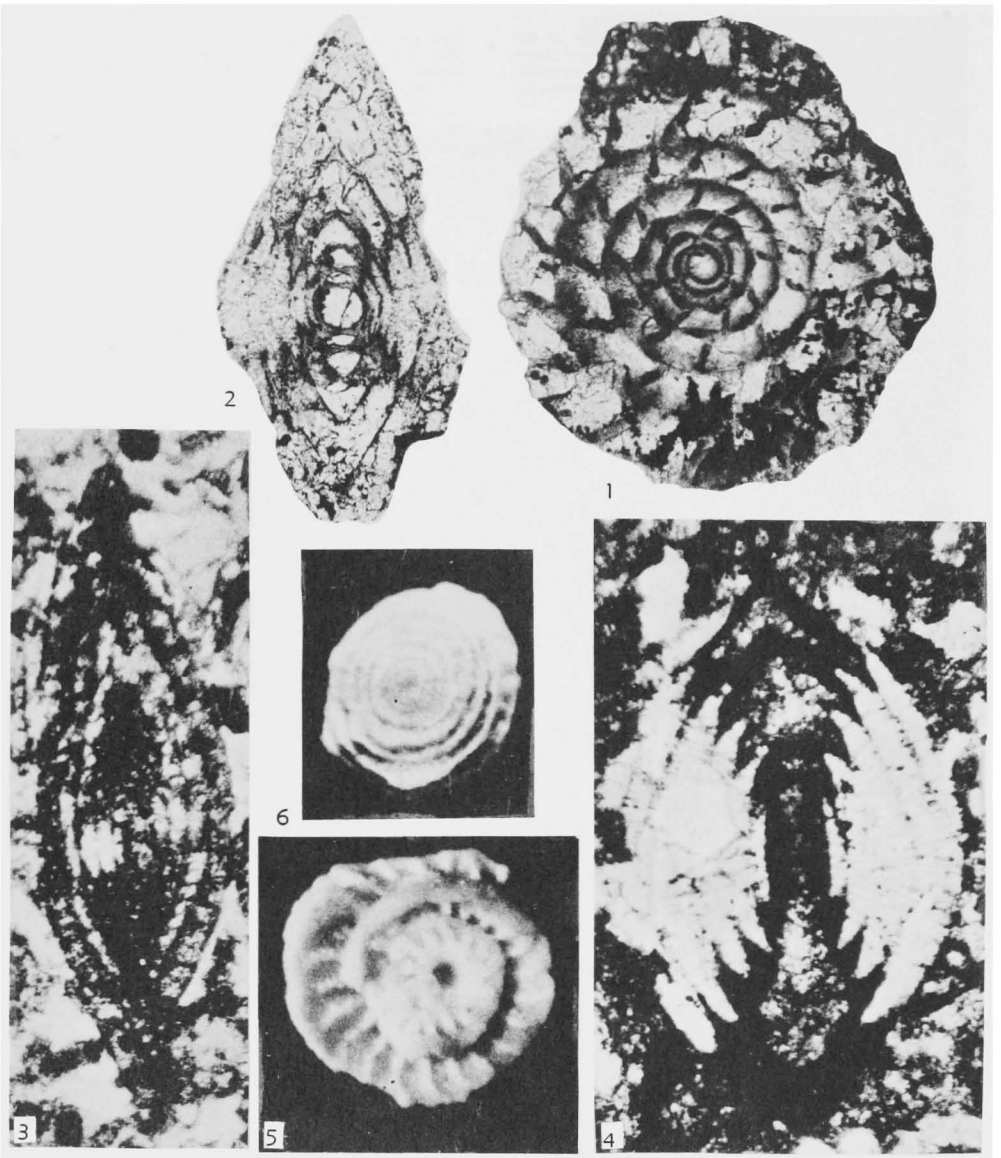


FIG. 377. Soritidae (Meandropsininae; *1-6, Nummofallotia*) (p. C488-C490).

area. Some axial sections indicate the presence of secondary transverse septa, but these are apparently not observable on free specimens. A noticeable similarity of *Nummofallotia* to sections of *Praepeneroplis senoniensis* (HOFKER) from the Senonian of the Netherlands is observed but the recrystallization phenomenon has not been noted in *Praepeneroplis*, which also lacks indications of secondary transverse septa. The exterior of *Nummofallotia* is unknown. Additional study is required in order to determine if *Nummofallotia* is a junior synonym of *Praepeneroplis*. The stated magnification of the accompanying figured sections of the French specimens seems questionable, as the figures of axial sections appear nearly twice the diameter of equatorial sections; the original plate explanation stated them to be half this magnification. No test measurements were given for the French specimens but those from Spain were stated to be approximately 0.8 mm. in diameter, indicating that the axial sections probably are about ×100, not ×30.]

Pseudedomia HENSON, 1948, *902, p. 95 [**P. multistriata*; OD]. Test flattened, early stage planispiral, evolute, bilaterally symmetrical, later flabelliform, with uniserial chambers; numerous transverse secondary partitions project short distance into chambers from outer wall, median region of each chamber with single row of large interseptal pillars; apertures not observed. [Differs from *Edomia* in its evolute early planispiral stage and uniserial later stage. The genus is known only from the holotype of the type-species.] *U. Cret.(Maastricht.)*, Asia(Arabia, Qatar Penin.).

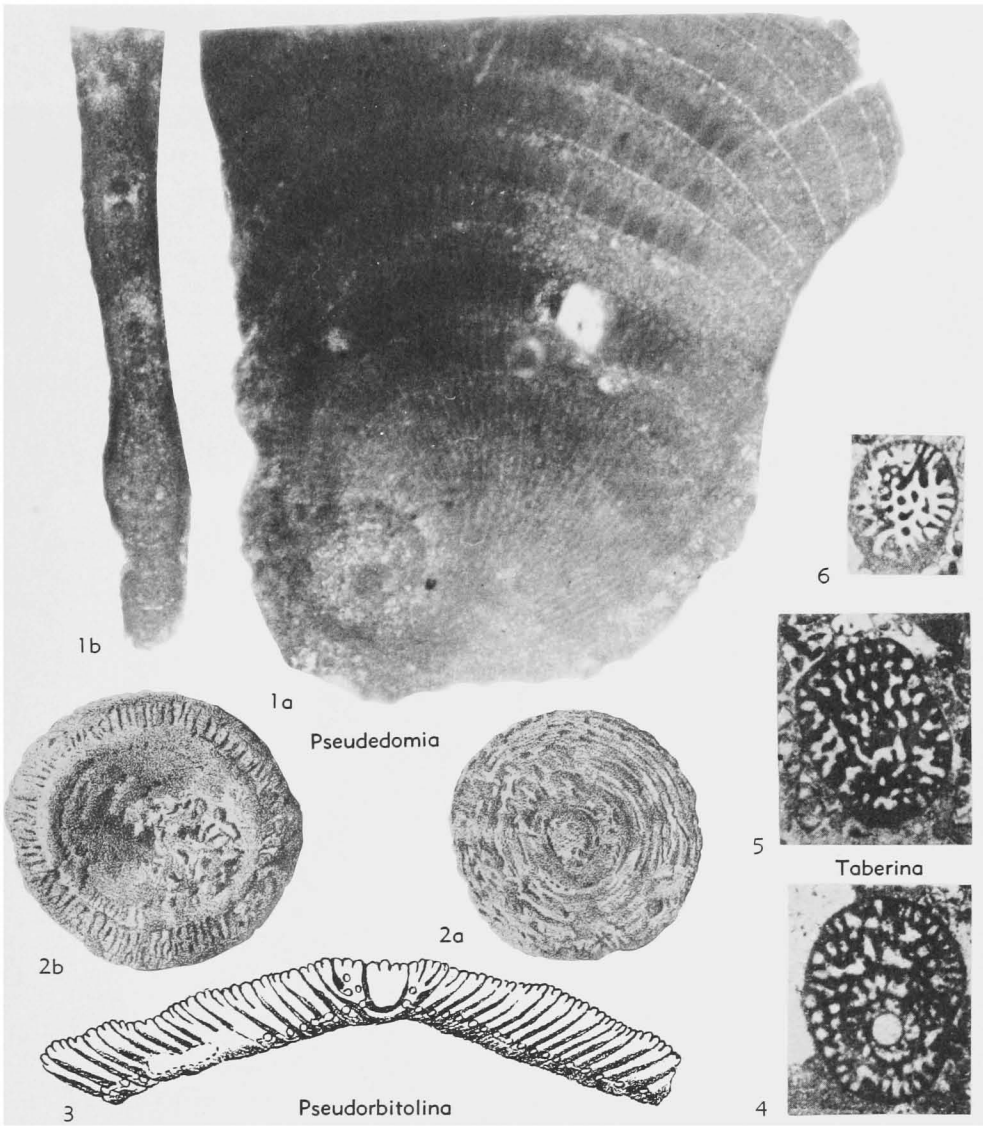


FIG. 378. Soritidae (Meandropsininae; *1, Pseudedomia; 2,3, Pseudorbitolina; 4-6, Taberina*) (p. C490-C493).

——FIG. 378,*1*. **P. multistriata; 1a,* equat. sec. of holotype, ×41; *1b,* transv. sec. of fragment of holotype cutting through interseptal pillars, ×45 (*2115).

Pseudorbitolina DOUVILLÉ, 1910, *619, p. 57 [**P. marthae*; OD]. Test low conical to concavoconvex; with transverse and parallel subepidermal partitions on one side of test, transverse partitions thickening inward to form chamberlets; wall agglutinated, convex side with concentric growth lines and reticulate surface; aperture consisting of single row of openings near periphery of concave side, which open into annular canal. *U.Cret. (Maastricht.)-Eoc.,* Fr.-Arabia-Carib.——FIG. 378, *2,3*. **P. marthae,* U.Cret.(Dordon.), Fr.; *2a,b,* convex upper and concave lower surfaces showing peripheral row of openings, ×10; *3,* axial sec. showing partitions and canal openings, ×27 (*619).

Taberina KEIJZER, 1945, *1030, p. 200 [**T. cubana*; OD]. Early stage planispiral, later uncoiling and circular in section; coiled stage dominant, with short radial septa, interior with incomplete transverse interseptal partitions and interseptal pillars; aperture multiple, of pores in chamber face. [*Taberina* has both the subepidermal parti-

tions characteristic of *Meandropsina* and the interseptal pillars such as occur in *Archaias*.] *U.Cret. (Cenoman.)-Paleoc.(Dan.)*, Cuba-Iran-Syria-Palest.

——Fig. 378,*4-6*. **T. cubana*, Paleoc.(Dan.), Cuba; *4*, median sec. perpendicular to axis of coiling; *5*, tang. sec. parallel to axis of coiling;

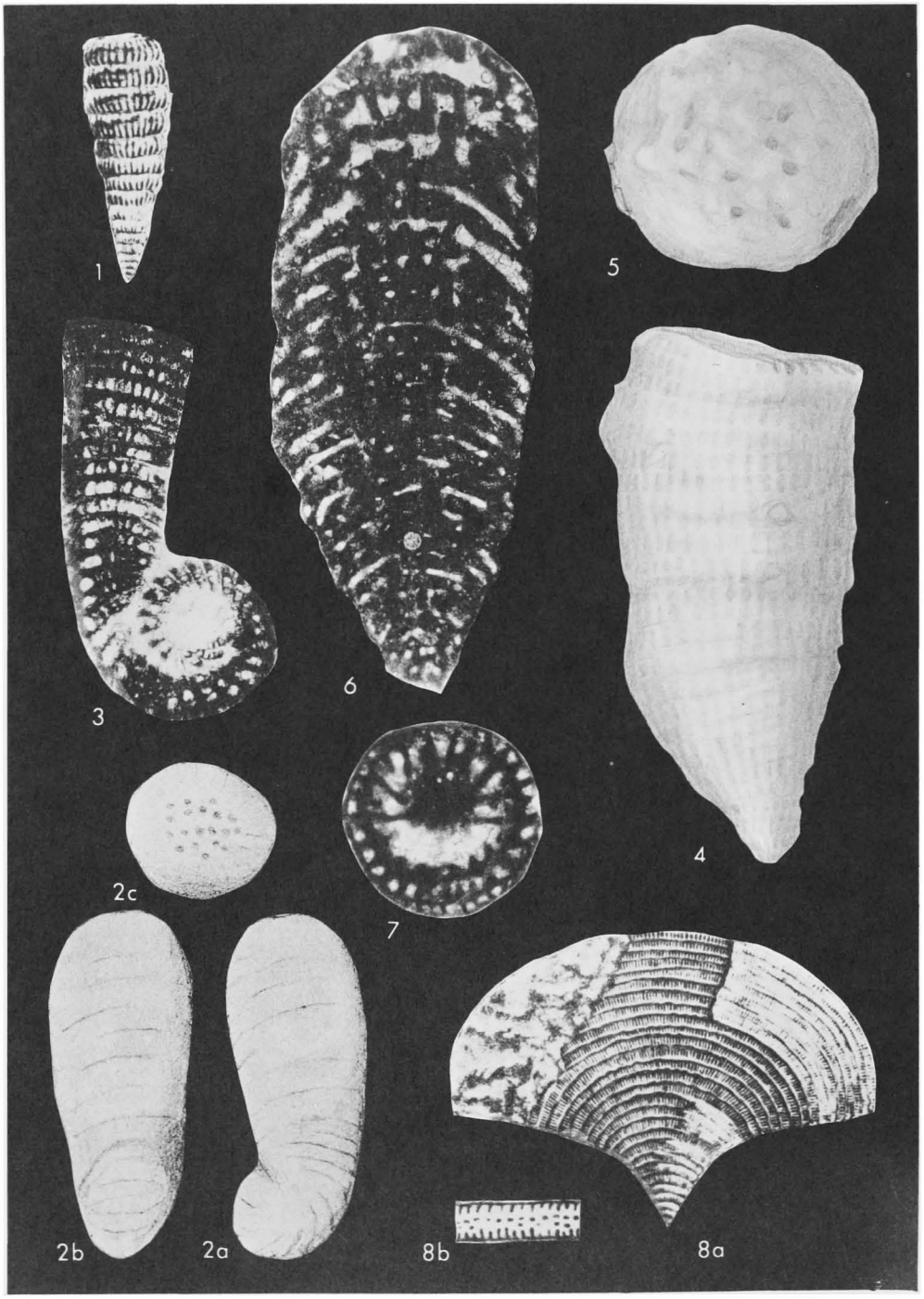


Fig. 379. Soritidae (Rhapydioninae; *1-7, Rhapydionina; 8, Rhipidionina*) (p. C493).

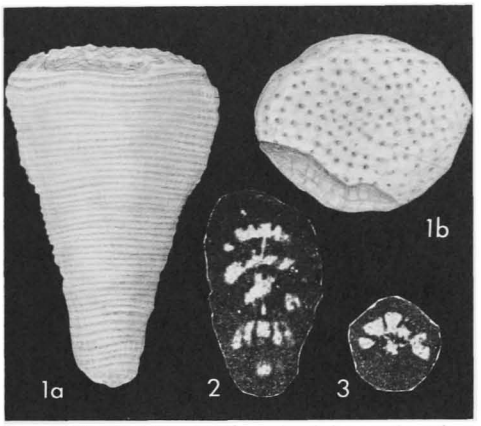


FIG. 380. Soritidae (Rhapydioninae; *1, Ripacubana; 2,3, Praerhapydionina*) (p. C493).

6, transv. sec. through terminal stage, showing apert. pores, pillars and radial partitions, ×25 (*1030).

Subfamily RHAPYDIONININAE Keijzer, 1945

[Rhapydioninae KEIJZER, 1945, p. 200]

Test elongate, conical; chambers in rectilinear series, subdivided into chamberlets; aperture terminal, cribrate. *Jur.-Rec.*

Rhapydionina STACHE, 1913, *1829, p. 661 [**Peneroplis liburnica* STACHE, 1889, *1828, p. 89; OD (M)] [=*Rhapidionina* VAN DEN BOLD, 1946, *155, p. 123 *(nom. van.)*; *Haurania* HENSON, 1948, *902, p. 11 (type, *H. deserta*)]. Test elongate, conical, early stage may have involute planispiral coil, later uniserial; chamber interior subdivided by transverse subepidermal partitions; aperture terminal, cribrate. [*Haurania* was originally included in the Lituolidae, but regarded (*902, p. 11) as "almost an isomorph of *Rhapydionina*." It is here regarded as a synonym.] *Jur.-M.Eoc.,* Istria-Iraq-Cuba-C.Am.——FIG. 379,*1. *R. liburnica* (STACHE), L.Eoc., Yugosl.(Istria); holotype, enlarged (*700).——FIG. 379,*2,3. R. urensis* HENSON, M.Eoc., Iraq; *2a-c,* opposite sides and top view of holotype, ×15; *3,* long. tang. sec. showing subepidermal partitions, ×18 (*902). ——FIG. 379,*4-7. R. deserta* (HENSON), Jur., Iraq; *4,* side view of holotype, ×41; *5,* apert. view of paratype, ×72 (*2117); *6,* long. sec. of paratype; *7,* transv. sec. of paratype, ×40 (*2115).

Craterites HERON-ALLEN & EARLAND, 1924, *912, p. 611 [**C. rectus*; OD (M)]. Test attached, club-shaped, narrowing slightly just above basal expansion and then gradually enlarging in diameter, upper surface convex, perforated; trunklike portion composed of 10 or 12 superimposed layers of polygonal chamberlets, which increase in number with expanding diameter of test; wall calcareous, nonperforate except for large apertural openings; aperture consisting of numerous large pores on upper surface, which open into chamberlets, and where upper surface has been broken away similar openings may be seen in preceding layer of chamberlets. [This genus is represented by a single known specimen, the holotype of the type-species in the British Museum (Natural History) (BMNH-ZF3613), from between tidemarks as "Middle Beach," lat. 31°31'30"S., long. 159° 15'28"E., on the east side of Lord Howe Island, South Pacific. As no additional material was available, sections could not be made for a study of the internal structure.] *Rec.,* S.Pac.——FIG. 381, *1. *C. rectus*; *1a,b,* side, top views of holotype, ×36 (*2117).

Praerhapydionina VAN WESSEM, 1943, *1980, p. 43 [**P. cubana*; OD]. Test similar to *Rhapydionina* in form and internal structure, differing in having single terminal aperture instead of cribrate one. *U.Cret.-Oligo.,* Cuba-Iraq.——FIG. 380,*2,3. **P. cubana,* Maastricht., Cuba; *2,* long. deep tang. sec., showing part of subepidermal partitions; *3,* transv. sec. partially cutting septum, showing subepidermal partitions at margins and central aperture, ×22 (*700).

Rhipidionina STACHE, 1913, *1829, p. 661 [**Pavonina liburnica* STACHE, 1889, *1828, p. 85; OD (M)]. Test compressed, flabelliform, early stage with abbreviated and involute planispiral coil followed by numerous uniserially arranged broad, low chambers, with transverse subepidermal partitions; aperture consists of numerous pores in the terminal face. *L.Eoc.-M.Eoc.,* Yugosl.(Istria)-Iraq.-——FIG. 379,*8. **R. liburnica* (STACHE), L.Eoc., Yugosl.; *8a,* ext., ×5; *8b,* apert. surface, enlarged (*700).

Ripacubana LOEBLICH & TAPPAN, *nom. nov.* [*pro Conulina* D'ORBIGNY in DE LA SAGRA, 1839. *1611, p. 24 (*non* BRONN, 1836)] [**Conulina conica* D'ORBIGNY in DE LA SAGRA, 1839, *1611, p. 24, here designated as type-species]. Test free, conical, early stages unknown as only specimen is broken, chambers numerous, low and broad, uniserial in later stage, subdivided by vertical partitions into chamberlets; sutures horizontal, closely appressed;

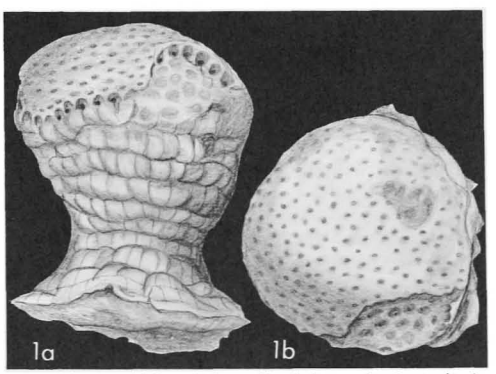


FIG. 381. Soritidae (Rhapydioninae; *1, Craterites*) (p. C493).

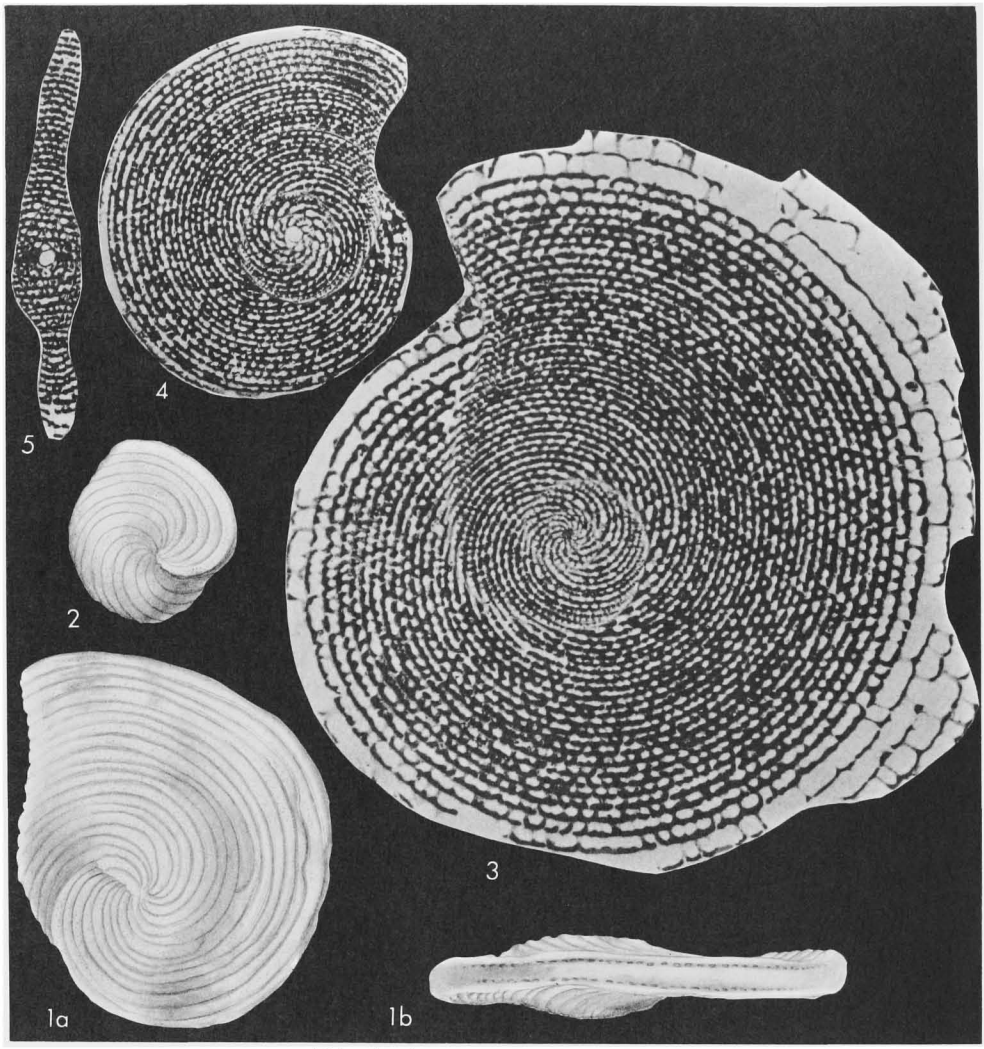


FIG. 382. Soritidae (Archaiasinae; *1-5, Archaias*) (p. C494-C495).

wall appearing calcareous; aperture terminal, consisting of numerous equally spaced small pores on broad face, opening into chamberlets. [D'ORBIGNY based this genus on the single specimen of his type-species. It has not been recognized since, and as only the holotype is known, no sections are available to determine more exactly its internal characters. Although considered by D'ORBIGNY to be a living species (Rec.), it is probable that the specimen may represent a reworked fossil form. The holotype of *R. conica,* here refigured, is preserved in the Muséum National d'Histoire Naturelle, Paris, and is from Recent sand of Cuba. *Ripacubana* is from *ripa* (Lat., shore or bank)+Cuba, and refers to the only locality from which the genus has been recorded, shore sands of Cuba.] *?Rec.,* Cuba.——FIG. 380,*1*. **R. conica* (D'ORBIGNY); *1a,b*, side, top views of holotype, ×17 (*2117).

Subfamily ARCHAIASINAE Cushman, 1927

[Archaiasinae CUSHMAN, 1927, p. 55] [=Orbiculininae SCHUBERT, 1920, p. 168; WIESNER, 1920, p. 17; Archaiadinae WIESNER, 1931, p. 60, 74, 111]

Test planispiral, later may become annular; chambers divided into rectangular chamberlets which do not alternate regularly with those of adjacent chambers; aperture commonly double row of pores on peripheral face of last chamber. *M.Eoc.-Rec.*

Archaias DE MONTFORT, 1808, *1305, p. 190 [**A. spirans* (=*Nautilus angulatus* FICHTEL & MOLL, 1798, *716, p. 113); OD] [=*Helenis* DE MONTFORT, 1808, *1305, p. 194 (type, *H. spatosus,* =*Nautilus aduncus* FICHTEL & MOLL, 1798, *716, p. 115); *Ilotes* DE MONTFORT, 1808, *1305, p. 198 (type, *I. rotalitatus,* =*Nautilus orbiculus*

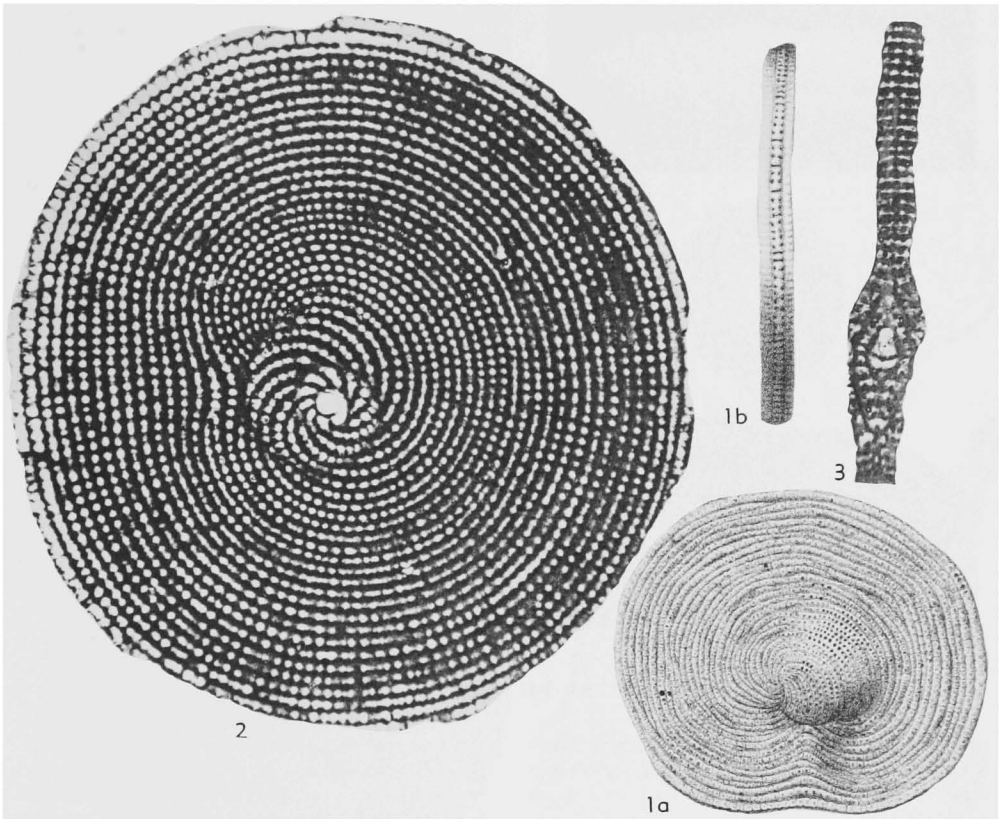


FIG. 383. Soritidae (Archaiasinae; *1-3, Cyclorbiculina*) (p. C495).

FICHTEL & MOLL, 1798, *716, p. 112); *Archais* OKEN, 1815, *1385, p. 322 *(nom. null.)*; *Orbiculina* LAMARCK, 1816, *1089, p. 14 (type, *O. nummata*, =*Nautilus orbiculus* FICHTEL & MOLL, 1798, *716, p. 112) *(non N. orbiculus* FORSKÅL, 1775); *Archaia* AGASSIZ, 1844, *5, p. 3 *(nom. van.)*; *Elenis* AGASSIZ, 1844, *5, p. 9 *(nom. van. pro Helenis* DE MONTFORT, 1808); *Nemophora* CONRAD, 1865, *380, p. 74 (type, *Nummulites (Assilina) floridanus* CONRAD, 1846, *379, p. 399) *(non Nemophora* ILLIGER, 1798; *nec* HUEBNER, 1825; *nec* DAHLBOM, 1854)]. Test compressed, early stage planispiral, involute, later chambers flaring, becoming evolute to cyclical; interior of chambers with interseptal pillars; aperture multiple, with rows of pores on terminal face of final chamber. *M.Eoc.-Rec.*, cosmop.——FIG. 382,*1-5*. **A. angulatus* (FICHTEL & MOLL), Rec., Bermuda *(1,2)*, Barbados *(3-5)*; *1a,b*, side, apert. views, ×19 (*2117); *2*, side view of juvenile specimen, ×19; *3*, equat. sec. of microspheric test, ×8; *4*, equat. sec. of megalospheric test, ×13; *5*, axial sec. of megalospheric test, ×13 (*1806).

Cyclorbiculina A. SILVESTRI, 1937, *1787, p. 88 [**Orbiculina compressa* D'ORBIGNY in DE LA SAGRA, 1839, *1611, p. 66; OD (M)]. Early stage close-coiled and involute, later chambers evolute, flabelliform, and finally cyclical; interior with distinct subepidermal partitions and with interseptal pillars in central zone; apertures consisting of pores on periphery. [SMOUT & EAMES, 1958 (*1806, p. 222) differentiated *Archaias* with interseptal pillars only from *Cyclorbiculina* with both interseptal pillars and subepidermal partitions.] *U. Oligo.-Rec.*, Carib.-GulfMex.-Atl.-Panama.——FIG. 383,*1-3*. **C. compressa* (D'ORBIGNY); Rec., Atl.; *1a,b*, side, apert. views of cyclical form, showing transverse partitions, ×13 (*200); *2*, equat. sec., ×13; *3*, axial sec., ×27 (*363).

Fusarchaias REICHEL, 1952, *1523, p. 459 [**F. bermudezi*; OD] [=*Fusarchaias* REICHEL, 1949, *1520, p. 148 *(nom. nud.)*]. Test elongate, fusiform, planispirally enrolled, elongated axially, externally similar to *Alveolinella;* chambers numerous, with interseptal pillars perpendicular to septa similar to *Archaias*; aperture consisting of circular multiple openings on terminal face, alternating in position between pillars. *Oligo.-Mio.*, Cuba.——FIG. 384,*1-4*. **F. bermudezi*; *1*, holotype, ×13; *2*, axial sec. showing interseptal pil-

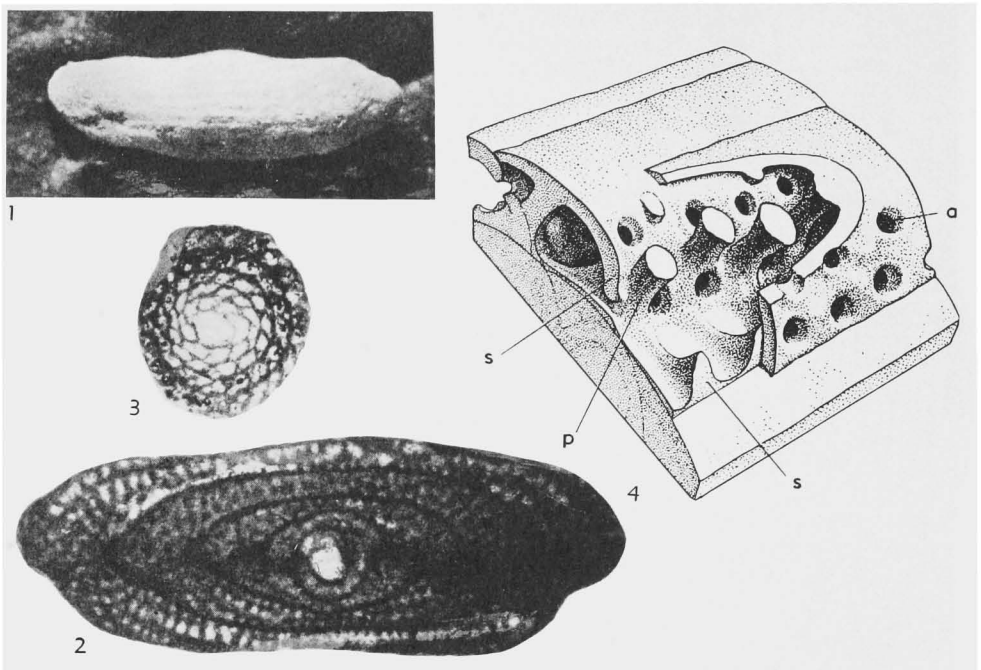


FIG. 384. Soritidae (Archaiasinae; *1-4, Fusarchaias*) (p. C495-C496).

lars; *3,* equat. sec., ×30; *4,* reconstruction showing structure, section of parts of last 3 chambers showing apertures *(a)*, pillars *(p)*, and septa *(s)* (*1523).

Subfamily SORITINAE Ehrenberg, 1839

[*nom. transl.* WIESNER, 1931, p. 60, 74, 111 (*ex* family Soritina EHRENBERG, 1839)]——[All names are of subfamily rank]——[=Orbitulinidea REUSS, 1862, p. 320; =Orbitolitinae BRADY, 1881, p. 43; =Orbitolitidinae WIESNER, 1920, p. 17]

Growth occurs by addition of numerous small chambers in arcuate or annular series, without intercommunications between those of single series, apertures connect adjacent chambers of successive series. *Eoc.-Rec.*

Sorites EHRENBERG, 1839, *667, chart opposite p. 120 [**S. dominicensis* (=*Orbulites marginalis* LAMARCK, 1816, *1088, p. 196); SD CUSHMAN, 1927, *433, p. 190] [=*Taramellina* MUNIER-CHALMAS, 1902, *1328, p. 353 (type, *Sorites dominicensis* EHRENBERG, 1839, *667, p. 134); SD LOEBLICH & TAPPAN, herein (obj.)]. Test discoidal, early stage with proloculus followed by tubular enrolled second chamber of nearly complete coil in length, later chambers added simultaneously in flaring peneropline series and finally in annular series in single layer; adjacent chambers of series interconnected by stolons; apertures connecting each chamber with 2 chambers in preceding and 2 in succeeding series. [Although reported from the Miocene of Venezuela (*1535) the type-species of *Sorites* has not been recorded from Recent deposits of this area, but has undoubtedly been reported as *Sorites marginalis* from the Dominican area (*614), Cuba, and the Atlantic. The types of EHRENBERG were not available for restudy, and were neither figured adequately nor described originally. *Sorites dominicensis* EHRENBERG, 1839 (nominally the type-species) is here regarded as a junior synonym of *S. marginalis* (LAMARCK), 1816, and the generic name is retained on the basis of this latter well-known species.] *Mio.-Rec.,* Carib.-Cyprus-Red Sea-Pac.-Atl.-S.Am.——FIG. 385,*1,2*. **S. marginalis* (LAMARCK), L.Mio., Venez. *(1),* Rec., N.Pac. *(2); 1a,b,* side, edge views, ×33 (*1535); *2,* optical section of early stages of megalospheric form showing chamber development, ×50 (*404f).

Amphisorus EHRENBERG, 1839, *667, chart opposite p. 120 [**A. hemprichii*; OD] [=*Bradyella* MUNIER-CHALMAS, 1902, *1328, p. 353 (type, *Orbitolites duplex* CARPENTER, 1883, *271c, p. 561 (=*A. hemprichii*)]. Test discoidal, biconcave, embryonic region of megalospheric form may be slightly inflated, embryonic apparatus of megalospheric form consisting of globular proloculus, followed by tubular chamber (flexostyle) and then by broadly overlapping chamber with marginal openings that lead into chamberlets of first cyclical series; later chambers cyclical, with 2 layers of chamberlets alternating in position with those of previous cycle and those of same cycle alternating

in position when viewed from periphery; a single annular canal in equat. position visible at center of axial sections and in equat. secs. appearing as undivided area adjacent to previous chamber wall (FIG. 386,*1*); apertures in 2 alternating rows on periphery in small sutural depressions and open-

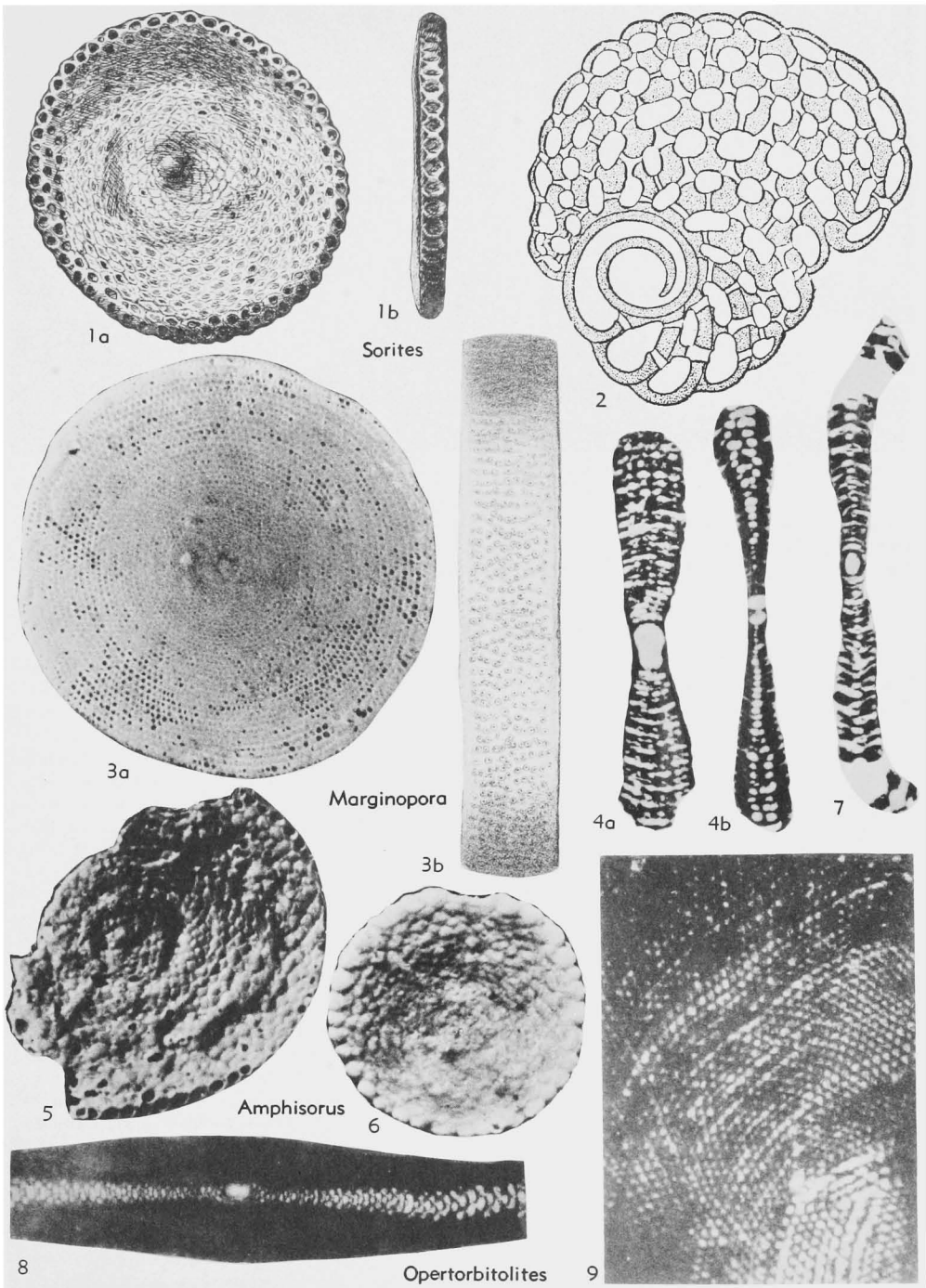


FIG. 385. Soritidae (Soritinae; *1,2, Sorites; 3,4, Marginopora; 5-7, Amphisorus; 8,9, Opertorbitolites*) (p. C496-C498).

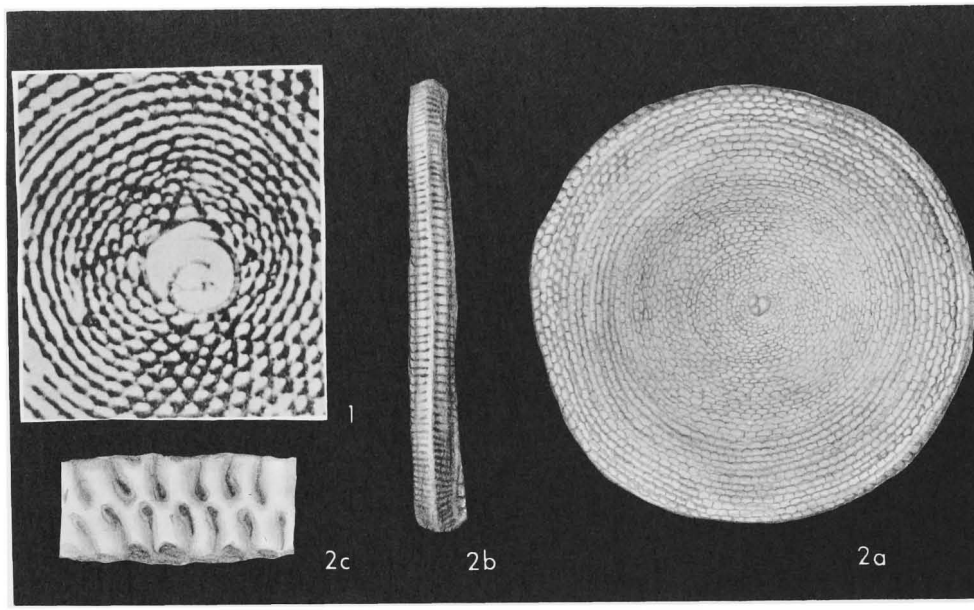


FIG. 386. Soritidae (Soritinae; *1,2, Amphisorus*) (p. C496-C498).

ing into stolons which lead obliquely into annular canal. *Mio.-Rec.,* Medit.-Pac.-Carib.-N.Am.-S.Am.-Eu.——FIG. 385,*5-7;* 386,*1,2*. **A. hemprichii* Rec., Bermuda (385,*5,6*), Bikini Atoll (385,*7*), Kei Is. (386,*1*), Ifaluk Atoll (386,*2*); 385,*5,6,* side views, ×20 (*444); 385,*7,* axial sec. originally figured as *Marginopora,* but showing equatorial annular canal and alternating intersection of chamber cavity at one side and septum on opposite side, characteristic of alternating chamberlets of *Amphisorus,* ×20 (*361); 386,*1,* equat. sec. of megalospheric form, showing embryonic apparatus in center, equatorial annular canal intersected in median part of section, remainder of section slightly tangential to equatorial plane and intersecting chamber walls, ×50 (*1122); 386,*2a,b,* side, edge views, ×15 (*2117); 386,*2c,* portion of edge view, enlarged to show position of apertures, ×41 (*2117).

Marginopora QUOY & GAIMARD in DE BLAINVILLE, 1830, *141d, p. 377 [**M. vertebralis*; OD (M)]. Test discoidal, biconcave, ovate proloculus followed by cyclic chambers, without distinct flexostyle such as occurs in *Amphisorus* and *Sorites*; chambers similar to *Orbitolites* but less regular, annular canals connecting chamberlets, as in *Amphisorus*, but with one at each side of main chamber in all but first 1 or 2 cyclical chambers, stolons interconnecting primary chamberlets, smaller lateral chamberlets not interconnected, but joined to main chamberlets by stolons; numerous apertural pores in rows in slight depressions on periphery, as in *Orbitolites*, but more irregularly arranged. *Mio.-Rec.,* Atl.-Pac.-Red Sea.——FIG. 385,*3,4*. **M. vertebralis,* Rec., Fiji *(3a),* Rec., Pac. *(3b),* U.Mio., Bikini Atoll *(4a),* Plio.-Rec., Bikini Atoll *(4b)*; *3a,* side, ×8 (*462); *3b,* edge, ×20 (*200); *4a,b,* axial secs., ×20 (*361).

Opertorbitolites NUTTALL, 1925, *1368, p. 447 [**O. douvillei*; OD]. Test lenticular, with median layer of annular chambers similar to *Orbitolites,* chambers of successive annuli arranged alternately but with thick imperforate laminae on either side of chamber layer, laminae closely adjacent rather than enclosing vacuoles, as in *Somalina. L. Eoc.,* Baluch.——FIG. 385,*8,9*. **O. douvillei*; 8, central portion of axial sec. of holotype; *9,* equat. sec. passing through chambers in median plane; both ×16 (*1368).

Orbitolites LAMARCK, 1801, *1084, p. 376 [**O. complanata*; SD DOUVILLÉ, 1902, *614, p. 296] [=*Discolithes* FORTIS, 1801, *735, p. 106 *(nom. neg.)*; *Discolithus* FORTIS, 1802, *735A, p. 97 (obj.); *Discolites* DE MONTFORT, 1808, *1305, p. 186 (type, *D. concentricus,* =*Orbitolites complanata* LAMARCK); *Orbitolithes* OKEN, 1815, *1385, p. 827; *Orbitulites* BRONN in BRONN & ROEMER, 1854, *214b, p. 254 *(nom. van.) (non* BERTHOLD, 1827, *nec* EICHWALD, 1829, *nec* GRIFFITH & PIDGEON, 1834)]. Test discoidal, similar to *Sorites,* megalospheric form with large globular multilocular nucleoconch, surrounded by numerous chambers in annular series, chambers in successive alternate series, each chamber with pores connecting those of preceding and succeeding annulae only, but without stolons interconnecting chambers of single series; annulae poorly defined in later stages and chamberlets separated by thick oblique walls; apertures on periphery in rows perpendicular to median plane. *U.Paleoc.-Eoc.,* Eu.——FIG. 387,*1-4*. **O. complanata,* M. Eoc.(Lutet.), Fr.; *1a,b,* opposite sides of micro-

spheric topotype, with external wall preserved in center, abraded, showing chamberlets at margins, ×5; *1c*, edge view; *1d*, portion of side showing opened nucleoconch, ×10; *2a,b*, opposite sides of smaller megalospheric topotype, ×5; *2c*, central portion of *2b* showing opened nucleoconch

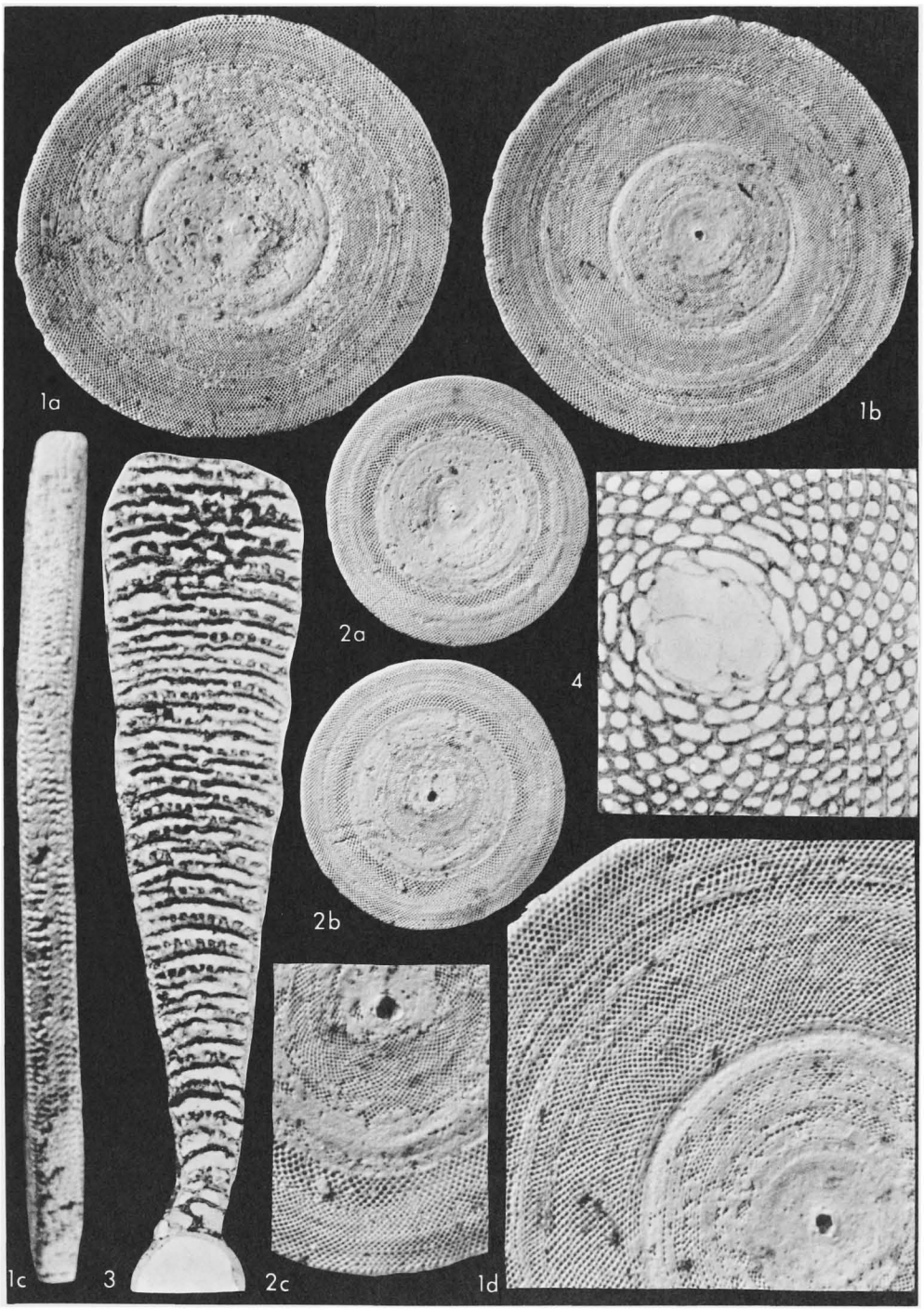


FIG. 387. Soritidae (Soritinae; *1-4*, *Orbitolites*) (p. C498-C500).

and chamberlets where external wall is abraded, ×10 (*1,2*, *2117); *3,4*, portions of axial and horiz. secs., ×50 (*1122).

Somalina A. Silvestri, 1939, *1788b, p. 51 [**S. stefaninii*; OD (M)] [=*Somalina* A. Silvestri, 1938, *1788a, p. 59, 64 (*nom. nud.*)]. Test dis-

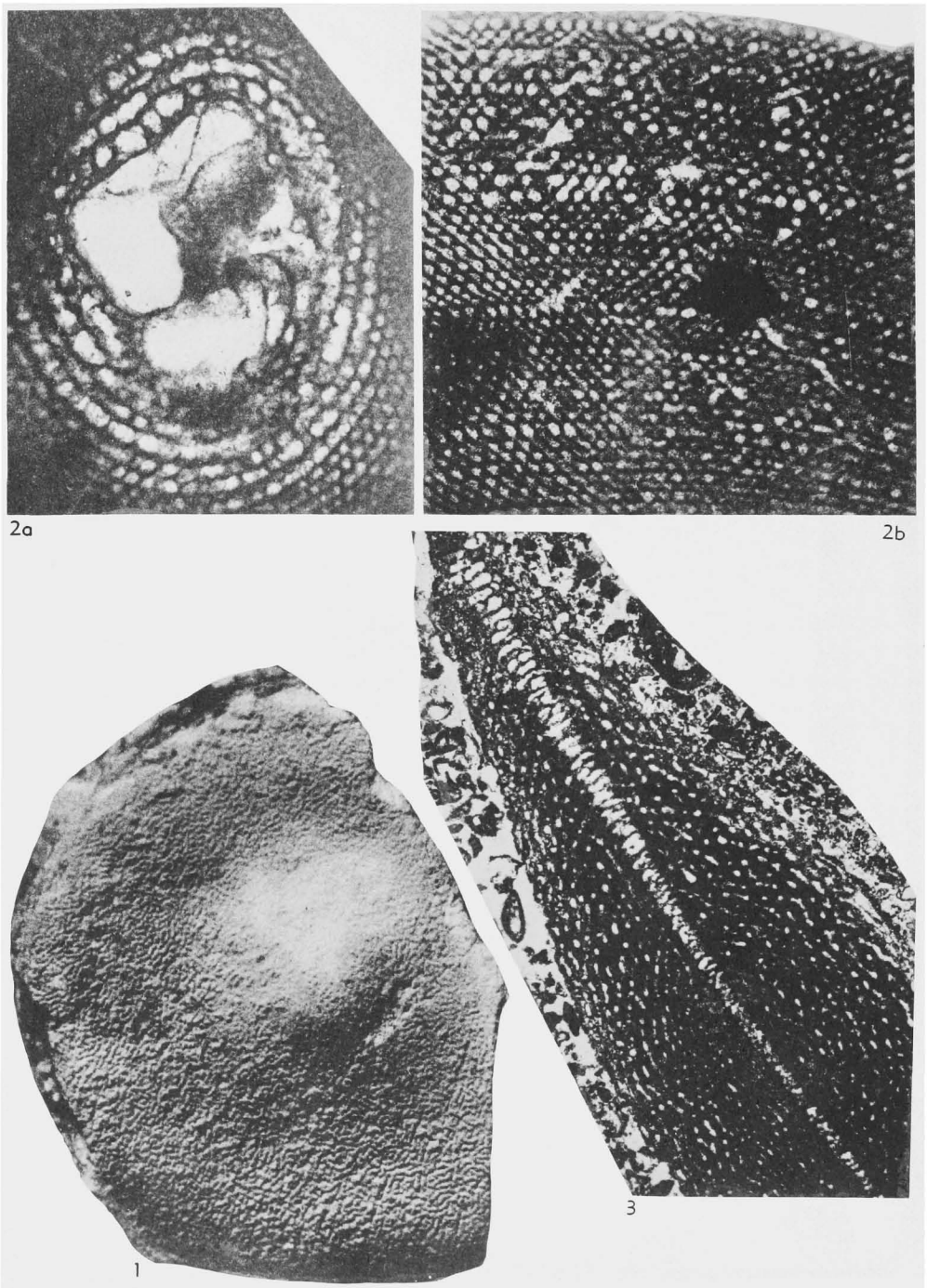


Fig. 388. Soritidae (Soritinae; *1-3, Somalina*) (p. C500-C501).

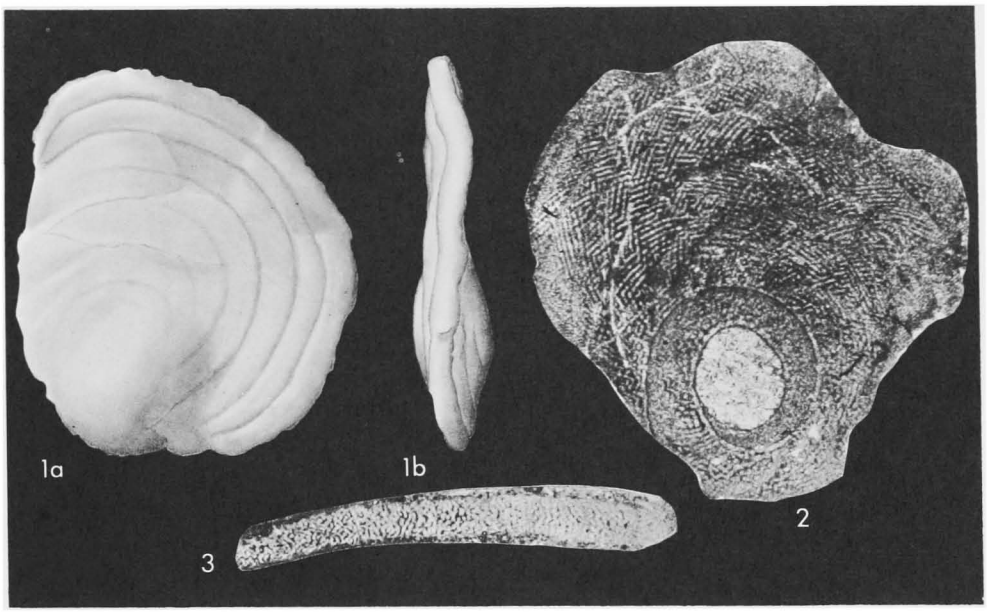


FIG. 389. Soritidae (Soritinae; *1-3, Yaberinella*) (p. C501).

coidal to lenticular, similar to *Orbitolites* in absence of stolons between adjacent chambers of single annular series, chambers forming equatorial layer similar to *Opertorbitolites* but with lateral layers of shell material enclosing vacuoles, superficially resembling chamberlets, but apparently without communication between vacuoles. *Eoc.*, Somali.-Egypt-Iraq.——FIG. 388,*1-3*. **S. stefaninii*, L.Eoc., Somali.; *1*, ext., ×5; *2a,b*, central and marginal parts of equat. sec. of megalospheric test showing "nucleoconch" of large chambers, and small peripheral chambers, ×31 (*1788b); *3*, axial sec., ×20 (*1788a).

Yaberinella VAUGHAN, 1928, *1989, p. 7 [**Y. jamaicensis*; OD]. Test large, operculine to discoidal in plan, up to 50 mm. diam., early stage peneropline, with very broad, low chambers, which may become cyclical, especially in microspheric form; chambers subdivided into secondary chamberlets; septula numerous, intersecting at low angles to give hachured appearance in section; aperture apparently a series of pores on apertural face, chamberlets communicating through stolons, which occur in 3 planes. *M.Eoc.-U.Eoc.*, Carib. (Jamaica).——FIG. 389,*1-3*. **Y. jamaicensis*, M. Eoc.; *1a,b*, side, edge views of lectotype (here designated, one of VAUGHAN's figured specimens), ×9 (*2117); *2*, horiz. sec. of megalospheric paratype, showing fine radial surface striations at sides, and interwoven appearance of septula in central portion, ×13; *3*, vert. sec. of microspheric specimen, ×7 (*1989).

Subfamily KERAMOSPHAERINAE Brady, 1884

[Keramosphaerinae BRADY, 1884, p. 63]

Test globular, concentric chambers subdivided into chamberlets; pores between chambers of same series and between those of successive series. *Mio.-Rec.*

Keramosphaera BRADY, 1882, *198, p. 242 [**K. murrayi*; OD (M)] [=*Orbulinaria* RHUMBLER, 1906, *1571, p. 23 (type, *O. fallax* RHUMBLER in EGGER, 1909, *662, p. 11); *Arbulinarium* RHUMBLER, 1913, *1572b, p. 347 (*nom. van. pro Orbulinaria* RHUMBLER, 1906)]. Test free, spherical, to 2.5 mm. diam., with numerous somewhat inflated chamberlets of irregular outline added in concentric spherical series, chamberlets of each layer with short lateral stolons for intercommunication, chamberlets of successive layers neither directly superposed nor regularly alternating in position; apertures consisting of pore at margin of each chamberlet, previous apertures serving for intercameral connections between chamberlets of successive layers. *Rec.*, S.Atl.-W.Pac.-N.Sea.——FIG. 390,*1*. **K. murrayi*, SW.Australia; *1a*, ext., holotype, ×25 (*2117); *1b*, part of median sec., ×50 (*198).——FIG. 390,*2*. *K. fallax* (RHUMBLER), S.Atl.; ext., ×218 (*1572a).

[*Orbulinaria* was placed with the agglutinated genera by GALLOWAY (1933, *762) and CUSHMAN (1948, *486) but was originally stated to be entirely calcareous, with scaly meandrine surface and scattered pores according to RHUMBLER. This is identical to *Keramosphaera*, and the type-species of the 2 differ only in size. Although the Cretaceous spheres (=*Oligostegina*) were included in *Orbulinaria* by RHUMBLER, the type is *O. fallax*, a Recent form from the South Atlantic, Ascension Island.]

Kanakaia HANZAWA, 1957, *873, p. 38 [**K. marianensis*; OD]. Test encrusting, to 4 mm. diam., with chambers in layers similar to those of *Keramosphaera*; stolons through septa connecting cham-

bers of same series and oblique stolons connecting chambers with those of preceding and succeeding layers. *Mio.(Aquitan.)*, Saipan-Tinian-Rota.——

FIG. 390,*3-5*. **K. marianensis*, Saipan; *3,4*, horiz. and vert. secs., ×20; *5*, vert. sec. through proloculus, ×80 (*873).

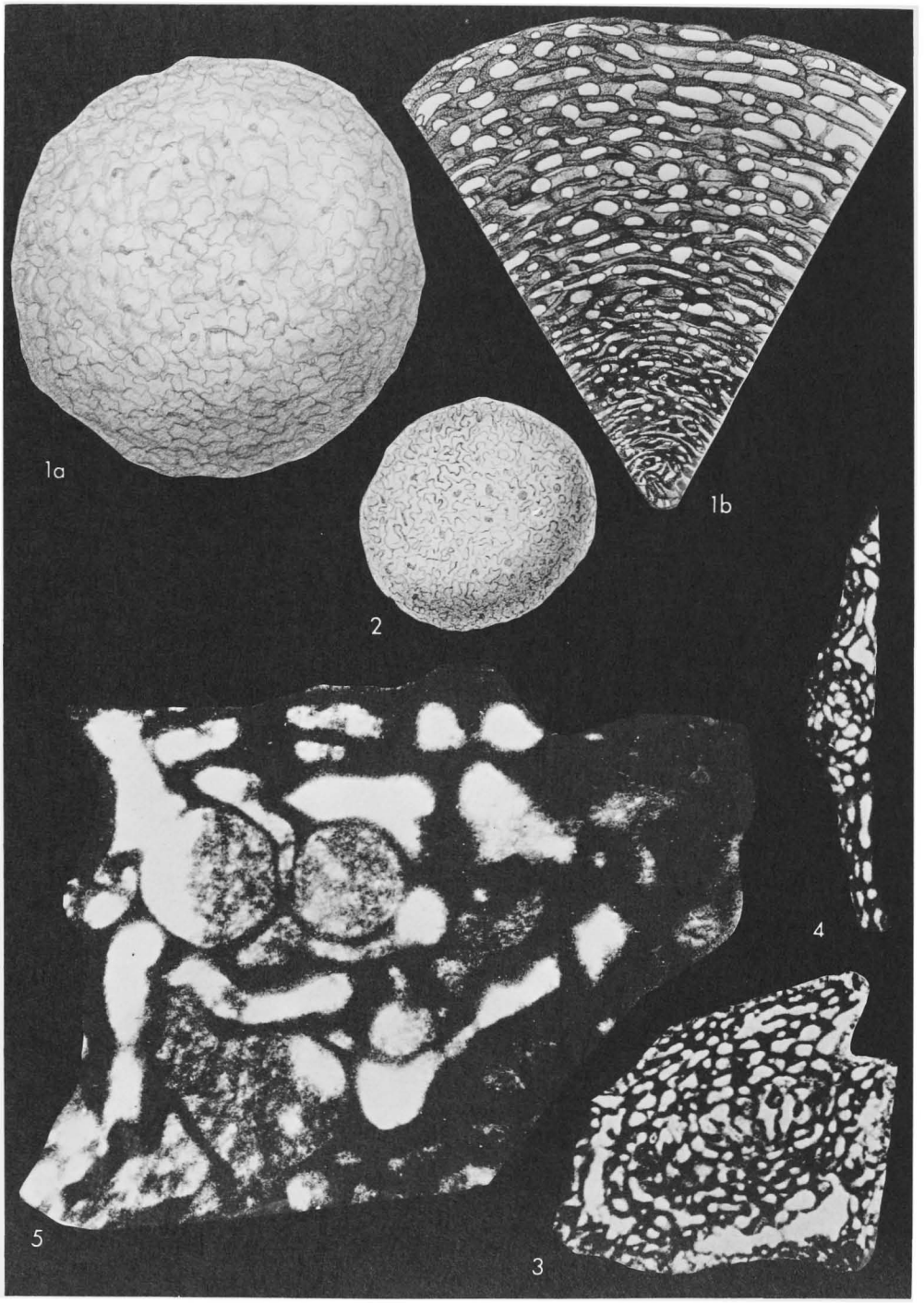


FIG. 390. Soritidae (Keramosphaerinae; *1,2, Keramosphaera; 3-5, Kanakaia*) (p. C501-C502).

ALVEOLINIDAE

By MANFRED REICHEL
[Bernoullianum, Universität Basel]

Family ALVEOLINIDAE Ehrenberg, 1839

[*nom. correct.* STEINMANN, 1881, p. 41 (*pro* Alveolinea EHRENBERG, 1839, table opp. p. 120; type-genus *Alveolina* D'ORBIGNY, 1826, which is junior objective synonym of *Borelis* DE MONTFORT, 1808)]——[In following citations superscript numbers indicate taxonomic rank assigned by authors as follows: [1]family, [2]subfamily; dagger(†) indicates *partim*]——[=[1]Polythalama† LATREILLE, 1825, p. 161 (*nom. nud.*); =[1]Enthomostégues† D'ORBIGNY, 1826, p. 304 (*nom. nud.*); =[1]Fasciolitidae BAKX, 1932, p. 257]——[=[1]Alveolinida SCHULTZE, 1854, p. 53; =[2]Alveolininae BRADY, 1884, p. 62; =[1]Alveolinina LANKESTER, 1885, p. 847; =[1]Alveolininae DELAGE & HÉROUARD, 1896, p. 127]——[=[1]Borelida SCHMARDA, 1871, p. 165; =[2]Borelidinae WIESNER, 1931, p. 60, 75; =[1]Borelidae HANZAWA, 1932, p. 36, 102]——[=[1]Alveolinellidae CUSHMAN, 1927, p. 58; =[2]Alveolinellinae GALLOWAY, 1933, p. 148]

Wall porcelaneous, imperforate. Test free, usually large, coiled about elongate axis, subcylindrical, fusiform, ellipsoidal or spherical, rarely somewhat nautiloid. Proloculus followed by spiral tube (flexostyle). Juvenile volutions commonly coiled irregularly, at least in microspheric form. Chambers numerous, divided into tubular chamberlets by means of secondary partitions (septula) parallel to direction of coiling; chamberlets may occur in several layers. Apertures numerous, arranged in one or more rows, exceptionally fused into horizontal slit. *L.Cret.-Rec.*

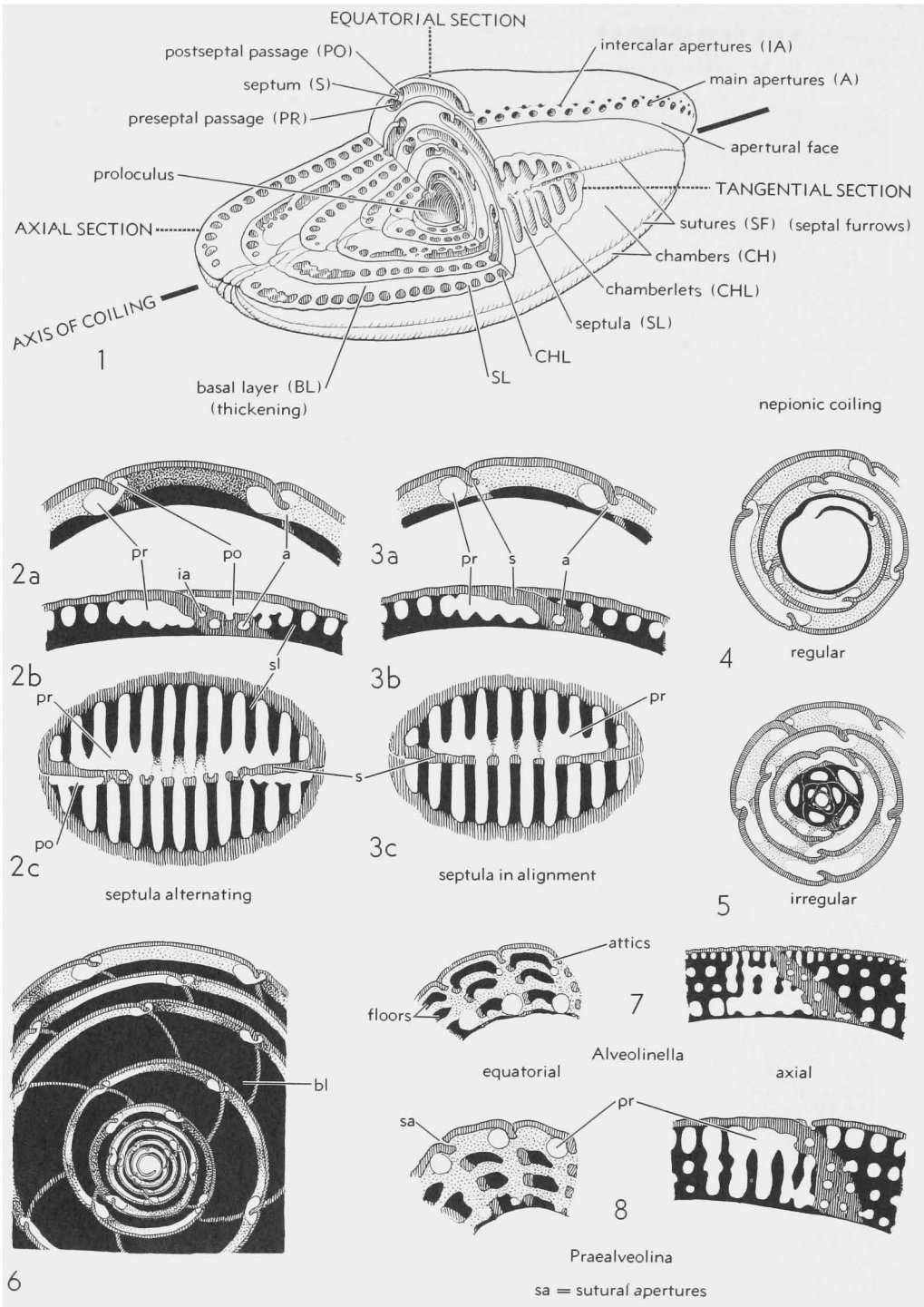
These features make of the Alveolinidae a morphologically well-defined family but probably not a phylogenetic unit. Some of the genera that followed each other in the course of geological epochs surely did not evolve one from another.

In their general shape the alveolinids are somewhat isomorphous with fusulinids but between these families no genetic relations exist. The irregular coiling of the first volutions found in the microspheric forms of nearly all genera and species shows that the Alveolinidae are closely related to the Miliolidae. Their relationship with the Peneroplidae is smaller. Yet in Recent *Alveolinella,* HOFKER has observed pores in the wall of the proloculus and peneropline-like coiled first volutions in the microspheric form. It is therefore possible that this genus evolved independently from a peneropline ancestor. Nevertheless, for practical reasons I have placed it in the Alveolinidae. Further study will be needed of the relations between *Alveolinella* which appears in the Miocene, and the structurally very similar Miocene genus *Flosculinella,* the microspheric form of which we still do not know.

The essential feature of the family—axial elongation of the shell—is extremely variable. As a rule, the axial diameter is greater than equatorial diameter, but very commonly both are of the same length (globular tests) and rarely the equatorial diameter is greatest. The ratio of elongation may reach 9:1 in most elongate shells. The shape of the test also varies greatly. Some genera with only small species (e.g., *Ovalveolina, Bullaveolina, Borelis*) are represented by shells with axial diameter of 1 to 2 mm. Other genera comprise small as well as large forms (e.g., *Praealveolina, Subalveolina, Fasciolites*). The largest tests occur in microspheric specimens of *Fasciolites,* which may attain a length of 100 mm. (e.g., *F. levantina,* from the Mediterranean region).

Internal structure furnishes the most important taxonomic features for distinction of genera (Fig. 391,*1-8*). Almost invariably a definite type of structure is found to characterize the alveolinids of a given time-stratigraphic division. In the endoskeleton we may distinguish: (1) the **basal layer** (basal thickening), usually well developed in the axial region and in some shells enormously thickened (e.g., *"Flosculina"*) (Fig. 391,*6*); (2) the secondary partitions or **septula** which are arranged in the direction of coiling; and (3) the **floors** which divide several layers of chamberlets (e.g., *Praealveolina, Alveolinella*) (Fig. 391,*7,8*).

The septula of two adjacent chambers show either an alternating or a continuous arrangement (Fig. 391,*2,3*). A section across the chamberlets is circular or oval. The chamberlets of the uppermost layers in *Flosculinella* and *Alveolinella* are half the size of those of the lower layers and may be compared with the attics (Fr., *mansardes*) of a building. **Alveoli** are blind chamberlets without an opening at their front. At the back, they are connected with the preceding chamber by means of secondary apertures (e.g., *Subalveolina, Bullalveolina*). Irregularly arranged supplementary chamberlets are sometimes seen in the basal layer of certain species of *Fascio-*



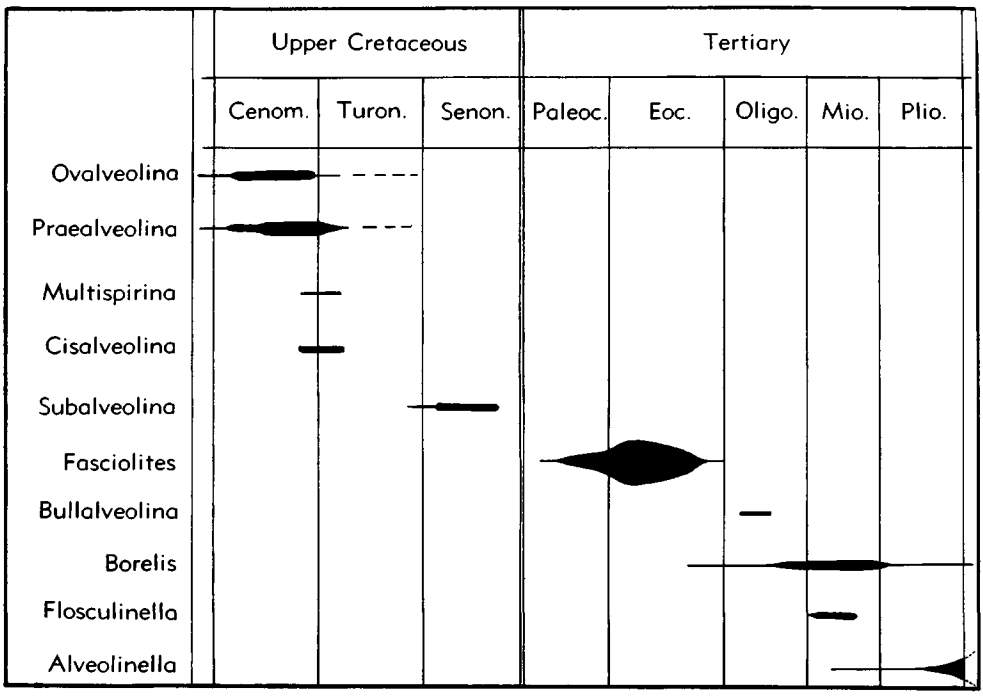


FIG. 392. Stratigraphic distribution of Alveolinidae (*2119A).

lites ("subgenus *Eoalveolinella*"). All chamberlets of the same chamber are connected by a preseptal passage, located in the anterior part of the chamber. A postseptal passage appears in *Fasciolites* in the angle between wall and septum at the back of the chamber. In *Cisalveolina* it occupies the whole posterior part of the chamber and then the preseptal passage is extremely reduced.

In a single genus *(Multispirina)* several spires may be observed. In the megalospheric generation the first spires begin on the proloculus, which possesses several rows of apertures. All species of medium and large size show a clear dimorphism and some exhibit trimorphism.

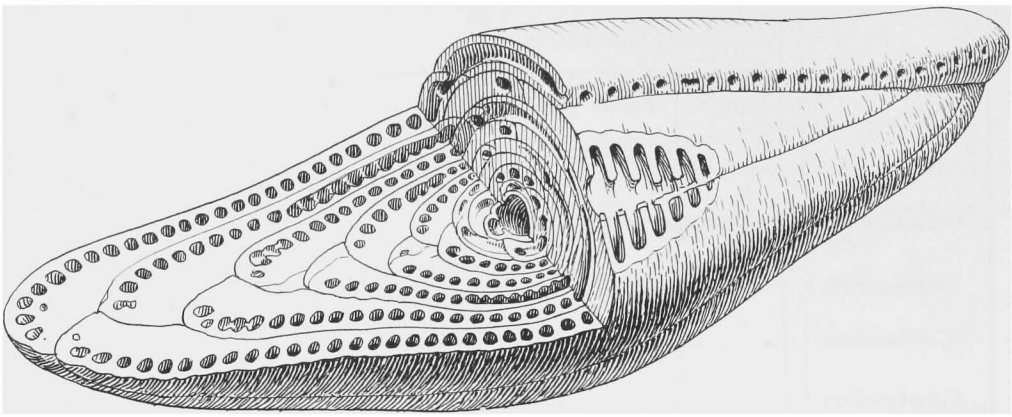
Fossil alveolinids are only found in neritic sediments where they may be associated with miliolids and calcareous algae. Many large species occur in great abundance and are therefore rock-builders (*Praealveolina,* Cenomanian; *Fasciolites,* Eocene).

Alveolinella lives in tropical seas at depths of 10 to 80 m. *Borelis* has been found to a depth of 411 m.

Stratigraphic distribution of alveolinid genera is indicated in Fig. 392.

Borelis DE MONTFORT, 1808, *1305, p. 170 [**B. melonoides* =**Nautilus melo* var. β FICHTEL & MOLL, 1798; OD] [*non Borelis* OKEN, 1815] [=*Clausulus* DE MONTFORT, 1808, *1305, p. 178 (type, *C. indicator,* =*Nautilus melo* FICHTEL & MOLL, 1798); *Melonites* LAMARCK, 1812, *1087, p. 122 (type, *M. sphaerica* LAMARCK, 1816, *1089,

FIG. 391. *(Facing page.)* Morphological features of alveolinid tests and terminology applied to them.——*1. Fasciolites* (×32.5), oblique view of partially sectioned test showing morphological nomenclature.——*2,3.* Types of septula illustrated by much-enlarged sections (*2a,3a,* equatorial; *2b,3b,* slightly oblique axial showing septal part; *2c,3c,* tangential); *2, Fasciolites,* with alternating septula; *3, Borelis,* with continuous, aligned septula [wall and septa, hatched; septula and basal layer, stippled and black].——*4.* Proloculus and regularly coiled first whorls of *Fasciolites (Fasciolites) schwageri.*——*5.* Proloculus and irregularly coiled first whorls of *Fasciolites (Glomalveolina) primaeva.*——*6.* Equatorial section of *Fasciolites (Fasciolites) pasticillatus* showing very thick basal layer of *"Flosculina"* type.——*7,8.* Parts of equatorial and axial sections of *Alveolinella quoyi (7)* and *Praealveolina cretacea (8)* showing chambers with several rows of chamberlets (*2119A).



Borelis

FIG. 393. Alveolinidae; *Borelis* (p. C505-C506).

p. 469, =*Nautilus melo* FICHTEL & MOLL, 1798, SD GALLOWAY, 1933, *762, p. 150); *Melonia* LAMARCK, 1822, *1090, p. 615 (type, *Melonites sphaerica* LAMARCK, 1816, =*Nautilus melo* FICHTEL & MOLL, 1798, SD GALLOWAY, 1933, *762, p. 150); *Alveolina* D'ORBIGNY, 1826, *1391, p. 306 (type, *Nautilus melo* FICHTEL & MOLL, 1798, SD PARKER & JONES, 1860, *1417c, p. 182); *Borelia* AGASSIZ, 1844, *5, p. 4 (*nom. van. pro Borelis* DE MONTFORT, 1808); *Neoalveolina* SILVESTRI, 1928, *1783, p. 35 (type, *Alveolina bradyi* SILVESTRI, 1927, *1782, p. 227, SD BAKX, 1932, *68, p. 208, =*Nautilus melo* FICHTEL & MOLL, 1798]. Test minute, spheroidal to fusiform, with septula in continuous arrangement; in some tests, chamberlets of same chamber alternately large and small, with latter displaced toward exterior, septula therefore developing Y-shape; without postseptal passage, first whorls irregularly coiled. *U. Eoc.-Rec.,* Eu.-Asia-Afr.——FIG. 393. *B. schlumbergeri* (REICHEL), Rec., Mayotte Is.(NW of Madagascar); ×75 (*2119A).——FIG. 394,*2. B. melo curdica* (REICHEL), U. Mio., E. Turkey; ×85 (*2119A).

[The nominal genus *Alveolina* D'ORBIGNY, 1826, from which the family containing *Borelis* has been named and become widely known, is unquestionably a junior objective synonym, since *Nautilus melo* FICHTEL & MOLL, 1798, according to provisions of the international Rules of Nomenclature, is the type-species of both. For *Borelis* this is fixed by original designation. D'ORBIGNY did not designate any of the 7 species assigned by him to *Alveolina* as type-species and therefore the first author who selected one of these eligible species to be the type established it unalterably. Such first valid designation was made by PARKER & JONES, 1860, when they chose *Nautilus melo,* one of the original 7 species named by D'ORBIGNY, as type-species of *Alveolina.*—R. C. MOORE.]

Alveolinella DOUVILLÉ, 1906 [1907] *617, p. 585 [**Alveolina quoii* D'ORBIGNY, 1826, *1391, p. 307; OD]. Fusiform, very elongate, septa continuously arranged, with several layers of chamberlets, preseptal passages on floor of chambers; last whorls may have small secondary preseptal passages; apertures in several rows, with attics at top of uppermost ones, as in *Flosculinella. Mio.-Rec.,* IndoPac.——FIG. 395,*1. *A. quoyi* (D'ORBIGNY), Rec., Torres Str.; ×45 (*2119A).

[D'ORBIGNY's spelling of the specific name *"quoii,"* referring to the surgeon and student of corals J. R. C. QUOY, is indubitably an inadvertent error in which the last letter of the surname was incorrectly changed from *"y"* to *"i."* The Code (Art. 32,a,ii) provides for automatic correction to *"quoyi,"* as adopted by DOUVILLÉ, CUSHMAN, GALLOWAY, and other authors.—R. C. MOORE.]

Bullalveolina REICHEL, 1936, *1513, p. 140 [**Alveolina bulloides* D'ORBIGNY in DE LA SAGRA, 1839, *1611, p. 70 =*A. bulloides* D'ORBIGNY, 1826, (*1391, p. 306) *(nom. nud.)*; OD]. Test minute, subspherical, with several rows of apertures, upper ones opening into alveoli which occupy rear part of chambers; septula alternating, first coils irregular. *Oligo.,* Eu.(S.Fr.-Italy).——FIG. 394,*1. *B. bulloides* (D'ORBIGNY), L.Oligo., Fr.(Gaas); ×80 (*2119A).

Cisalveolina REICHEL, 1941, *1515, p. 255 [**C. fallax*; OD]. Test ovoid, spherical, or nautiloid, septula alternating, with spacious postseptal passages but preseptal passages greatly reduced; aperture comprising long slit that extends from pole to pole, its upper edge fluted; juvenile coiling of microspheric forms irregular. *U.Cret.(U.Cenoman.-L. Turon.),* M.East.——FIG. 396,*2. *C. fallax,* Cenoman., Iran; ×35 (*2119A).

Fasciolites PARKINSON, 1811, *1420, p. 158 [**Alveolina oblonga* D'ORBIGNY, 1826, *1391, p. 306, =PARKINSON's figured specimen, *1420, pl. 10, figs. 28-31; SD (SM) D'ORBIGNY, 1826, *1391, p. 306] [=*Miliolites* DE MONTFORT, 1808, *1305, p. 175 (type, *M. sabulosus*) (*non Miliolites* LAMARCK, 1804); *Oryzaria* DEFRANCE in BRONN, 1825, *209, p. 30 (type, *O. boscii*); *Alveolina* AUCTT. *(partim)* (*non* D'ORBIGNY, 1826 =*Borelis* DE MONTFORT, 1808); *Flosculina* STACHE, 1880,

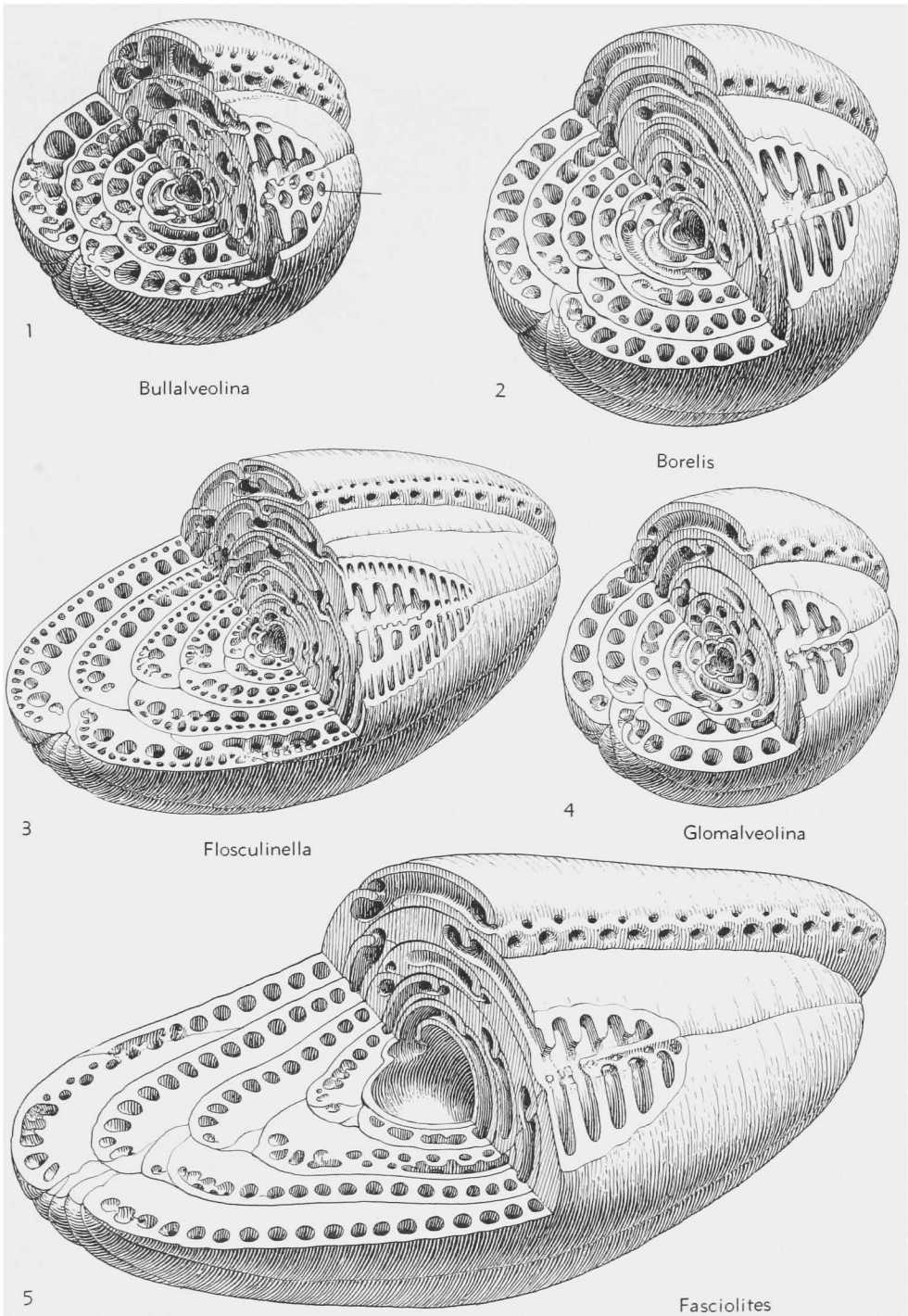


FIG. 394. Alveolinidae; *1, Bullalveolina; 2, Borelis, 3, Flosculinella; 4, Fasciolites (Glomalveolina); 5, F. (Fasciolites)* (p. C505-C510).

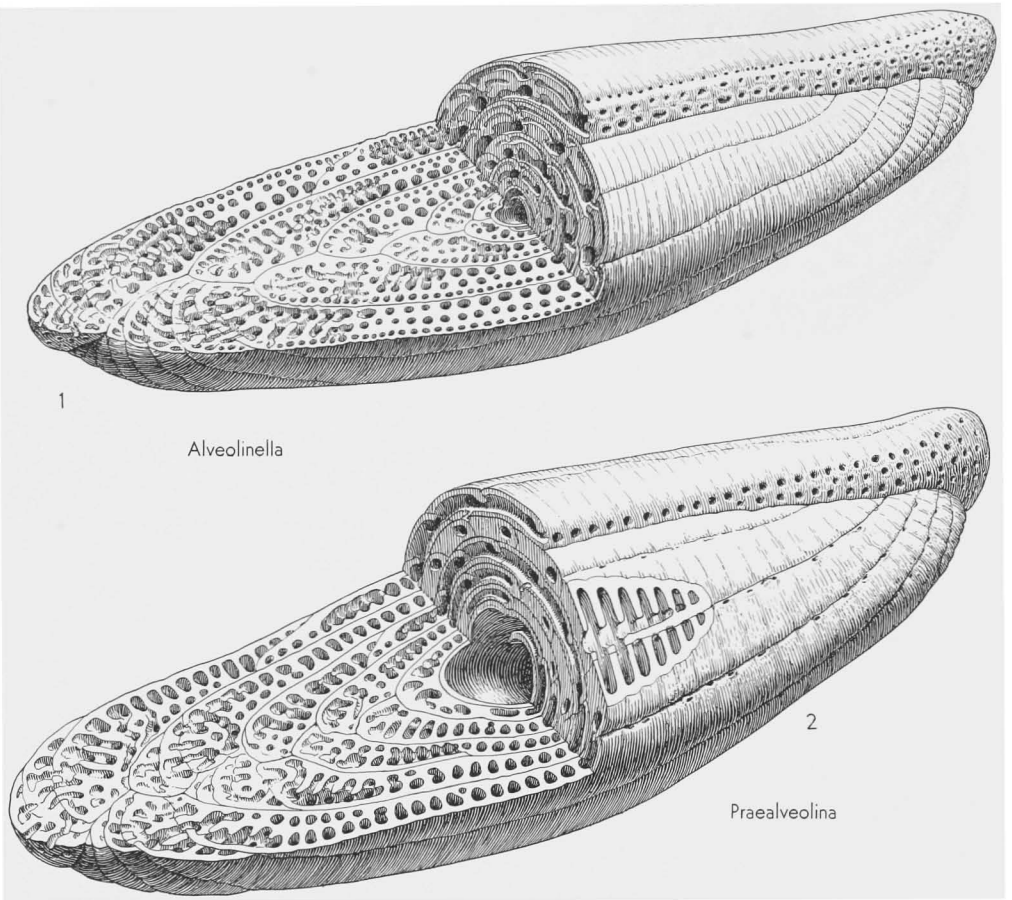


FIG. 395. Alveolinidae; *1, Alveolinella; 2, P. (Praealveolina)* (p. *C*506, *C*510).

*1827, p. 199 *(nom. nud.)*; *Flosculina* STACHE in SCHWAGER, 1883, *1707, p. 102 (type, *F. decipiens* SCHWAGER, 1883, SD GALLOWAY, 1933, *762, p. 151); *Flosculina (Semiflosculina)* DONCIEUX, 1905, *608, p. 124, no species named; *Eoalveolinella* SILVESTRI, 1928, *1783, p. 35 (type, *Alveolina violae* CHECCHIA-RISPOLI, 1905, *329, p. 165; *Flosculina (Checchiaites)* SORRENTINO, 1935, *1815, p. 137 (type, *Flosculina daunica* CHECCHIA-RISPOLI, 1912); *Alveolina (Fasciolites)* REICHEL, 1936, *1514, p. 80 (obj.)]. Test spherical, ellipsoidal, fusiform, or cylindrical; septula alternating in adjacent chambers, with pre- and postseptal passages; coiling of first whorls irregular in microspheric form of all species but regular in megalospheric form of most species; 2 rows of apertures alternating in position; may show enormous basal thickening in several internal whorls (e.g., *"Flosculina"*) or secondary apertures and chamberlets irregularly distributed in axial zone and mostly not connected with preseptal passages (e.g., *"Eoalveolinella"*). [Many species are important as rock-builders.] *Paleoc.-Eoc.*, Eu.-Asia-Afr.

[No named species originally were included in *Fasciolites*. *Alveolina oblonga* D'ORBIGNY was based on specimens collected by him from the Eocene (Cuisian) of France, and *Fasciolites* PARKINSON was mentioned by D'ORBIGNY as a synonym of *Alveolina*. GALLOWAY (1933, *762, p. 150) regarded this as constituting subsequent monotypy (ICZN, Art. 2, Op. 46).] [Note by REICHEL.—Because of strong preference, ingrained by many years of usage, especially on the part of European paleontologists, including me, I have endeavored to find ways of conserving the name *Alveolina*, hallowed by tradition. This is because (1) all authors describing Eocene species from Africa and Europe have used it; (2) since adoption of *Alveolina* for recognition in my structural studies (1931, 1936-37) of the tests, the name has become the symbol of a well-defined and characteristic morphological type that is common to all observed Paleocene and Eocene species; (3) deserving respect are the attempts of D'ORBIGNY to establish priority of the name *Alveolina* since "Alvéolite de Bosc" was the oldest name (DESHAYES, 1828, p. 228) without doubt assigned to an Eocene form *(Alvéolite grain de fétusque)* figured 9 years before the *Fasciolites* of PARKINSON; and (4) it has seemed desirable to avoid use of *Fasciolites* as defined by GALLOWAY on the basis solely of test proportions and size of chamberlets. But unfortunately these arguments are insufficient for the Rules of Nomenclature. The term Alvéo-

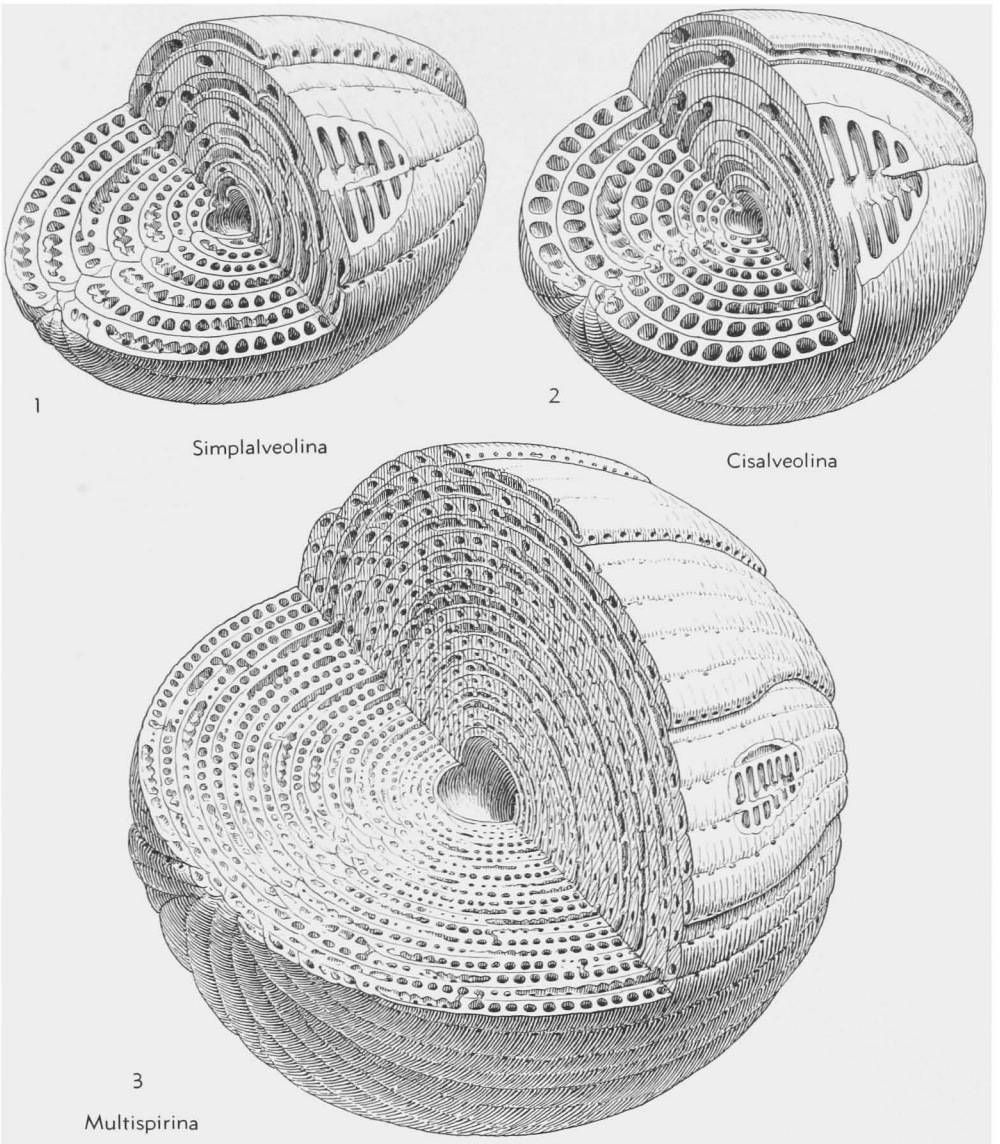
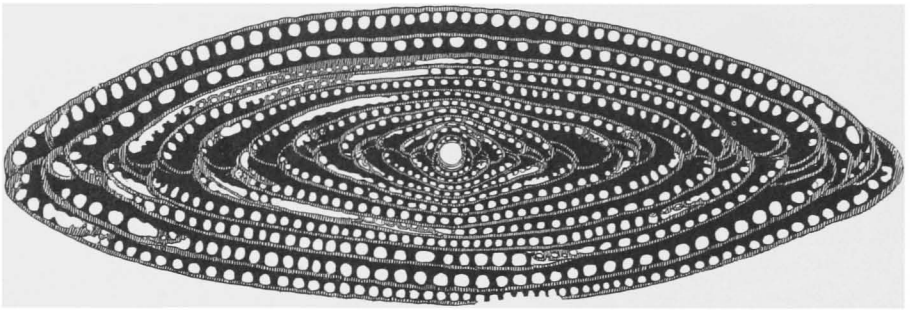


FIG. 396. Alveolinidae; *1, Praealveolina (Simplalveolina); 2, Cisalveolina; 3, Multispirina* (p. C506, C510).

lite of Bosc is a vernacular name; D'ORBIGNY's figures intended for publication with his 1826 text were not published until much later. Readers should be warned that *Fasciolites* refers only to forms of the structural type of *Alveolina* of REICHEL (1931, 1936-37) and *not* to all elongate-ovoid, fusiform, and cylindrical tests with a single layer of chamberlets, as defined by GALLOWAY.]

F. (Fasciolites). Coiling of first whorls regular in megalospheric form; test generally ellipsoidal to fusiform or cylindrical, but may be spherical, *U.Paleoc.-Eoc.,* Eu.-Asia-Afr.——FIG. 397. *F. (F.) boscii* (DEFRANCE), Eoc. (Lutet.), Fr. (Grignon); axial sec. of topotype, ×40 (*2119A).——FIG. 394,*5. F. (F.) schwageri* (CHECCHIA), L.Eoc., N.Italy(Vicentino); first whorls, ×55 (*2119A).

F. (Glomalveolina) HOTTINGER, 1962, *962, p. 54 [**Alveolina dachelensis* SCHWAGER, 1883, *1707, p. 96; OD] [=*Alveolina (Glomalveolina)* REICHEL, 1936, *1514, p. 80 *(nom. nud.)* (type, *Alveolina ovulum* STACHE, in SCHWAGER, 1883, p. 95, *nom. nud.*, =*A.* cf. *ovulum* SCHWAGER, 1883, *1707, p. 95, *nom. nud.*)]. Test very small, spherical to ovoid, with irregularly coiled first whorls in both micro- and megalospheric forms. *Paleoc.-Eoc.,* Eu.-Afr.-?Asia.——FIG. 394,*4. F.*



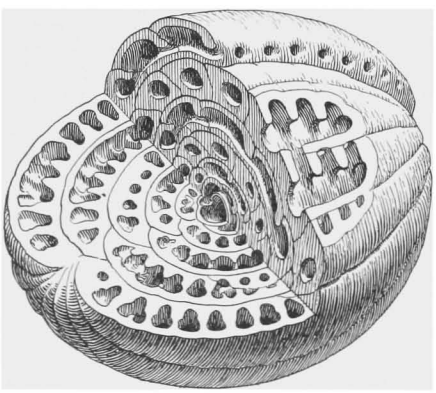
Fasciolites

FIG. 397. Alveolinidae; *Fasciolites* (p. C506-C509).

(G.) primaeva (REICHEL), Paleoc., S.Fr.; ×55 (*2119A).

[REICHEL's (1936) publication of the nominal subgenus *Glomalveolina* failed to comply with requirements of nomenclatural rules (Zool. Code, 1961, Art. 13,b) relating to generic names published after 1930. These must be accompanied by definite fixation of a (valid) type-species. *Glomalveolina* had the status of a *nomen nudum* because its originally designated type-species was (and remains) a *nomen nudum*. This generic name was first validated in 1962 by HOTTINGER with designation of *Alveolina dachelensis* SCHWAGER as its type-species. The provisional use of *A. dachelensis* by SCHWAGER and attribution of *Glomalveolina* to REICHEL by HOTTINGER have no effect on the validity of *A. dachelensis* and recognition of HOTTINGER as author of *Glomalveolina*. Also, the date of this nominal subgenus must be given as 1962—not 1936. An unimportant detail is the designation of SCHWAGER, rather than bystander STACHE, as the author of *Alveolina* cf. *ovulum*.—R. C. MOORE.]

Flosculinella SCHUBERT in RICHARZ, 1910, *1578, p. 533 [**Alveolinella bontangensis* RUTTEN, 1913, *1597, p. 221; SD GALLOWAY, 1933, *762, p. 151]. Test globular to fusiform, septula alternating; apertures in 2 rows, upper ones small, leading into narrow chamberlets; first whorls irregularly coiled, *Mio.*, E.Indies-Australia.——FIG. 394,*3*. **F. bontangensis* (RUTTEN), Burdigal., Borneo; ×60 (*2119A).



Ovalveolina

FIG. 398. Alveolinidae; *Ovalveolina* (p. C510).

Multispirina REICHEL, 1947, *1518, p. 2 [**M. iranensis*; OD]. Test spherical, with several spires and numerous sutural apertures; internal structure as in *Praealveolina (Simplalveolina). U.Cret.*, Iran.——FIG. 396,*3*. **M. iranensis*, Cenoman.; ×40 (*2119A).

Ovalveolina REICHEL, 1936, *1514, p. 69 [**Alveolina ovum* D'ORBIGNY, 1850, *1397b, p. 185; OD]. Test spherical to ovoid, chambers numerous, septula continuous, short and widely spaced, apertures in single row; coiling regular throughout. *L.Cret. (U.Alb.)-U.Cret.(Cenoman.-Turon.)*, Eu.(Fr.-Sp.-Port.)-N.Afr.——FIG. 398. **O. ovum* (D'ORBIGNY), U.Cret. (Cenoman.), SW.Fr. (Île Madame); ×50 (*2119A).

Praealveolina REICHEL, 1933, *1512, p. 270 [**P. tenuis* (=*?Alveolina cretacea* D'ARCHIAC, 1837, *35, p. 191, unfigured); OD]. Test ovoid, fusiform, or cylindrical; septula of 2 adjacent chambers continuously arranged, with several rows of chamberlets (and apertures) below main row; at least in microspheric form of elongate species, chamberlets of layers belonging to same chamber connected by radial passages which extend downward from preseptal passage; narrow sutural apertures connecting successive whorls, most species regularly coiled throughout (although microspheric form slightly irregular). *L.Cret.(U.Alb.)-U.Cret. (Cenoman.-Turon.)*, N.Afr.-Eu.(Fr.-Spain-Port.)-Asia(M.East-India).

P. (Praealveolina). Microspheric form at least provided with secondary chamberlets. *U.Cret. (Cenoman.)*, Fr.(Beausset).——FIG. 395,*2*. **P. (P.) tenuis*; ×45 (*2119A).

P. (Simplalveolina) REICHEL, n.subgen., herein [**P. simplex* REICHEL, 1936, *1514, p. 67]. Secondary chamberlets lacking in both micro- and megalospheric generation. *U.Cret.(Cenoman.)*, Eu.(Fr).——FIG. 396,*1*. **P. (S.) simplex*, Île Madame; ×55 (*2119A).

Subalveolina REICHEL, 1936, *1514, p. 73 [**S. dordonica*; OD]. Test fusiform in type-species, spherical in smallest ones; septula without definite arrangement, with small alveoli instead of postseptal